Spencer Creek Pilot Watershed Analysis

A day of huckleberry picking at Buck Lake around 1905 (photo courtesy of the Anderson family photo collection).

August 1995

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Executive Summary

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Executive Summary

Introduction

The following is a short executive summary of the Spencer Creek Pilot Watershed Analysis. It is intended to highlight and integrate the significant findings and recommendations of the analysis. For a detailed explanation of the findings, a thorough review of the watershed analysis is necessary.

The major concerns for resource values in the watershed are:

- Late successional forest habitat for wildlife;
- forest health; and
- stream, riparian, and wetland habitat and its impact on associated aquatic dependent species.

Although these values are still present and stable, they have been reduced over time in quantity and quality. Late successional habitat is most likely limited primarily to the upper portion of the watershed on federal lands. The lack of connectivity between blocks of late successional habitat may limit the movement of some wildlife species within the watershed and between watersheds. Fire suppression and logging have altered stand densities, fuel loads, stand structure, distribution of seral stages, and species composition. The incidence of disease and insects in some areas and the potential for high intensity fires in the watershed have increased. Sedimentation and elevated stream temperatures have changed habitat conditions to favor species more tolerant of fine sediments and warm water. This, coupled with exotic species introductions has altered fish, aquatic plant, and macroinvertebrate communities. The migratory Klamath River fish population spawning in Spencer Creek appears to be fairly stable and may be less impacted by changes and current conditions in Spencer Creek watershed. Prior to the construction of dams on the Klamath River, Spencer Creek supported anadromous fish spawning runs.

Snow melt processes drive the hydrologic cycle, with precipitation ranging from 20 inches at the lower elevations to over 60 inches in the wilderness. Buck Lake, a 1,500 acre wetland near the headwaters, historically provided a catchment for storage of spring snow melt, but no longer functions in this capacity. Air temperatures and moisture regimes vary from the lower to higher elevation zones and support several vegetation communities. Vegetation ranges from ponderosa pine communities in lower elevations to white bark pine communities in the Mountain Lakes Wilderness. Historically (around 1900), 60 to 70 percent of the vegetation was in the mid to late seral stage. Currently, 30 to 40 percent of the forest is in mid to late seral condition. This includes both upslope and riparian zone vegetative communities. Lightning fires, insects, and disease historically maintained stand structure, seral stage distribution, densities, fuel loads and species composition. See Table A later in this summary for further information.

Highlights of the Analysis

Human use of the Spencer Creek watershed has a long and varied history. Prior to European settlement, Native Americans used the area for seasonal hunting and gathering activities. Problems concerning the watershed's cultural resources mostly relate to protection of historic, 19th Century sites and features near the mouth of Spencer Creek. Recreation use in the watershed has been and continues to be light. Primary areas of concern regarding recreation activities are the unauthorized firewood cutting in the upper reaches of Clover and Spencer Creeks, off-road motorized vehicle use, and uncontrolled recreational activities primarily at the mouth of Spencer Creek. Of the 40 human caused fires on record for USDA Forest Service and Oregon Department of Forestry protected lands in the watershed, nine of the fires occurred near the mouth of Spencer Creek.

Different resources in Spencer Creek have contributed to the economic base for local and surrounding communities. Native Americans no longer use the area for seasonal hunting and gathering. The watershed area provides recreational opportunities that include: sightseeing, fishing/hunting, camping, hiking, mushroom and firewood collection, skiing, and snowmobiling. Livestock grazing has been a viable use in the watershed since the 1860s. Buck Lake was drained in the 1940s to increase grazing forage in the watershed. Commercial timber harvesting began in 1930 and has provided a continual supply of timber for the last 65 years. Approximately 90 percent of the watershed has been entered for harvest, and roads have been built to access these areas.

Logging and associated road development, and fire suppression are identified as the management activities most affecting the terrestrial forest environment. Currently, approximately 25 percent of the federal land and 15 percent of all the lands in the watershed is late successional forest. The majority of the late-successional forest occurs in the Mountain Lakes Wilderness and the Late Successional Reserves in the upper portion of the watershed. In the remainder of the watershed, late-successional forest occurs as small isolated blocks. Due to the distribution of blocks of late-successional forest, habitat connections are minimal between large late-successional forest patches occurring within the watershed. This may restrict the movement and dispersal of some late-successional dependent wildlife species through the watershed. Early to mid seral stands now dominate the forest structure in the lower half of the watershed. The number of stands dominated by large pine (sugar pine, western white pine, and ponderosa pine) has been substantially reduced from historic levels. Harvesting, combined with fire suppression, has reduced the potential of obtaining large pine due to the establishment and dominance of shade tolerant species in the understory (white fir). Protection buffer wildlife species (as defined in the Northwest Forest Plan's "Standards and Guidelines") and the bald eagle are dependent upon large pine. Populations of special status plant species, other plant species of concern, and plant communities of interest, appear to be stable. Populations of noxious weeds are increasing slightly in disturbed areas.

White pine blister rust (*Cronartium ribicola*) and the fir engraver beetle (*Scolytus ventrailis*) appear to be the two most impacting diseases and insects within the watershed. Annous root rot (*Fomes annous*) and western and mountain pine beetles (*Dendroctonus spp.*) are impacting some areas as well. Snag and downed log requirements on federal land as stipulated in the "Standard and Guidelines" currently exist in most areas on and in many areas exceed the requirements. However, the level of snags and downed logs in the lodgepole pine community may be affected by ongoing firewood cutting. In the Mountain Lakes Wilderness and vicinity, slow changes in seral-stage composition, fuel loading, species composition, and structure may be occurring due to fire suppression.

Currently there are 290 miles of roads in the watershed which equals approximately 4 miles per square mile. In most areas, this density exceeds the 1.5 mile per square mile recommendation of the Spencer Creek Coordinated Resource Management Plan and both Forest Service and Bureau of Land Management Resource Management Plans. The high density of roads is contributing to the excess levels of sediment in Spencer Creek. There are 150 road crossings and 23 miles of road within 100 feet of stream channels within the watershed. Roads and areas of compaction decrease soil productivity, prolong the vegetative recovery process and increase runoff potential. The density of roads also exceeds the recommended level for several wildlife species of concern, including deer and elk.

The riparian zone condition in Spencer Creek is influenced by timber harvest, grazing, and road building in the forest environment. Problems related to cattle grazing are primarily within riparian, meadow, and other wetland areas. Road densities and harvest have reduced near term large woody debris recruitment and stream side canopy closure in many areas. In addition, there has been an increase in the amount of solar radiation and stream warming due to a reduction in shading and an increase in sediments. The conversion of the 1,500 acre Buck Lake to irrigated grazing pasture greatly modified the largest wetland in the watershed. Similarly, in unconfined reaches of Spencer Creek and wet meadow environments, grasses, forbs, and willows have been impacted in some areas due to grazing. Forage in upland areas is underutilized because of the distribution of water and livestock. Springs, wet meadows, and other stillwater habitats are very limited in the Spencer Creek watershed. The draining of Buck Lake is the most significant loss of wetland habitat in the system. Wildlife species which could be affected by these changes include one of three known populations of the spotted frog in the Klamath basin, other amphibians, the great gray owl, marten, deer, and over 100 vertebrate species associated with riparian or wetland habitats.

The mainstem of Spencer Creek is influenced by the net effect of activities in the stream, forest, and riparian environment and past removal of large wood debris from the channel. Roads are routing water and sediment from the upslope environment to the channel environment. Likewise, ditches and canals in Buck Lake route water with elevated temperatures and levels of sediment into the mainstem of Spencer Creek. Logging has reduced the late seral stage composition by approximately 30 percent along the stream corridor. Spencer Creek and associated tributaries frequently do not meet State of Oregon Water Quality Standards for salmonid bearing streams of the Klamath Basin. Spencer Creek may continue to exceed maximum summer water temperatures above 58 degrees Fahrenheit (ODEQ Standard) because the mainstem originates as outflow from a shallow wetland area (Buck Lake). Poor water quality and lack of cold water habitat could cause a decline in intolerant species with a resulting shift in the community structure toward those species tolerant of warm water and simplified habitat structure. Based on macroinvertebrate community indicators, impacts are apparent from high summer water temperatures and fine sediment in Spencer Creek. These factors negatively affect the biotic and habitat integrity of Spencer Creek and influence the distribution and abundance of invertebrates and those fish that are dependent on invertebrates as a food source. Recent implementation of some of the recommendations contained in the Spencer Creek Coordinated Resource Management Plan (1994) and the Weyerhaeuser Company Watershed Analysis (1994) should reverse a downward trend in aquatic habitat quality.

The loss of wetland function and the road system design are the mechanisms of change that are most influential in altering run-off patterns. Associated with the loss of wetlands is the ability to attenuate peak discharge. The ability to storewater for slower releases throughout the summer months has decreased due to the draining of Buck Lake. Concurrently, the design of the road system has resulted in water being routed into the stream channel. The net effect is more efficient delivery of water into the channel system. These activities have a high probability to increase peak flow. Similarly, the timing of peak flow most likely occurs earlier in the year than it did historically. Baseflows have likely decreased with the loss of wetland function and the withdrawal of water for irrigation at Buck Lake. The presence of pools has been decreased in confined reaches primarily due to the removal of wood.

Three changes in habitat condition were determined to be chronic and problematic for native fish in Spencer Creek; fine sediment, high temperature, and low flows. The significant causal mechanisms for reduced habitat quality are road crossings, streamside timber harvest, and channelization and grazing at Buck Lake. Observed changes in fish communities over time indicated that the number of species adapted to simplified habitat structure are increasing. Restoration projects and management recommendations in this document, the Spencer Creek Coordinated Resource Management Plan, and the Weyerhaeuser Company Watershed Analysis is intended to improve riparian and stream conditions and specifically address sedimentation, water temperature, and flow issues.

Desired Future Conditions

Desired future conditions for the Spencer Creek watershed are:

- maintain and encourage mid to late seral stage forest connectivity;
- improve wetland function at Buck Lake, and riparian habitat;
- reduce tree mortality from fire/insects/ disease:
- encourage and enhance the large pine tree component; and
- improve water quality and stream flow - decrease stream temperatures and fine sediment input.

Recommendations to achieve desired future conditons are listed in Tables B and C as restoration opportunities and management considerations and recommendations. Monitoring concerns and information needs are addressed in Table D.

Table A. Some Vital Statistics of the Spencer Creek Watershed (All numbers are approximate)

	Acres	Percent
Federal Land in Watershed	30,852	(57%)
Private Land in Watershed	23,310	(43%)
Total Acres	54,162	
Forest Plan Allocations		
Administrative Withdrawal (Wilderness)		11%
Late Successional Reserves		33%
Riparian Reserves		3%
Matrix		33%
Vegetation:		
1899 Leiberg Mid and Late Seral Stage		60 to 70%
1899 Leiberg early seral stands as a result of fire		10 to 20%
1945 Mid and Late Seral Stage		60%
1994 Mid and Late Seral Stage		35%
%Federal Lands in Late Successional Habitat		25%
%All lands (Federal and private) in Late Successional Habitat		15%
Tree canopy closure between 11 to 55%, percent of the watershed		67%
Tree canopy closure greater than 55%, percent of the watershed		22%
Shrub canopy closure in the watershed		11%
	Number	
Lightning starts per year [Highest Year (1987) 18 starts]	3 to 4	
Human starts per year [Highest Year (1983) 6 starts]	1 to 2	

Table B. Restoration Project Opportunities - High Priority/Red Flag Items

Restoration Opportunity	Concern/Objective	Cooperative Agreements
1. Construct security fencing around Spencer Creek Cemetery.	The Cemetery has been badly vandalized.	Yes-Weyco
2. Restore the wetland function of Buck Lake (CRMP initiated project) through fencing and cross fencing (up to 10 miles of fencing). Implement a grazing system and reseed/replant dikes and channels in and below Buck Lake with native seed/species. Improve/install headgates and culverts. Reduce duration of low flow periods.	Decrease sediment and nutrient input from Buck Lake into Spencer Creek. Decrease water temperatures.	Yes-Hugh Charley, NRCS (formerly SCS), ERO and the Spencer Creek CRMP[1] group.
3. Short Term: Build exclosure fencing around specified USFS riparian areas including Desolation Swamp, unnamed area in the vicinity of Buck Lake, and Muddy Springs and develop off-site watering facilities.	Short Term: Enhance control of livestock use over important riparian areas and increase the use of underutilized upland areas. Address adverse grazing impacts on habitats and species at risk.	Yes-Hugh Charley, USFS, and Weyco.
Long Term: Implement the rest rotation grazing system outlined in the USFS "Range Analysis Narrative". Up to 24 miles of fencing would be needed to implement this system.	Long Term: To implement the recommendations of the "Range Analysis and meet the growth requirements of critical riparian and meadow plant communities.	None identified.
4. Address adverse recreation impacts through the following: decrease OHV/ATV use above the mouth of Spencer Creek by closing and rehabilitating inappropriate ATV/social trails and roads; and discourage inappropriate camping along streams and restore impacted areas through road closures and rehabilitation	Decrease fine sediment input into streams.	Yes-Weyco.

[1]See Appendix 8 for more information on the Coordinated Resource Management Plan.

Table B. Restoration Project Opportunities - High Priority/Red Flag Items (Continued)

Restoration Opportunity	Concern/Objective	Cooperative Agreements
5. Thin forested communities mechanically and/or with prescribed fire to reduce stand densities. Place emphasis on drier sites, south-facing slopes, and the lower portion of the mixed conifer zone.	Maintain, enhance, and/or restore the existing pine component in the vegetative communities once dominated by one species and are presently dominated by shade tolerant species (such as white fir). Improve the currently poor recruitment potential for ponderosa pine and address the associated long-term wildlife pine habitat dependency problems.	Yes-Weyco is already intensively pursuing these thinning treatments.
6. Close and/or obliterated roads, OHV/ATV trails, and skid trails to reduce road densities toward the goal of 1.5 miles per square mile. Reduce the number of roads crossing streams and obliterate roads paralleling streams within 100 feet of the stream channel.	Reduce fragmentation of habitat and disturbance to many wildlife species, including deer, from high road densities. Reduce sediment delivery to streams, increase stream shading and increase the large woody debris input potential.	Yes-Weyco.
7. Place large woody debris structures in those confined channel reaches that lack coarse structure and have low potential for short-term recruitment of large woody debris.	Increase the amount of coarse structure in confined reaches to dissipate stream energy and create pool habitat.	None identified.

Abbreviations used in this table:

ATV	=All-Terrain Vehicle	CRMP	=Coordinated Resource Management Plan	USFS	=Forest Service	OHV	=Off-Highway Vehicles
DBH	=Diameter at Breast Height	ERO	=Ecosystem Restoration Office	NWFP	=Northwest Forest Plan	Weyco	=Weyerhaeuser Company
LSR	=Late-Successional Reserve	NRCS	=Natural Resource Conservation Service (Formerly the Soil Conservation Service)				

Table C. Management Considerations for Future Project and Program Planning - High Priority/Red Flag Items

Management Recommendation	Concern/Objective	Design Features
1. Develop the rest-rotation grazing system as recommended in the USFS "Range Analysis Narrative" for the Buck Allotment and, if feasible, include the BLM's Buck Lake Allotment. Develop Allotment Management Plans for these allotments.	Provide livestock control and management to meet meadow and riparian utilization and condition objectives and to increase use of the under-utilized upland areas.	Construct up to 24 miles of fencing to divide the Buck Allotment into 7 pastures. Implement a 2 herd, 7 pasture rest-rotation system. Include BLM's Buck Lake Allotment into the rotation if feasible.
2. Provide Enhanced law enforcement, educational efforts and OHV closures to protect resources and control inappropriate behavior at the mouth of Spencer Creek and control unauthorized firewood cutting elsewhere.	Protect riparian resources and address public concerns about uncontrolled recreation and illegal activities.	Develop a cooperative law enforcement contract with Weyco and PP&L for use of Reserve Deputies on weekends. Develop a site specific plan for the area around the mouth of Spencer Creek to address resource damage, educational needs, and law enforcement efforts. Continue Oregon State Forestry fire patrols in summer.
3. Short Term: Focus harvesting activities in residual early-mid and mid seral stage forests in the Matrix. Long Term: Conduct thinning and light underburning projects to achieve fuels and forest management objectives. Through thinnings and underburning, control densities and species composition to meet stand-specific objectives.	Enhance the sustainability of some existing forest communities in the watershed.	Reduce fuel loads to natural levels. Reduce stand densities, particularly in areas where understory densities are competing with over-story component and where the overstory component and needs to be retained. Increase the composition (percent) and vigor of shade-intolerant species (especially pines). Thinning and removal of material must include the smaller diameter classes (2 to 8 inches dbh). Give higher priority to treatment of drier sites, south slopes, and in the lower portion of the mixed conifer zone.

Table C. Management Considerations for Future Project and Program Planning - High Priority/Red Flag Items (Continued)

Management Recommendation	Concern/Objective	Design Features
4. Enhance, maintain, and restore the ponderosa, sugar, and western white pine component wherever feasible.	Address reductions in these species from past harvesting. Protect remaining stands where threatened by dense stands of shade tolerant species (except in plantations). Address the loss of habitat for wildlife species dependent upon large ponderosa pine.	Reduce stand densities around residual natural stands of pine in the watershed. During thinning treatments, retain and enhance the pine component where shade tolerant species predominate.
5. Manage lands north or south of Buck Lake as a connector for late-successional dependent wildlife and to optimize the use of unmapped Late Successional Reserves. Consider adoption of Corridor 3 as the preferred option; Maintain the opportunity for providing connectivity where the potential is the greatest.	Provide habitat connections between Late-Successional Reserves that are not being provided by Riparian Reserves. The Riparian Reserves are disjunct due to private ownership and run north/south. Desired connectivity pathways would be most beneficial in an east/west direction.	Develop a corridor with a minimum width of 600 feet. Maintain at least 40 percent of the forest with connectors in late-seral condition (50 to 60 percent canopy closure) and the remainder in mid-seral condition with at least 40 percent canopy closure. Place logs in deficient areas. Close or obliterate unnecessary roads. Minimize the disturbance to wildlife from planned snowmobile trails in the vicinity of corridors by implementing specifications listed in the Management Recommendations chapter.
6. Develop a comprehensive road management plan for the watershed across all ownerships.	Reduce fragmentation of wildlife habitat and disturbance to wildlife from high road densities. Reduce sediment delivery to streams and increase stream shading.	Close and/or obliterate roads to reduce density, especially in high impact areas. Establish Transportation Management objectives as specified in the NWFP.
7. Consider thinning and prescribed fire in Riparian Reserves to meet Aquatic Conservation Strategy objectives.	Reduce the risk of fire and stand densities and improve the health of forested riparian areas.	Treatment must meet Aquatic Conservation Strategy Objectives. Treatment objectives would address mostly trees 3 to 18 inches in diameter.

Abbreviations used in this table:

ATV	=All Terrain Vehicle	CRMP	=Coordinated Resource Management Plan	USFS	=Forest Service	OHV	=Off-Highway Vehicles
DBH	=Diameter at Breast Height	ERO	=Ecosystem Restoration Office	NWFP	=Northwest Forest Plan	Weyco	=Weyerhaeuser Company
LSR	=Late Successional Reserve	NRCS	=Natural Resource Conservation Service (Formerly the Soil Conservation Service)			PP & L	=Pacific Power and Light

Table D. Information and Monitoring Needs - High Priority/Red Flag Items

Information/Monitoring Need	Concern/Objective	Why	How
1. Monitor forage utilization and physical impacts from livestock in riparian areas periodically throughout the grazing season.	Improve long term conditions and functionally of important meadow and riparian areas.	Ensure that agency utilization objective standards are not exceeded.	Follow respective agency methods and procedures for the establishment and reading of range monitoring studies.
2. Monitor insect activity, particularly mortality caused by the fir engraver.	Assess the level of activity, which appears to be increasing with the increase of shade tolerant true fir in forested stands.	Assess uncontrollable habitat change that could be occurring in late successional habitat in the Matrix and in LSRs, with corresponding adverse impacts to wildlife.	Conduct stand exams and yearly aerial monitoring flights done by ODF and the USFS.
3. Monitor disease activity, particularly annosus and blister rust.	Assess apparent increased incidence of these diseases.	Assess declining forest health and resiliency.	Conduct stand exams and establish control plots.
4. Monitor livestock use in riparian, wetland, and spring areas after short-term restoration or long-term grazing management is implemented.	Improve the condition of plant communities and riparian, wetland, and spring-associated wildlife populations.	Monitor the effectiveness of restoration and/or grazing management changes.	Track movements of livestock on a weekly basis to monitor the effectiveness of changes in grazing management. Check fenced sites periodically throughout the season to ensure that fenced exclosures are functioning as designed.
5. Survey for Survey and Manage species (animals, plants, amphibians, molluscs, and fish) listed in the NWFP.	Verify the existence of species that are likely to occur in the watershed.	Implement requirements of the NWFP.	Follow survey protocols. Conduct spawning redd count surveys to monitor redband trout.

Table D. Information and Monitoring Needs - High Priority/Red Flag Items (Continued)

Information/Monitoring Need	Concern/Objective	Why	How
6. Determine and/or verify classifications for streams in the watershed (perennial, intermittent, and ephemeral; fishbearing and non-fishbearing).	Update existing delineations to reflect actual on-the-ground conditions.	Apply Riparian Reserves and the Aquatic Conservation Strategy.	Survey for each project area. Update GIS and stream maps.
7. Monitor harvest prescriptions within the matrix to determine if owl dispersal conditions are being met.	To verify the assumption that the dispersal habitat needs of the northern spotted owl will be met through the green tree retention requirements in the Northwest Forest Plan.	To fulfill the federal agency obligation to the U.S. Fish and Wildlife Service under the Endangered Species Act, and the obligation under Agency Resource Management Plans.	Based on biologists' judgement of adequate dispersal condition, evaluate the quantity and size of downed woody material for adequate prey base opportunities, and cover for protection and movement.
8. Evaluate the percentage and arrangement of suitable spotted owl dispersal habitat available within the time period harvest is planned for a given area (e.g. subwatershed) to determine the type of harvest prescription and the area which could be harvested while maintaining adequate dispersal conditions.	To evaluate if the dispersal needs of the owl are being met within the waterhsed.	To fulfill the federal agency obligation to the U.S. Fish and Wildlife Service under the Endangered Species Act, and the obligation under BLM's Resource Management Plan and the Winema National Forest's Land and Resource Management Plan.	Evaluate future harvest plans, stand inventories, aerial photographs and/or Pacific Meridian Resources data.

Abbreviations used in this table:

ATV =All Terrain Vehicle
DBH =Diameter at Breast Height
LSR =Late-Successional Reserve
CRMP =Coordinated Resource Management Plan
ERO =Ecosystem Restoration Office
NRCS =Natural Resource Conservation Service (Formerly the Soil Conservation Service)
USFS =Forest Service
NWFP =Northwest Forest Plan
OHV =Off-Highway Vehicles
Weyco =Weyerhaeuser Company

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A day of huckleberry picking at Buck Lake around 1905 (photo courtesy of the Anderson family photo collection).

August 1995

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User's Guide

The Spencer Creek Watershed Analysis document you hold in your hands was designed with the iterative nature of watershed analyses in mind. This document is not a "final" product in the sense that it has been completed. As new information is collected, discovered, or generated, that information will need to be added to this analysis. Therefore, in designing this document we have attempted to design a document that will be relatively easy to update.

There will be three "official" binders containing copies of this document. These three copies will reside, one each, in the following offices; Winema National Forest Supervisor's office, Klamath Ranger District office, and the Klamath Falls Resource Area office of the BLM. Other copies will be available, but may not contain the newest information.

Two of the features that you should note in this document include:

- the extra wide margins on the outside of the pages; and
- a date on the bottom of each page.

The extra wide margin is there for you to make notes in. When something within the watershed has changed, you should note that change in the margin of one of the "official" binder copies. Occasionally, these binders will be reviewed and the new information incorporated as appropriate. For example, if a timber sale occurs within the watershed, a note in the margin describing when, where, how, why, etc. will help the reviewer(s) know what has changed since the last update. It should also help the reviewer(s) determine when a major review of the analysis is needed.

A date has been provided on each page so that minor changes can be incorporated into the "official" documents without having to reprint every page each time there is a revision/change. A single or a few pages can be reprinted showing the new information. The dates on the new pages will also let the reviewer(s) know that new information has been incorporated. In addition, the dates should also help reviewers with older versions compare their version of the document with the newer version to see where and what changes have been made.

Suggestions on the format, appearance, and usability of this document would be appreciated. Such suggestions/comments should be inserted into the back of the "official" binders for later review and action. Enjoy and thank you.

Chapter 1 Introduction to the Watershed Analysis

Introduction

In April 1994, the Record of Decision for the Northwest Forest Plan was released. That document includes Standards and Guidelines for the management of late-successional and old-growth forest related species within the range of the northern spotted owl. Included in the Standards and Guidelines is a list of objectives known as the "Aquatic Conservation Strategy". This strategy provides direction for the restoration of riparian/wetland habitats, and has four primary components, as follows:

1. It establishes Riparian Reserves on public lands along streams and on unstable and potentially unstable areas where special standards and guidelines direct land use.

2. It also establishes a system of Key Watersheds throughout the range of the northern spotted owl that are crucial to at risk fish species and stocks that provide high water quality.

3. It requires that Watershed Analysis be completed to provide the basis for monitoring and restoration programs and the foundation from which Riparian Reserves can be delineated.

4. A comprehensive, long-term program of Watershed Restoration to restore watershed health and aquatic ecosystems is the final component of the strategy.

This document, the Spencer Creek Pilot Watershed Analysis, has been prepared to partially meet requirements under the Northwest Forest Plan's Aquatic Conservation Strategy. It was prepared by an interagency (BLM, USFS, EPA, USFWS), interdisciplinary team as part of the pilot program for revising the federal interagency guide to watershed analysis (see Appendix 1).

The Spencer Creek Watershed Analysis presents an ecosystem analysis at the watershed scale. It describes the current understanding of the processes and interactions of concern occurring within the Spencer Creek watershed. The analysis looked at the entire watershed regardless of ownership so that a more complete understanding of the watershed could be achieved. It is intended to guide management on the federal lands within the watershed. It is also meant to help us understand how past land use activities interact with the physical and biological environments in the watershed. This analysis provides a logical way to learn more about how ecological systems function within the watershed. This information is essential to protect beneficial uses and to protect and sustain the natural systems that society depends upon. The analysis provide a vehicle to efficiently identify and balance multiple concerns. The analysis provides a summary of trends for resources where restoration actions are needed.

Mostly existing information was used for this analysis. Some information team members wanted and/or needed was not available to assist in describing conditions, predicting trends, or evaluating relationships. There is a section that outlines data needs that would improve this analysis and could aid in future evaluations of activities. The analysis focused on specific issues, values, and uses identified within the watershed that are essential for making sound management decisions. The historic, current, and desired conditions of the watershed are described, as are the processes and activities affecting the resources in the watershed.

This is the first iteration of this analysis. New versions of the document will be produced over time as new information is gathered, generated, or discovered. It is not expected that new iterations will be produced and distributed on specific time schedules.

Two additional items need to be addressed here. The Weyerhaeuser Company completed a watershed analysis for the Spencer Creek watershed in 1994. That watershed analysis was carefully reviewed by this team, and their contribution to existing knowledge of the area is hereby acknowledged. In addition, there is also an active Cooperative Resource Management Plan process working in the Spencer Creek watershed. The cooperative management and information provided by those members has been helpful. The Spencer Creek Pilot Watershed Analysis Team expects that any new information that was gathered through this process will just contribute to the cooperative management efforts already underway.

Chapter 2
Introduction to the Watershed

Location

The 54,160 acre watershed is located in Klamath County, approximately 20 miles west of Klamath Falls (see the General Location Map 1). The watershed originates at the crest of the southern Oregon Cascades, flows southeast, and empties into the Klamath River just above Topsy Reservoir. Elevations range from approximately 8,200 feet at the top of Aspen Butte to 4,000 feet at the mouth of Spencer Creek.

Within Spencer Creek watershed are two subwatersheds, Clover Creek and Miners Creek. There is also the mainstem of Spencer Creek itself (See Map 2). Some of the analysis will be broken down by subwatersheds for cumulative impact and landscape level analyses.

Unique features within the watershed include Buck Lake, presently owned by Hugh Charley. Buck Lake lies in the upper end of the watershed and is a significant contributor to the ecological systems within the watershed. The northeastern part of the watershed lies within the Mountain Lakes Wilderness Area where no significant past management activities, with the exception of fire suppression, have occurred. The lower part of the watershed is almost wholly owned by Weyerhaeuser Company.

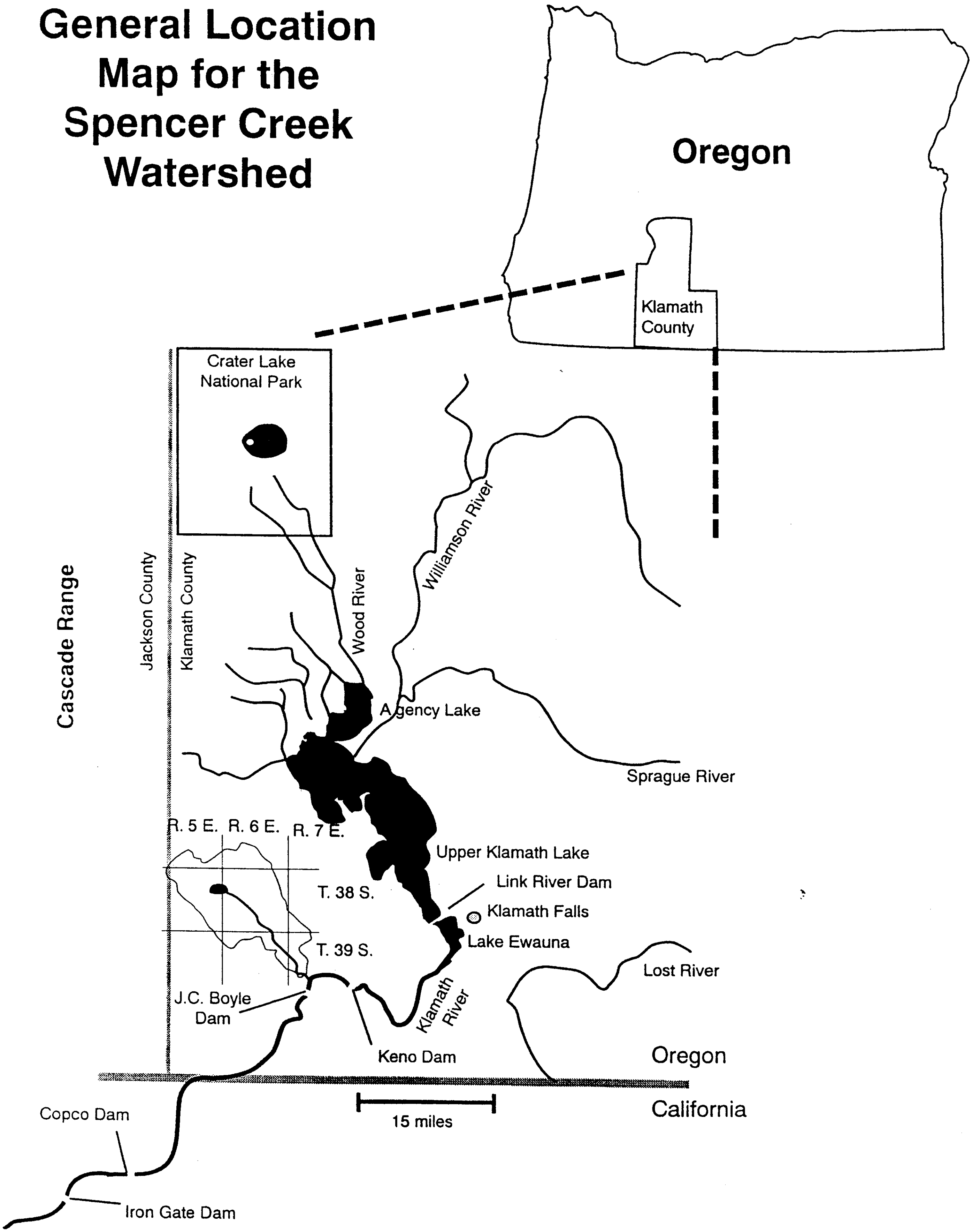
Ownership

Ownership within the watershed is displayed in Table 3 and Map 3. The primary non-federal landowners include Weyerhaeuser Company, Charley Livestock Company, and Roseburg Forest Products Company. There are other scattered land owners as well.

Table 3. Administration/Land Ownership within Spencer Creek Watershed

Ownership/Administration	Acres	Acres	Percent
USFS			
Winema	22,290		40
Rogue River	10		0.02
BLM	8,810		16
Weyerhaeuser Co.		17,755	32
Charley Livestock Co. (Buck Lake)		2,173	4
PacificCorp		7	0.01
Roseburg Forest Products Co.		1,920	3
Jeld Wen		160	3
Other Private		2,574	2
Totals	30,852	23,310	54,162

Map 1 General Location Map for the Spencer Creek Watershed



Soils/Geology

The Spencer Creek Watershed covers approximately 54,200 acres containing more than 11 soil types and 19 mapping units. At lower elevations, soils on upland benches, side slopes, and ridgetops are formed in residuum and/or colluvium derived from andesite, tuff, and/or volcanic ash. At high elevations the parent material is comprised of mudflows, pyroclastics, and/or unconsolidated glacial material. Other soils on basins and floodplains are formed in lacustrine sediments or alluvium derived from volcanic ash. For a complete description of the different soil types by vegetation zone, please see the Spencer Creek Coordinated Resource Management Plan. See Map 4 for Topography in the Spencer Creek watershed.

Climate

Warm, dry summers and cold, snowy winters characterize the climate of the watershed area. Most of the precipitation comes in the form of snow from November through March, although occasional thunderstorms deliver precipitation in the summertime. Deep snowpacks can accumulate, particularly at the higher elevations. Mean annual precipitation ranges between 15 inches and 40 inches.

The timing of peak runoff is determined by spring rains and the duration is a function of snow pack. Rain on snow events occur infrequently. A 100 year flood resulted from a rain on snow event in 1964 (Christmas Flood).

Hydrology

The headwaters of Spencer Creek originate at an elevation of about 8,000 feet in the Mountain Lakes Wilderness and empties into the Klamath River at the upper end of J.C. Boyle Reservoir at an elevation of about 4,000 feet. Buck Lake, a 1,500 acre drained marsh, and Spencer Creek are the primary perennial hydrologic areas functioning in the watershed. Two main tributaries into Spencer Creek are Clover Creek and Miners Creek which are perennial, spring-fed segments, but normally subside before reaching Spencer Creek during the summer. Springs, seeps, and wet meadows are scattered throughout the watershed.

Potential Vegetation

Potential vegetation is defined in the context as the potential climax specie that would occur in the absence of natural disturbance such as fire. For example, ponderosa pine was the dominant specie in much of the lower part of the watershed because of the repeated lightening fires and white fir's intolerance to fire. In the absence of fire, white fir has the potential of becoming the dominant climax specie in lieu of ponderosa pine.

Five different potential forested vegetation zones as defined by Franklin and Dyrness, (1973) occur in the watershed area. Although Atzet and McCrimmon (1990) further defined the zones into series, the series that Atzet and McCrimmon applied still reflect the potential, dominant climax species. Using Franklin and Dyrness forest vegetation zone classifications, the following zones are represented in the Spencer Creek watershed.

- Ponderosa Pine Zone
- Mixed Conifer Zone
- Lodgepole Pine Zone
- Shasta Red Fir Zone
- Mountain Hemlock Zone
- Miscellaneous Wetland Areas

The acreage and distribution of those zones is displayed in Table 4 and Map 5 respectively. Within each forested vegetation zone, more than one locally recognized plant association as described by Hopkins (1979) occurs. A detailed breakdown of the different plant associations within each forested vegetation zone is shown in Appendix 2.

At the beginning of the analysis process, potential plant communities had been identified and mapped only on U.S. Forest Service-administered lands. The potential plant communities on the remaining part of the watershed were subsequently mapped

TABLE 4 . Potential Forest Vegetation Zones Within Spencer Creek Watershed By Ownership

Potential Vegetation Zone	By Ownership/Administration Acres			
	Private	BLM	USFS	Total
Ponderosa Pine	526	0	0	526 (1%)
Mixed Conifer	18,831	7,306	7,210	33,347 (62%)
Lodgepole Pine	815	190	2,698	3,703 (7%)
Shasta Red Fir	1,397	1,311	10,464	13,174 (24%)
Mountain Hemlock	10	0	1,297	1,307 (2%)
Nonforest Rock	0	0	474	474 (1%)
Grass/Shrub	1,453	4	52	1,509 (3%)

in the fall of 1994 (Hopkins 1994). The following is a brief discussion of each zone.

Ponderosa Pine Zone. At the mouth of Spencer Creek where it empties into the Klamath River (an elevation of approximately 3,800 feet), the watershed contains approximately 526 acres within the Ponderosa Pine Zone (See Map 4). This is a zone that would have ponderosa pine as the climax species with or without fire disturbances. It is located on some of the dryer and flatter areas in the lower part of the watershed. It also contains an occasional component of juniper and mountain mahogany. Most of this zone is located on Weyerhaeuser Company lands. The Ponderosa Pine Zone is generally associated with less precipitation, shallower soils, and warmer temperatures in relation to the other zones.

Mixed Conifer Zone. The Mixed Conifer Zone lies just above the Ponderosa Pine Zone elevationally. The Mixed Conifer Zone is generally the most productive zone within the watershed because of deeper soils, greater precipitation, and moderate temperatures. As Table 4 displays, approximately 62 percent (33,347 acres) of the watershed is within the Mixed Conifer Zone. Over half of the Mixed Conifer Zone is located on private lands. The Mixed Conifer Zone starts at about 4,500 feet and extends up to approximately 5,600 feet. Plant associations include: mixed conifer/snowberry-bearberry, white fir/chinquapin-boxwood-prince's pine and a small area of white fir-alder/shrub meadow. Franklin and Dyrness (1973) define a small, narrow White Fir Zone between the Mixed Conifer Zone and the Shasta Red Fir Zone. This narrow zone is represented in the watershed, but because it is so poorly defined, it has been lumped into the Mixed Conifer Zone. The 1945 Dominant Species Groups Map, Map 6 displays pure stands dominated by either Douglas-fir or white fir.

Lodgepole Pine Zone. Within the watershed and located along valley bottoms where cool air drainage is poor are isolated areas that fall into the Lodgepole Pine Zone. Hopkins (1979) and Atzet (1990) indicate that this zone varies from about 4,800 feet up to 6,600 feet in elevation. Most of the 3,703 acres (about 7 percent of the watershed, see Table 4 of Lodgepole Pine Zone within Spencer Creek Watershed) occurs at about 5,000 feet in elevation. The largest stands of lodgepole pine occur in areas surrounding Buck Lake, and in the upper reaches of Spencer Creek around the desolation swamp area where there are large flat benches and cool air concentrates. Plant associations include lodgepole pine/

huckleberry/forb and lodgepole pine/grouse huckleberry/long-stolon sedge. Some of the existing lodgepole pine stands have a significant understory of white fir, indicating that the potential climax vegetation is white fir. However, whether this understory of white fir survives or not is dependent upon frost, soil moistures, and fire cycles. The point of differentiation between the true Lodgepole Pine Zone and the White Fir Zones is extremely variable. Atzet (1990) describes in detail the climatic features that maintain this particular zone. Because of the frost problems and soil moistures of Spencer Creek, as well as occasional fires, there will always be a component of lodgepole pine in these stands. Many old clearcuts have been planted with lodgepole pine due to their frost resistance in such harsh, open sites.

Red Fir Zone. This zone lies above (elevationally) the Mixed Conifer Zone and is particularly evident on the northern slopes of Surveyor Mountain and the upper western slopes of Aspen Butte. The soils are generally shallower and rockier than in the Mixed Conifer Zone, and the temperatures are generally cooler. Approximately 13,174 acres (24 percent of the watershed) lie within the Red Fir Zone. As Table 4 displays, most of this zone is located on federal land. This zone starts at about 5,500 feet and extends up to approximately 6,600 feet in elevation. The plant association shasta red fir-white fir/chinquapin-prince's pine/long stolon sedge is the dominant plant association within this zone. The other two plant associations identified include shasta red fir/long-stolon sedge and shasta red fir-mountain hemlock/pinemat manzanita/long-stolon sedge.

Mountain Hemlock Zone. The highest elevation zone within the watershed is the Mountain Hemlock Zone. Approximately 1,307 acres (2 percent) are located within this zone. Elevations range from approximately 6,600 feet up to the timberline slopes on Aspen Butte at about 7,600 feet. Most of the Mountain Hemlock Zones is located on the western slopes of Aspen Butte within the Mountain Lakes Wilderness Area. The main plant association identified includes the mountain hemlock/grouse huckleberry association in the upper reaches of the Mountain Hemlock Zone, particularly near the ridge tops on Aspen Butte, there are some isolated areas of what Franklin and Dyrness (1973) would refer to as Alpine Zone. Within the Alpine Zone, scattered clumps of whitebark pine grow on exposed ridges.

Miscellaneous Zones. Within the watershed there are many non-forest, rock-dominated areas, as well as dry and wet meadows. As Table 4 displays, approximately 474 acres (1 percent) of the watershed consists of non-forest rock and approximately 1,509 acres (3 percent) of grass and/or shrub habitat.

Chapter 3
Beneficial Uses and Values

7/18/95

I. Beneficial Uses and Values

Introduction

This chapter introduces the values and uses that are represented in the Spencer Creek watershed. These values and uses are those federal and private management activities and public practices that have and/or are currently happening in the watershed.

Part I. Social Ecosystems

A. Recreation

Wilderness and Environmental Education

The Spencer Creek watershed area contains 5,900 acres of the Mountain Lake Wilderness. Wilderness uses and values include: primitive recreation experiences and the ability to find solitude; scientific and educational uses; a benchmark for ecological studies; and the preservation of historical and natural features. See Map 6 for the location of recreation opportunities.

While no designated Research Natural Areas (RNAs) are located within the watershed, two areas of educational importance are worth noting. The Clover Creek Forest Educational Area, located south of the Spencer Creek hookup road (see Map 7), is used by elementary classes for educational purposes for its annual forestry tour. The Tunnel Creek Wetlands area, a lodgepole pine swamp located south of Buck Lake, offers an opportunity for education regarding protection, maintenance, and/or restoration of natural systems or processes.

Recreation

Because the Spencer Creek watershed is only 45 minutes driving time from Klamath Falls, and has three main paved roads providing ready vehicle access, (Clover Creek, Dead Indian Memorial, and Keno roads) the watershed attracts a variety of recreational users. The watershed provides recreational opportunities that include: sightseeing, fishing, hunting, camping, backpacking/hiking (primarily in the Mountain Lakes Wilderness), horseback riding, mushroom gathering, firewood and Christmas tree collection, cross-country skiing, and snowmobiling. Four-wheel drive use occurs in the watershed, primarily on existing roads, jeep trails, and skid trails. Fishing occurs along much of Spencer Creek. Primitive, non-designated camping areas are located on Weyerhaeuser Company property near the mouth of Spencer Creek, along the Clover Creek Road on National Forest lands, and at the Clover Creek trailhead. Other areas in the watershed receive occasional primitive camping use, primarily during hunting season.

The Clover Creek trail provides access to the southern portion of the Mountain Lakes Wilderness area. Use of the trail is relatively low (usually one to five parties each day during the summer months).

The Buck Peak snowmobile trail and a portion of the Sunset snowmobile trail are located in the northern portion of the watershed. These two trails are part of a much larger, groomed, snowmobile trail network in southern Oregon. A series of turnouts along the Clover Creek Road are plowed in winter by Klamath County and used as unofficial Snow-Park areas. An additional Snow Park and connecting snowmobile trail has been identified on BLM land near the junction of Clover Creek Road and the Spencer Creek Hookup. The watershed currently provides good unstructured snowmobile and cross-country skiing opportunities, especially in the area near the Dead Indian Memorial Road.

The recent paving of Clover Creek Road will increase recreation use as driving for pleasure and access to the National Forest and BLM-administered lands is increased. Clover Creek Road has also been included in published brochures as part of a scenic tour route and bicycle tour route. The scenic tour route follows Highway 66 from Ashland, up Clover Creek Road and returns to Ashland on the Dead Indian Memorial Road.

The residents of Keno and Lake of the Woods also influence recreation use in the watershed. These "local" residents affect recreation use to a moderate amount within five miles of their respective communities. The areas within the watershed affected by this zone of influence includes the area at the mouth of Spencer Creek and the upper portion of the watershed. This recreation use by "local" residents is in addition to the use by Klamath Falls urban residents.

The Applegate National Historic Trail crosses Spencer Creek near its confluence with the Klamath River, on Weyerhaeuser Company land.

Aesthetic/ Scenic

The watershed offers good to excellent scenic quality. Within certain portions of the watershed, especially the Mountain Lakes Wilderness, the scenic quality is rated excellent. This is because forest visitors recreation experience is in a natural appearing forest setting with little evidence of human activity.

The Spencer Creek watershed is visible from Highway 66 by looking north from the Highway 66 bridge over John C. Boyle Reservoir. It can be seen as foreground views (for up to one-half mile) along the Dead Indian Memorial Road near its intersection with Clover Creek Road, and middleground views (for up to one-half mile to five miles) by travelling Keno Road and Clover Creek Road. The watershed is visible from the air to travellers on air flights to and from the Medford airport. It is also easily viewed from the top of Hamaker Mountain, south of Keno.

In general, the visual quality of the Spencer Creek watershed is good and meets visual quality objectives on BLM- and Forest Service-administered lands (see Map 8). For BLM-administered lands, the Clover Creek and Spencer Creek road corridors have visual resource management (VRM) class III objectives, of partially retaining the existing character of the landscape. The foreground from the Clover Creek Road on National Forest lands is also managed to achieve a partial retention objective. The foreground along the Dead Indian Memorial Road is managed to retain the characteristic landscape where evidence of human activities is slight.

In the Buck Lake area, visual resource management class IV objectives, which allow for major modification of the existing character of the landscape, are used. The BLM lands within one quarter mile on either side of Spencer Creek are managed for Visual Resource Management class II objectives of retaining the existing character of the landscape. The access route to the Clover Creek trailhead is managed to partially retain the characteristic landscape in the foreground areas.

Weyerhaeuser Company provides for visual resource management of their lands through an aesthetics screening process. Because many of their lands in the watershed receive partial cut treatments rather than clear cut treatments, the visual quality is at least partially retained.

Portions of the Spencer Creek watershed have a modified appearance due to clearcutting and uniform replanting. These areas are most visible along the lower sections of the Clover Creek Road and southwest of Buck Lake. Several strip clearcuts along Surveyor Mountain are occasionally visible at middle ground distances along Clover Creek Road, and can be seen at background distances from Highway 97, north of Klamath Falls.

B. Livestock Grazing

Livestock grazing has occurred in the watershed at varying levels since the late 1800s. Grazing levels have probably varied with the amount of logging activity, which opened up areas and increased production of herbaceous vegetation. Livestock grazing still occurs throughout the watershed at levels on the low end of what has occurred in recent decades.

Properly managed public lands grazing contributes to the economic vitality and stability of local communities in the West, including the Klamath Basin. It also supports a lifestyle that many people feel is important to support and maintain. Livestock grazing on public lands contributes to the national production of meat.

See also the Livestock Grazing discussion under the Terrestrial Ecosystems Section.

C. Cultural Resource

The concept of "Beneficial Uses" is not relevant to cultural resources.

Part II. Terrestrial Ecosystems

A. Timber and Roads

The Spencer Creek watershed has been producing a steady flow of timber since the 1930s. This timber supply has benefited the surrounding economies of Klamath Falls and Medford, Oregon. Although some harvesting by the Spencer Family occurred in the late 1800s (Sokol 1994, pers. comm.), significant harvesting didn't begin until Weyerhaeuser Company started acquiring land in the 1920s and 1930s and built a railroad system for transporting logs (Sokol 1994, pers. comm.). The first recorded significant harvesting on USFS and BLM administered lands was in the early 1940s. Harvesting levels have increased with each subsequent decade.

On BLM-administered lands within Spencer Creek watershed, over 100 million board feet of timber has been removed since the early 1970s. Substantially more volume has been removed from the private lands within the watershed. This is due to the larger amount of private land ownership (approximately 43 percent of the watershed), and reliance of private landholders on even-age management. Early harvesting on Weyerhaeuser Company (Sokol 1994) and BLM-administered lands was usually based upon a diameter limit as well as for capturing salvage. Most of the existing stands on BLM- and USFS-admininstered lands, particularly in the mixed conifer zones and the lower reaches of the watershed, indicate that the dominant harvest prescription was overstory removal of the large ponderosa pine, sugar pine, and Douglas-fir. The BLM records support this assumption as indicated by many entries on historic ledgers stating that white fir and shasta fir below 22 inches in diameter was suppose to be reserved. In addition, the economic demand for true fir in the 1940s was less than for Douglas-fir and pine.

As a result of past harvesting, an extensive road system has been built within the watershed. The watershed area currently has approximately 290 miles of roads. The existing road system facilitates timber management activities and provides benefits in the form of recreational use, administrative access for monitoring and inventory, and fire suppression access.

With the adoption of the Northwest Forest Plan, federal land within the watershed has been allocated into a number of different categories (Table 5 and Map 9). Beneficial uses on federal land in the future will be based upon how much land is allocated into a particular category and the subsequent guidelines on how that land is to be managed. The Northwest Forest Plan allows for sustainable timber harvesting to occur on those federal lands allocated to the Matrix (17,758 acres, or 33 percent of the watershed). For private lands, the assumption was made that most private lands will be intensively managed for timber production. The utilization of special forest products within the watershed is increasing, although still low. Popular products include mushrooms, firewood, boughs, and Christmas trees.

B. Wildlife

The geographical location of the watershed and the wide range of elevations, landforms, and aspects within it contribute to the biodiversity of the watershed area. Spencer Creek is the only drainage with significant area of forests containing both the mesic elements characteristic of west of the Cascades and more xeric elements found east of the Cascades. It is also one of the only perennial drainages on the east slope of the Cascades where nearly the entire drainage has a south-facing aspect.

The watershed contains potential habitat for 293 species of vertebrates which have either been documented or are expected to occur. Approximately 55 of these species are associated with late-seral stage forests. Several species that are candidates for federal listing as threatened or endangered have been documented within the watershed. These include the northern goshawk and mountain quail. Federally listed species with nesting territories in the watershed include the bald eagle and northern spotted owl. An additional 44 vertebrate species with special status designated by the U.S. Fish and Wildlife Service or the Oregon Department of Fish and Wildlife have been documented or have the potential to occur within the watershed.

Big game documented in the watershed include elk, black-tailed deer, mountain lion, and black bear.

Table 5. Spencer Creek Watershed Land Allocations for Federal Ownership and as Defined by the Northwest Forest Plan (Acres)

Ownership/ Administration	Congressional Withdrawals & Wilderness	Riparian Reserves	Matrix	LSRs	Private Land	Total
USFS	5,920	695	10,282	5,342		22,240
BLM	0	622	7,476	514		8,612
PRIVATE					23,310	23,310
Totals	5,920	1,317	17,758	5,856	23,310	54,162
Percent	10.9	2.4	32.8	10.8	43	

C. Soils

Long-term soil productivity is the capability of soil to sustain the inherent, natural growth potential of plants and plant communities over time. Most land uses ultimately depend on a productive soil resource. Maintenance of long-term soil productivity is widely recognized as a basic requirement of land management.

D. Livestock Grazing

Properly managed grazing can benefit the land in various ways, including the following: reduction of fine fuel loads and accompanying fire hazards; positive manipulation of some types of wildlife habitat; and the construction and maintenance of watering facilities that are used by both livestock and wildlife.

Grazing animals can be used as a tool to manipulate vegetative conditions towards or away from specific vegetative community structures, commensurate with potential. Grazing can also be a tool to maintain plant succession at certain stages and to maintain biological diversity.

Also see the Social Ecosystems Section.

Part III. Riparian Ecosystems

Spencer Creek watershed has approximately 110 miles of fish bearing and intermittent streams which depend on healthy functioning riparian areas for key habitat input factors. In addition, over 2,000 acres of wetland area have important effects on water quality and hydrologic function. The riparian zone of influence is the most important link between the terrestrial and aquatic environments. Riparian zones are the only dependable source of large woody debris in the Spencer Creek watershed. Large woody debris functions to create pool habitat, retain spawning gravel beds, and provide hiding cover for fish. Riparian vegetation functions to prevent excessive erosion of streambanks and entrap fine sediments before they enter streams. Vegetation in floodplain areas functions to allow sediments to drop out of the water column as it slows water velocities and increases channel sinuosity. The processes of nutrient cycling in the aquatic environment are linked directly to shading, organic input from riparian vegetation, and water quality.

Although riparian and wetland communities are limited within the Spencer Creek watershed they are valuable to approximately 111 species of wildlife which have been documented or have a high potential to occur. Riparian and wetland habitat associated with Buck Lake and Tunnel Creek provide habitat for a population of spotted frogs. The spotted frog is a federal Category 1 candidate for federal listing as threatened or endangered. This population represents one of only three spotted frog populations known to occur within the Upper Klamath Basin.

Riparian and wetland communities function as crucial breeding and feeding habitat for wildlife. Some of the attributes which make riparian areas so valuable are the presence of diverse and highly productive vegetation, the positive edge effects of streams, the high availability of terrestrial and aquatic insects, and the presence of water.

Part IV. Aquatic Ecosystems

A. Water Quality

Spencer Creek drains into the Klamath River and thus is a contributor to the overall water supply of the aquatic system from J.C. Boyle Reservoir and below. The relative contribution of Spencer Creek to the overall flow in the anadromous fish reaches of the Klamath River is small (less than one percent). The contribution of Spencer Creek to the wild resident fish reach below J.C. Boyle is more significant and water quality from this watershed may be of some importance.

Designated Beneficial Uses, as defined under Oregon Administrative Rules (OAR 340-41-006) "Means the purpose or benefit to be derived from a water body, as designated by the Water Resources Department or the Commission".

Spencer Creek has been designated as having moderately impaired water quality conditions and moderately impaired conditions affecting aquatic habitat (1988 Oregon Statewide Assessment of Nonpoint Sources of Water Pollution). The Beneficial Uses listed as impacted by water quality conditions in Spencer Creek are coldwater fish and water recreation.

According to OAR 340-41-962, Spencer Creek may have one or more of the following Beneficial Uses, Public Domestic Water Supply, Private Domestic Water Supply, Industrial Water Supply, Irrigation, Livestock Watering, Salmonid Fish Spawning, Resident Fish and Aquatic Life, Wildlife and Hunting, Fishing, Boating, Water Contact Recreation, and Aesthetic Quality.

B. Aquatic Biodiversity

The value of aquatic biodiversity in the Spencer Creek watershed is described here by example and illustration. The intent is to describe the value of aquatic biodiversity in the Spencer Creek watershed within the context of the Klamath Basin and the Pacific Northwest Region.

Like any watershed, Spencer Creek has a combination of physical attributes that makes it unique compared to any other. The relative position to adjacent watersheds, elevations, gradients, dominant aspects, and geology combine to create conditions which support a diverse assemblage of aquatic habitat types. This complexity of watershed features encourages the maintenance of aquatic systems to which species and communities are uniquely adapted. For example, the watershed probably supports cold water spring obligates such as some aquatic snails, as well as warm water wetland adapted amphibians like the spotted frog.

Other species have local adaptations which appear to be different from the regional population as a whole. A unique population of Pacific giant salamander was recently discovered in Spencer Creek and is the first reported population of this species east of the crest of the Cascade Mountains. In contrast to the semi-terrestrial populations west of the crest of the Cascade Mountains, in Spencer Creek, this salamander remains aquatic (retains gills) during all life history stages. This is an apparent adaptation to harsh and dry conditions at the presumed eastern periphery of its range (Hayes 1994).

Species which have high mobility and migrate in and out of the watershed are a source of genetic diversity to basin and regional populations. The Spencer Creek watershed provides spawning and rearing habitat for the Klamath River redband (rainbow) trout population. This population is migratory and therefore has connectivity to the main-stream Klamath River and nearby tributary watersheds. It is a unique population because it is naturally adapted to environmental conditions found in the middle

Klamath Basin and because mature fish migrate into Spencer Creek to spawn (Buchanan et al. 1990-1992). This basin connectivity coupled with homing behavior (and associated straying of individuals) allows Spencer Creek rainbow trout to be a source of adaptive variability in Klamath Basin trout populations.

Other aquatic species in the Spencer Creek watershed have not been studied in such detail that their contribution to basin and regional biodiversity is well understood. In general, it is known that the resilience and viability of populations and communities is dependent upon the availability of diverse habitat types and community structures (Moyle and Leidy 1992, Odum 1985). While the Spencer Creek watershed may not be unique in supporting a diverse assemblage of aquatic species, it is obviously an important source of population diversity for the region.

C. Population Viability

Three aquatic animal species with state and federal management status, the redband (rainbow) trout, Pacific lamprey, and the spotted frog, are documented to occur in the Spencer Creek watershed. Other special status species and species listed in the Northwest Forest Plan under Survey and Management Guidelines probably occur. As survey protocols are developed and implemented, the list of special status species occurring in the Spencer Creek watershed is likely to increase. These species require varying levels of protection under federal and state management direction as well as assessments of their habitat conditions. The relative contribution of the Spencer Creek watershed to the viability of these species will largely depend on their distribution outside the watershed and population connectivity between watersheds. Some mollusc species occurring in the watershed may have very narrow distributions and low mobility and therefore are more susceptible to isolated disturbances (Frest 1993). Other species such as the redband (rainbow) trout can probably sustain short-term disturbances since they are more widely distributed in the basin and can seek out more favorable conditions and then repopulate disturbed areas when conditions become favorable again (Frissel 1994).

Chapter 4
Issues, Key Questions, and Analysis

Issues Addressed in the Analysis

The analysis of the ecosystem on a watershed scale is driven by a set of issues. There were 16 issues developed for the Spencer Creek drainage. These issues, in no particular order of importance, are listed below:

Issue 1: Recreation use is occurring in the watershed and may be affecting different resources.

Issue 2: Forage utilization patterns in the watershed are uneven.

Issue 3: Land in the Spencer Creek watershed was ceded to the United States by the Treaty of Klamath Lake in 1864. The Klamath Tribes have a hereditary interest in the Spencer Creek watershed.

Issue 4: Historic and prehistoric cultural resources exist in the watershed.

Issue 5: Forest/Range ecosystem health and resiliency has been altered in the watershed area.

Issue 6: Existing and recruitment levels of large dead standing and downed woody material have been altered.

Issue 7: Habitat for Federally listed, proposed or candidate species, State listed species, USFS Region 6 Sensitive species and BLM Special Status Species of plants has been altered.

Issue 8: Past and present land use activities may be contributing to the introduction, spread and increasing density of exotic/noxious plant species.

Issue 9: The density of roads in the watershed is negatively affecting wildlife.

Issue 10: Late successional forest in the watershed has been fragmented and reduced in size through harvest.

Issue 11: The size and distribution of cover patches (versus the size of openings) is inadequate for big game.

Issue 12: Wetlands, riparian and meadow ecosystems in the Spencer Creek watershed have been altered.

Issue 13: Water quality has been altered in Spencer Creek watershed.

Issue 14: The hydrograph has been altered in terms of base flow, peak flow, and timing of peak flow.

Issue 15: Channel condition has degraded.

Issue 16: Management practices have altered habitat conditions and caused changes in species assemblages, connectivity, and distribution.

To address each issue, a set of key questions was developed to focus the analysis on those aspects of the issue that are of most concern.

This analysis is grouped into four main categories to help keep the analysis readable. While there are undeniable connections between these components of the ecosystem, the groupings were formed to show one kind of flow within the watershed and facilitate a clearer understanding of the technical organization of the document. The four main categories are Social Ecosystems, Terrestrial Ecosystems, Riparian Ecosystems, and Aquatic Ecosystems.

The issues are divided into four main parts based on which aspects of the watershed they are concerned with: the social, terrestrial, riparian, or aquatic ecosystem. Obviously, some issues cross these artificial divisions, so some issues are discussed in more than one place. While in one way this makes it harder for the reader to find an answer to a specific issue, we felt that having the ecosystem components (social, terrestrial, etc.) discussed together in one place would enable the reader to gain a better understanding of the watershed as a whole.

The Social Ecosystem is discussed first in this chapter, as it is for all of this document. This is followed by the Terrestrial Ecosystem, Riparian Ecosystem, and Aquatic Ecosystem, respectively, in all chapters.

In a physically based hydrologic model of the watershed, energy flow is initiated at the summit and proceeds downslope, through the riparian zone, into the stream channel, and is delivered to the next body of water. Therefore, the physical/biological analysis begins upslope, with the forest structure and associated biological communities. Next, the riparian zone serves as the interface between the upslope and aquatic environments. The final section focuses on the aquatic system and its ability to transport watershed products and support aquatic dependent species.

The Social Ecosystem section is designed to acknowledge that human interactions with the environment--Terrestrial, Riparian, and Aquatic ecosystems--follow different energy patterns (flows) than the hydrologic model.

Part I. - Social Ecosystem

A. Recreation

Introduction

This section describes the recreation uses that are occurring in the Spencer Creek watershed, highlighting areas where other resources may be negatively affected. It will describe recreation use of the recent past, processes of change, and trends for the future.

Issue 1: Recreation use is occurring in the watershed and may be affecting different resources.

Key Questions: What recreation use is occurring in the watershed? Where/when is it occurring? Where are the problem areas and what resources are being impacted?

Assumptions/Analytical Process

Assumptions on recreation use levels are based on personal observation and discussions with other resource and agency specialists. In addition, recreation use information from the Spencer Creek Coordinated Resource Management Plan and the Weyerhaeuser Company Watershed Analysis was incorporated into this recreation assessment. In general, recreation use in the Spencer Creek watershed, including fishing, is estimated to be light (less than 10 visitors per day) at any given time and of a dispersed nature. An exception to this light use occurs at the mouth of Spencer Creek, which receives medium use (estimated to be 10 to 20 visitors per day) in the summer months.

However, some recreation use areas have been identified by resource specialists of the Bureau of Land Management (BLM), USDA Forest Service (USFS), and Weyerhaeuser Company as needing further analysis to determine if there are impacts to other resources. The specifics on how recreation impacts other resources is discussed under the appropriate issue, such as water quality.

Analysis Discussion

Historic Conditions

No historic or present day recreation use figures exist for the watershed. However, public input in response to the initiation of this watershed analysis indicates the area probably started receiving motorized recreation use in the 1940s and 1950s. Most roads in the watershed at that time were primitive, requiring high-clearance or 4-wheel drive trucks.

The mouth of Spencer Creek has historically been a popular area for recreationists in the watershed due to its relative ease of access and good fishing opportunities. See Map 6 for recreation opportunities.

Process of Change

As additional roads were constructed and improved for timber hauling, and the Keno and Clover Creek roads were paved, access to the watershed was greatly enhanced. By the mid to late 1960s, with good access, the watershed was available for use by a wide variety of recreationists.

The construction of J. C. Boyle Dam in the late 1950s enhanced recreational boating, swimming, and camping in the vicinity of Spencer Creek, and likely attracted greater numbers of recreationists. The mouth of Spencer Creek offers the availability of water for recreation, and until the last few years offer unstructured/unrestricted recreation with a lack of sufficient law enforcement. This in turn attracted a certain segment of the public looking for those amenities and lack of restrictions (weekend partiers). A pattern of unrestricted use was established over thirty years and continues to present problems for landowners, the law abiding public, and law enforcement in the present.

Current Conditions

As stated in the assumptions section, recreation use in the watershed is light at any given time, and of a dispersed nature. Fishing use is most likely concentrated in the spring and early summer months. Since no recreation use figures exist for the watershed, it is difficult to estimate use numbers. However, based on personal observations, recreation use of the watershed is very light most of the year, probably averaging less than 10 visitors per day. In summer months this probably expands to 100 to 150 visitors per day on weekends.

Because the Spencer Creek watershed is only 45 minutes driving time from Klamath Falls, and has three main paved roads providing ready vehicle access, (Clover Creek, Dead Indian Memorial, and Keno roads) the watershed attracts a variety of recreation users. The watershed provides recreational opportunities that include: sightseeing, fishing, hunting, camping, backpacking/hiking (primarily in the Mountain Lakes Wilderness), horseback riding, mushroom gathering, firewood and Christmas tree collection, cross-country skiing, and snowmobiling. Four-wheel drive use occurs in the watershed, primarily on existing roads, jeep trails and skid trails. Fishing occurs along much of Spencer Creek. Primitive, non-designated camping areas are located on Weyerhaeuser Company property near the mouth of Spencer Creek, along the Clover Creek Road on National Forest lands, and at the Clover Creek trailhead. Other areas in the watershed receive occasional primitive camping use, primarily during hunting season.

The Clover Creek trail provides access to the southern portion of the Mountain Lakes Wilderness area (see Map 6). Use of the trail is low (usually one to five parties each day during the summer months).

The Buck Peak snowmobile trail and a portion of the Sunset snowmobile trail are located in the northern portion of the watershed. These two trails are part of a much larger, groomed, snowmobile trail network in southern Oregon. A series of turnouts along the Clover Creek Road are plowed in winter by Klamath County and used as unofficial Snow-Park areas. An additional Snow Park and connecting snowmobile trail has been identified on BLM-administered land near the junction of Clover Creek Road and the Spencer Creek Hookup. The watershed currently provides good unstructured snowmobile and cross-country skiing opportunities, especially in the area near the Dead Indian Memorial Road.

The recent paving of Clover Creek Road will increase recreation use since the opportunity to drive for pleasure and access to the National Forest and BLM-administered lands is increased. Clover Creek Road has also been included in published brochures as part of a scenic tour route and bicycle tour route. The scenic tour route follows Highway 66 from Ashland, up Clover Creek Road and returns to Ashland on the Dead Indian Memorial Road.

The community of Keno and Lake of the Woods residents also influence recreation use in the watershed. These "local" residents affect recreation use to a moderate amount within five miles of their respective communities. The areas within the watershed affected by this zone of influence include the area around the mouth of Spencer Creek and the upper portion of the watershed. This recreation use by "local" residents is in addition to the use by Klamath Falls urban residents.

The Applegate National Historic Trail crosses Spencer Creek near its confluence with the Klamath River, on Weyerhaeuser Company land.

Trends

The greatest potential for negative impacts to the resources in the watershed from recreation use is from off-highway vehicle or all terrain vehicle use off of existing roads. The impact of the use of existing roads on wildlife and water quality are covered in the appropriate sections. Few areas of uncontrolled off-highway/all terrain vehicle use were noted in the upper portion of the watershed. This is primarily due to the more heavily vegetated, rocky or steeper slopes and the presence of Mountain Lakes Wilderness which is closed to off-highway vehicles. For the most part, the USFS Clover Creek Road primitive campground enclosure and rock barriers are preventing motorized access to the stream corridor. Recreation visitors occasionally move rock barriers so they can access the streambank by motorized vehicle. Some off-highway vehicle use may also be occurring in the area of the USFS road along the upper reaches of Clover Creek. This off highway traffic is in association with firewood/snag cutting of lodgepole pine.

Uncontrolled recreation use or "beer parties", around the mouth of Spencer Creek was identified as a concern based on public input during the watershed analysis team's field tour. Uncontrolled recreation use or beer parties are defined here as unorganized recreationists or groups of recreationists that are at times loud, intoxicated, shooting off firearms, running vehicles recklessly, and/or harassing other visitors and wildlife. These recreationists typically show little of no respect to private property rights or law enforcement personnel.

In the lower portion of the watershed, especially near the mouth of Spencer Creek, uncontrolled off-highway/all terrain vehicle use continues to occur. Although the enclosure at the mouth of Spencer Creek has been effective, off-highway vehicle/all terrain vehicle use just outside the enclosure and on some steeper slopes was noted.

All terrain vehicle use (estimated to be primarily by local Klamath Basin residents) occurs mainly on weekends by users looking for an off-highway vehicle play area. Uncontrolled use of all terrain vehicles off of existing roads is the primary problem, not all terrain vehicle use in general. This uncontrolled use is expected to continue or increase if restrictions (fences, barriers) and/or educational and law enforcement efforts are not implemented.

Weyerhaeuser Company currently allows this dispersed recreation use on their lands. If conflicts between recreation and other resources occur, this recreation access could be limited in the future. Such a restriction in access would displace recreation users to other areas. Much of the recreation use occurring around the mouth of Spencer Creek is due to its proximity to John C. Boyle Reservoir. It is likely that if restrictions to recreation access occur on

Weyerhaeuser Company lands, then those users would be displaced to other lands in the vicinity of John C. Boyle Reservoir.

A recreation use that has the potential to negatively impact riparian/wildlife values is unauthorized firewood/snag cutting. Unauthorized cutting of snags for firewood along the stream banks has occurred sporadically where easy road access to the stream bank exists. This unauthorized firewood/snag cutting seems to be associated with camping and fishing, in addition to general firewood gathering. Areas of concern include the upper portion of Spencer Creek, the area around the USFS Clover Creek Road primitive campground enclosure, the USFS Road along the upper reaches of Clover Creek, and where roads parallel or intersect the lower section of Spencer Creek on Weyerhaeuser Company lands.

Currently, and for the foreseeable future other recreation uses such as fishing, mushroom and Christmas tree gathering appear to be having extremely limited or no impact to other resources.

Activities such as hiking, cross-country skiing, and snowmobiling also appear to be having extremely limited or no impact to other resources at this time. The Klamath Falls Proposed Resource Management Plan, Final Environmental Impact Statement discusses the development of additional trails. New trails for hiking, cross-country skiing, and snowmobiling may be of concern because of potential wildlife disturbances.

Summary

Recreation use in the watershed is light, with few areas of concern. The area around the mouth of Spencer Creek is of concern due to the impacts caused by off-highway/all terrain vehicles. Unauthorized firewood/ snag cutting is occurring along the USFS road along the upper reaches of Clover Creek and Spencer Creek. Motorized recreation use of existing natural or poorly surfaced roads is also of concern for wildlife and water quality. Additional monitoring, educational efforts, law enforcement and use restrictions may be needed to identify and reduce impacts from recreation use.

B. Livestock Grazing

Introduction

Some level of grazing has taken place within the Spencer Creek watershed analysis area since before the turn of the century. The earliest record is from 1867, with O.T. Brown homesteading and "ranching" near the mouth of Spencer Creek. Sheep, cattle, and/or horses may have been grazed during this period, but no documentation of such is known. It is known that in the1870s horses were grazed in the area (see Appendix 3). See the Cultural Resources section for more information on the human history of the area. Grazing use of the area in these early years probably would have taken place primarily in areas cleared by the early settlers or opened by fires (either wild or set).

It is unclear whether the general uncontrolled use that occurred in much of the west as a result of the intense competition for "first come-first served" open government land policies of the time occurred in Spencer Creek. The intense competition lead to vast overstocking and over use of the western rangelands and commensurate changes in and deterioration of vegetative communities. This period presaged and eventually lead to the passage of the Taylor Grazing Act of 1934 (Stoddard 1975).

Although the above scenario was evident in most of the eastern (and more arid) portions of Klamath county, it is not clear that it happened in the Spencer Creek watershed. The generally dense tree cover in much of the watershed and the fact that extensive logging did not occur until the 1920s - opening up that tree cover - may have precluded the high use levels found in other areas. Prior to the 1930s a few people grazed sheep and other livestock in the area, including what are now the upper watershed USFS-administered lands. After the Weyerhaeuser Company began operations in the area in the 1920s, grazing appears to have increased. Sheep were apparently the predominant domestic herbivore in the upper watershed area until the 1940s (and even into the 1970s in the lower watershed), when cattle numbers began to increase. Sheep grazing faded out when the coyote predation problem became severe enough, along with poor lamb prices and other economic reasons, to eliminate sheep grazing as cost effective.

Since the 1960s, cattle have been the primary domestic herbivore in the area. Cattle appear to have been the main grazing animal in the Buck Lake area since the 1940s. Permits or leases for grazing use in the watershed area have been issued since the 1940s by the major land owners/administrators (Weyerhaeuser Company/BLM and USFS). Smaller grazing leases have been and will probably continue to be issued for lands owned by Boise Cascade, Divide Resources, and possibly others. Intensive grazing use on lands owned by the Charley Livestock Company in the Buck Lake area has occurred since the 1940s.

Charley Livestock Company has leases and permits to graze cattle on all of the USFS-administered lands, the Weyerhaeuser Company lands north of the USFS boundary, and most of the BLM-administered lands in the watershed. The remainder of the BLM-administered lands and Weyerhaeuser Company lands south of the USFS boundary are leased by Lester Hinton.

Key Questions: What has been the historical livestock grazing use of the watershed? What is the current grazing use of the watershed?

Assumptions/Analytical Process

No specific assumptions are made for this key question, since it is simply a narrative of the historic and current grazing taking place within the watershed.

Analysis Discussion

Historic and Current Conditions

Following is a summary of grazing use by major ownership/administrative types, including some of the recent history as it is known and/or applicable. Historic and current grazing use is combined as current use in many areas is the same as historic, that is, the last 40 plus years (See Maps 3 and 10 for more information):

Bureau of Land Management

The BLM-administered public lands lie within three different grazing allotments as follows (Note: none of the BLM allotments lie totally within the Spencer Creek watershed; all of them extend into areas outside of the analysis area. Thus, some of the information presented is pertinent to land outside the area. As necessary, information is appropriately differentiated):

Grub Spring Allotment (0147) - The intermingled BLM-administered and Weyerhaeuser Company owned lands in this allotment are currently leased by Lester Hinton of Klamath Falls. For many years prior, the leases were held by Lloyd Howard who subleased the area for cattle use, from John Larzabal. Larzabal historically ran sheep throughout this area during the late spring and early summer, while moving west from Keno towards Johnson Prairie where the sheep finished out the season (See Buck Mountain allotment and Weyerhaeuser Company sections). Following the sheep use, some cattle were run in the area for the remainder of the season. It was not until the early 1970s that sheep grazing ended in the area due to the economics of sheep ranching (Hinton 1995, pers. comm.).

The BLM-administered lands (3,524 acres) within this allotment are, in general, located 2 to 5 miles south and east of Buck Lake - the extreme northwest portion of the Grub Springs allotment (see Map 10). The BLM lease is for 26 cattle from 5/1 through 9/15 (130 animal use months maximum use) and is directly tied to the lease of the Weyerhaeuser Company lands within the allotment, which make up almost all of the other 34,620 allotment acres. These Weyerhaeuser Company lands receive the vast majority of the grazing use. The current combined maximum number of cattle that can be grazed on the Grubb Springs allotment within the mix of BLM and Weyerhaeuser Company lands is 126 head. (Approximately 40 percent of this allotment's total area lies outside of the watershed.)

Buck Lake Allotment (0104) - The BLM-administered land in the allotment has been leased since 1942. Originally the lease was with the Dead Indian Stockmen's Association and the Charley Brothers. Since 1966, the Charley Brothers and more recently, Charley Livestock Company (1975) have had the entire grazing lease for the Spencer Creek watershed portions of this allotment. (Note: portions of the allotment lie over the divide and into the Jenny Creek watershed. The Jenny Creek portions are leased by another grazing operator - Scott Johnson - and are not considered further in this analysis.)

The BLM-administered public lands make up 11,971 acres of the allotment, with another 4,380 acres of private lands owned by Charley Livestock Company (Buck Lake), and some owned by Divide Resources, a Roseburg timber company. Less than half of the BLM-administered acreage in the allotment is within the watershed and grazed by Charley Livestock Company. The Buck Lake private lands are largely fenced separate from the other grazing lands and are discussed later. The BLM grazing lease with Charley Livestock Company is for 50 head of cattle from 6/15 through 9/15. The maximum use is 175 animal use months of cattle grazing and is the amount of grazing allowed since the original lease in 1942. In addition, Charley Livestock Company is allowed to graze an additional 50 head of livestock due to the private lands intermingled with the BLM-administered lands. This gives a total of 100 head that are allowed to be grazed within this allotment.

Buck Mountain Allotment (0103) - A very small portion of the extreme eastern portion of this allotment lies within the Spencer Creek watershed. Approximately 2 sections of the allotments' 8,142 acres of public land is estimated to be in this watershed. This includes, however, the public lands around Miners Creek, a tributary of Spencer Creek. This allotment has been leased to John Larzabal, of Red Bluff, CA or family for many decades. The BLM grazing lease for this allotment is attached to and dependent on acquisition of the Weyerhaeuser Company grazing lease. Weyerhaeuser Company lands make up more than 80 percent of the allotment area.

In 1993, Weyerhaeuser Company did not issue a grazing lease for their lands for the reasons listed in the next section. Thus, there is currently no authorized livestock grazing use on this allotment. The BLM grazing lease for the entire allotment was for 44 head of cattle during the period 5/15 through 10/1, with a maximum use of 204 animal use months. Weyerhaeuser Company previously leased their lands in the allotment for 206 cattle for the same period, allowing for a total of 250 head within the allotment. Prior to the late 1980s, Weyerhaeuser Company and the BLM leased the allotment primarily for sheep grazing. Sheep numbers of at least 2,000 head were grazed throughout this allotment and, in years past, the adjacent Grubb Springs allotment discussed earlier. Cattle were also grazed in conjunction with the sheep, but in fewer numbers. In the last year of sheep grazing (1989), 2,300 head of sheep were grazed along with 30 head of cattle. At other times varying numbers of cattle and sheep were grazed. It is believed that Larzabal made very little use of the land area in this allotment which lies within the Spencer Creek watershed (Hinton 1995, pers. comm.).

Weyerhaeuser Company

Weyerhaeuser Company owned property makes up a large majority of the lands in the lower half of the watershed. According to Merle Anderson, a long time resident in the area, Weyerhaeuser Company leased their lands in the lower watershed for sheep grazing, beginning in the 1920s, with up to four bands of 400 sheep each grazing the Spencer Creek area (Anderson 1994, pers. comm.). During this time and later, if cattle were grazed it was via a sublease with the sheep lessees. Sheep grazing faded out by the 1970s, when the coyote predation problem became severe enough, along with poor lamb prices and other economic reasons, to eliminate sheep grazing as cost effective. According to Mr. Anderson, losses of up to 10 percent of the sheep herd to coyote predation were common. Prior to 1990 (and probably back to the 1970s when sheep were dominant), Weyerhaeuser Company's lease allowed for the grazing of 200 head of cattle from 5/1 to 9/30 (1000 animal use months). In 1991, the lease was for 175 head for the same period. From

1992 to date, the lease amount has been for 100 head from 5/1 through 9/15. All of the Weyerhaeuser Company lands, south of the USFS boundary, are leased to Lester Hinton and grazed in common with the BLM-administered lands in the Grubb Springs allotment (see that section for more information).

Recent Weyerhaeuser Company policy has been towards more restrictive livestock grazing on their lands. This is evidenced by recent cutback in the number of cattle allowed to graze in various areas. The primary reason for these restrictions is to enhance deteriorated riparian areas. Secondary is the lessened need for tree plantation undergrowth grazing suppression. Many of the Weyerhaeuser Company grazing leases in southwest Klamath County have been cancelled in the past 2 years. The lease on Grubb Springs is being continued, according to John Monfore of Weyerhaeuser Company, due to the grazing lessees and Weyerhaeuser Company's cooperative involvement in the Spencer Creek Coordinated Resource Management Plan (Monfore 1994, pers. comm.). The current combined maximum number of cattle that can be grazed on the Grubb Springs allotment mix of BLM-administered and Weyerhaeuser Company owned lands is 126 head.

USDA Forest Service

The grazed USDA Forest Service-administered lands are all incorporated within what is called the Buck allotment. This allotment historically was a number of different allotments, with several different livestock operators. Over time, Charley Livestock Company acquired all of the grazing permits and the Buck allotment is now a larger consolidated allotment made up of those past allotments. The USDA Forest Service-administered lands within the Mountain Lakes Wilderness Area are not allocated for livestock grazing; and, due to topography and tree cover receive little aberrant livestock use from adjoining areas. These lands are not considered further.

It was believed by some contemporaries, that fires were set deliberately by sheep herders in order to open up more grazing land (Pruyn-Sitter, 1995 pers. comm.). The current grazing level of 225 head of cattle for the season 7/1 through 10/15 is essentially the same as what has occurred since the early 1940s. As noted earlier, there were 3 different grazing permittees originally in the 1940s, including the Charley Brothers. Through acquisition and attrition, Charley Livestock Company combined the entire permit under their ownership by the 1960s

At the beginning of the grazing season (7/1), the cattle are typically split into two herds. Approximately one half of the animals are put into the far western portions of the allotment, around the Burton Butte area. The other half of the herd is placed into the eastern portion of the allotment in the vicinity of Buck Peak. Some of the cattle tend to drift back towards Buck Lake, where they were herded from, and frequent riding by the permittee is needed to keep the cattle away from Buck Lake and up in the USDA Forest Service upland areas.

In 1993, the USDA Forest Service contracted a rangeland survey of the Buck Allotment (contract performed by "Botanical Identification Service and Associates") which resulted in the preparation of a "Range Analysis Narrative for the Winema National Forest, Klamath Ranger District" (USDA-Forest Serivce 1993). This range survey/ analysis made estimations of the allotment carrying capacity, made observations of range condition and trend, identified problem areas, and made general management recommendations of how grazing could improve and continue. All of this information will be covered in later sections of the analysis, as appropriate.

Charley Livestock Company

The Charley Livestock Company owns the area in and around Buck Lake itself. Of the 2,170 acres they own, approximately 1,500 acres are the open "wet" meadow areas of Buck Lake itself. The remainder of 670 acres is forested land around the periphery of Buck Lake. The Buck Lake property has been in the Charley family since 1942 when Hugh Charley's maternal grandfather purchased the property from the California and Oregon Power Company. Cattle grazing began in earnest in the mid to late 1940s after the lakebed was ditched and drained to increase the grassland attributes of the property and allow access to grazing cattle. According to Hugh Charley, cattle grazing was less before the 1960s than after. Present numbers are currently at historical highs (Hugh Charley 1994, pers. comm.). Currently, Charley Livestock Company grazes approximately 350 head of cattle total, both on private land and outside on the other grazing lease areas (Spencer CRMP 1994). He typically brings his cattle to Buck Lake from California in mid-May, where they stay on private lands until about mid-June. At that time, 100 head are placed on the BLM permitted areas of the Buck Lake allotment, as described earlier. About July 1st, 225 head are placed on the USDA Forest Service grazing allotment. Also, about this time, an additional 150 pairs are brought in to the private land and added to the 25 head still remaining there. The cattle are all brought back to Buck Lake between mid-September and mid-October and shipped to other grazing lands by mid-November.

Process of Change

There are no particular processes of change in regards to the historic and current live-stock grazing, except for variations in the economics of livestock production, land ownership patterns, and changing govern-ment policies in regards to land uses.

Trends

Condition trends is not a viable concept in regards to this Key Question, beyond what is found in the following "Summary".

Summary

Grazing intensity has remained very stable in the mid to upper watershed, that is, within the BLM's Buck Lake and the USDA Forest Service's Buck allotments, since the 1940s. Although use prior to the 1940s is not quantifiable, it was probably of equal or higher intensity. It is expected that short of dramatic changes in federal land manage-ment policies, the trend in grazing use will continue the slight downward bias because of competing demands by other forest users and uses.

Grazing use in the lower watershed (Grub Springs allotment), has varied considerably since the 1930s However, the intensity of livestock use in the 1990s is probably at a 50 year low. Given the above stated predic-tion that federal land grazing will likely be down and the fact that the Weyerhaeuser Company is de-emphasizing livestock use on their lands, livestock use trends will probably be downwards.

Given the above conjectures, grazing use levels observed in 1994, are considered on the high end of what is expected in the future.

C. Cultural Resource

Introduction

The Spencer Creek Watershed Analysis Team decided that the social ecosystem and cultural resource section of the analysis should contain an overview of human activity in the watershed during prehistoric and historic time. This then allowed the team to analyze the Issues and Key Ques-tions with a base of knowledge about some of the human conditions that influenced the watershed. One must keep in mind, an overview is not a paradigm, theory, thesis, or antithesis. It is simply a statement of known facts.

The only temporal (time) reference is prehistoric and historic. There is a scarcity of archaeological research within the watershed. Prehistoric sites have been identified, and there is a very high probability that many other sites exist. However, surveys, testing, and data recovery have not been done. Prehistoric impact (pre-1860s) appears to be limited to various subsistence strategies, probably on an annual or sea-sonal round basis (see glossary). There appears to be some evidence of religious practice in the Clover Creek/ Aspen Butte area. There is also the possibility of a seasonal village near the confluence of the Klamath River and Spencer Creek. Historic records of Modoc use of the area for hunting and gathering activities exist. Essentially, nothing is known regarding culture and cultural change during the prehistoric period. More intensive archaeological investigation will be required to understand the level of human impact on the watershed during that time.

The historic period in this instance begins in the 1860s with the arrival of the first rancher, O. T. Brown. Brown's tenure in the watershed lasted for ten years. He sold out to Hiram and Mary Spencer around 1870; however, his occupation of cattle ranching; continues today, and is in fact one of the two commercial enterprises continuing in the watershed. The second commercial enterprise is timber harvest, which has been an on-going activity since the 1860s when Melvin Taylor established the first known sawmill in the area. These two commercial enterprises are the basis of human impact on the Spencer Creek watershed throughout the historic period.

Issue 3: Land in Spencer Creek watershed was ceded to the United States by the Treaty of Klamath Lake in 1864. The Klamath Tribes have a hereditary interest in the Spencer Creek watershed.

Key Question: Do the Klamath Tribes have treaty rights and/or resources, for example; hunting, fishing and gathering, in the Spencer Creek watershed and have these resources been affected by past activities?

Assumptions/Analytical Process

No specific assumptions are necessary.

Analysis Discussion

The 1864 treaty of Klamath Lake 1864 extends rights only to the Klamath Reservation. The Termination Act: 25 USCS - 564, suspended these treaty rights. Hunting, fishing and gathering rights were subsequently restored within the boundaries of the former reservation by the Final Consent Decree: Kimball v. Callahan, et. al., Civ. 73-155 United States District Court For The District of Oregon, April 29, 1981. Ceded lands outside the boundaries of the Klamath Reservation (The 1864 Treaty of Klamath Lake), were specifically exempted from the final consent decree. Therefore, there are no treaty rights in the Spencer Creek watershed. The Klamath Tribes have the same rights to use the land under federal management in the Spencer Creek watershed as any other American citizen.

Key Questions: What are the needs and interests of the tribes in this watershed? How should traditional use be considered?

Assumptions/Analytical Process

No specific assumptions are necessary. However, the following is provided for clarification:

Traditional Use

Traditional use is current use (for the past 50 years) by contemporary people, for example; a person's parents and grandparents used a fishing site, and the person continues to use the site, and views it as a family asset.

Cultural Use

Traditional cultural values are often central to the way a community or group defines itself, and maintaining such values is often central to maintaining the group's sense of identity and self respect. Traditional in this context refers to those beliefs, customs, and practices of a living community of people that have been passed down through the generations, usually orally or through practice. A cultural landscape may consist of an area associated with the traditions of a Native American group, concerning its origins, its cultural history, or the nature of the world. Also, a location where Native American religious practitioners have historically gone, and are known or thought to go today, to perform ceremonial activities in accordance with traditional cultural rules of practice. The traditional cultural significance then, is significance derived from the role the property plays in a community's historically rooted beliefs (National Register Bulletin No. 38).

A cultural landscape also applies to a community, urban or rural (Euroamerican), whose organization, buildings and structures, or patterns of land use reflect the cultural traditions valued by its long time residents. Examples would be Chinatown, in San Francisco or Germantown in Columbus, Ohio.

Analysis Discussion

Merle Anderson, the Great Grandson of Hiram and Mary Spencer, was born within the watershed in 1913, and has spent his lifetime as a rancher working his family's land along Spencer Creek (see Appendix 3). Hugh Charley's Grandfather (see Appendix 3) bought their family land in the Buck Lake area of the Spencer Creek watershed in 1942. Mr. Charley, born in 1948, has spent his lifetime working his family's ranch in the Spencer Creek watershed. During the oral history interviews of Mr. Anderson and Mr. Charley, both ranchers state they have no memory of Native American use in the Spencer Creek watershed during their lifetime.

There is no known Native American Traditional Use within the Spencer Creek watershed. In regard to Native American cultural uses in this watershed, the tribes involved include: Shasta, Takelma, Klamath, and Modoc. These tribes must determine if it is within their own best interest to share with the government, information concerning traditional use or cultural landscape. At the time of this writing, we have no knowledge of either Traditional Use or Cultural Landscape within the Spencer Creek watershed.

Euroamerican cultural use in the watershed is minimal. There are two ranchers working hereditary lands, both of which would come under traditional use. If one considers recreation as a social issue, then hunting and fishing by both Euroamericans and Native Americans is occurring as well as the subject of management actions. Neither activity can be considered as a necessary subsistence procurement activity. These social issues are better addressed in the planning process. Planning, in regard to cultural resources, must be in accordance with the National Historic Preservation Act and its amendments, and conform to the Section 106 process.

Issue 4: Historic and prehistoric cultural resources exist in the watershed.

Key Questions: How has human activity impacted the watershed? What is the history and prehistory of human activity in the watershed?

Assumptions/Analytical Process

No specific assumptions are necessary.

Analysis Discussion

Prehistoric activity was apparently of very low impact, limited to seasonal hunting and gathering activities which continued through the fall of 1873. There has been no known impact by Native American people since that time. See Appendix 3.

Euroamerican occupation in the Spencer Creek watershed began in 1867 with the establishment of Camp Day, an outpost of the United States Army. O. T. Brown's cattle ranching activity in that same year was closely followed by logging and sawmill activities. The Spencer Station stage stop was the most well known commercial activity during the 19th century. With the bridging of the Klamath River, the need for the stage stop diminished, but the Spencer family kept up their various other commercial activities including ranching and logging.

At this time, there are three active cattle ranching operations within the Spencer Creek watershed (see the Livestock Grazing Section). As part of the cattle ranching activities, Buck Lake, the source of Spencer Creek, was drained, and converted to irrigated pasture.

There has been logging activity in the watershed since the 1860s, which intensified at the turn of the century. Weyerhaeuser Company arrived in the 1920s with intensive railroad and subsequent road building to augment their logging activity. Other timber/logging companies have smaller interests in the watershed, however the USDA Forest Service, and Weyerhaeuser Company are the two largest land administrators/owners at over 20,000 acres each.

Key Questions: How has human activity impacted the watershed (continued)? What types of cultural resources exist in the watershed and where are they located?[1]

During the summer of 1994 Woods Cultural Research, Inc. conducted ethnographic studies in the Spencer Creek watershed for the Pacific Gas Transmission Company's, Medford Extension Project. At this time, seven historic and ethnographic sites were identified within one mile of the confluence of Spencer Creek and the Klamath River. Site types are discussed as part of the analysis in this document See Table 7 for historic sites and Table 8 for prehistoric sites), however the locations are classified as Confidential and are not identified in this document. See also Tables 9 and 10 for further information on cultural sites.

HS 053 was identified as a traditional resource procurement location important for plant gathering, fishing and hunting. Plants gathered included wild rose and strawberries. At this location there is a lithic scatter, a historic site, and there may be associated burials. Both Modoc and Shasta are known to have utilized the area.

HS K054 is a probable cremation site.

HS K055 is a known Native American Cemetery with positive identification of human remains.

HS K055b is a known Native American Cemetery.

ES 08 is the site of Camp Day.

ES 08a is the site mentioned by Spier (1930:9) as a Klamath Fishing Station. Spier also noted this as the downstream limit of Klamath Territory.

SC-001 is a prehistoric/Historic Site containing several pieces of bottle glass, obsidian biface thinning flakes, other obsidian flakes and one large Crypto Crystalline Silicate flake.

SC-002 (6HP-2) is a prehistoric/Historic Site containing a large number of historic and prehistoric artifacts. The site, location covers several acres on both sides of Spencer Creek. Shovel tests at the site yielded obsidian flakes, mammal bone and shell fragments. Obsidian and Crypto Crystalline Silicate debitage (see glossary) is extensive as is various bottle glass fragments. The oldest of which is from an aromatic schnapps bottle that dates between 1865 and 90 (Fagan et al., 1993, and Wilson 1981:17).

SC-003 is a prehistoric lithic scatter containing early stage core reduction, percussion flakes, thinning flakes, utilized flake tools, a groundstone bowl mortar and a battered hammer stone. Debitage is both obsidian and Crypto Crystalline Silicate.

Spencer Cemetery. The Spencer family cemetery has been badly vandalized, head stones have been stolen, and graves violated.

These sites are all within the area of the Pacific Gas Transmission Medford Extension pipeline route or on a reroute. Only one site has been recorded in the area between the pipeline route north to the boundary of the Winema National Forest. During 1990/91, 2,865 acres were surveyed on BLM-administered Lands in this area. No cultural material was recorded during these surveys. On USDA Forest Service-administered lands, approximately 1,250 acres have been surveyed for cultural resources with no cultural materials recorded. However, twenty-one sites have been recorded on other USDA Forest Service-administered Lands within the Spencer Creek watershed. Five of the twenty-one sites are located on or immediately adjacent to private lands located within the national forest boundary.

[1]Due to the sensitive nature of both historic and prehistoric sites, site locations are kept confidential but locations are considered in site specific planning.

Table 7. Historic Sites

Date	Site Characteristics
1910 - 1932	House and barn, some ruins evident.
ca1912	Associated with J. Whitcomb homestead.
ca1903	Whitcomb log cabin and small sawmill.
ca1920/30	Saddle notched log cabin.
ca1930	Log cabin and small dump.
No Date	Boards and tin cans.
1903	Homestead filed.
ca1920	No trace of camp at last visit in 1989.
1923	No information.
1910 - 1934	Contact Winema National Forest for Maintenance records which will give description.
No Date	Front axle and other Oak wagon parts.
Post 1900	Log and milled lumber structure. Datum tree and dump.
No Date	No information.Void Site
1860	Camp, Company L, 3rd artillery.
No Date	With prehistoric lithic scatter.
ca1870	Has prehistoric elements.
ca1870 - 1890	Spencer Family Cemetery has been badly vandalized. Cemeteries are not normally eligible for the National Registerof Historic Places.
No Date	Nine hole-in-cap cans.

Table 8. Prehistoric Sites

Resource Procurement	Important for plant gathering, fishing, and hunting.
Cemetery	Known Klamath Cemetery.
Probable Cremation	Klamath ethnographic site.
Cemetery	Known Klamath Cemetery.
Lithic Site	Full range of debitage including obsidian and CCS.
Lithic Site	Spencer Station, Prehistoric elements.
Lithic Site	Prehistoric element of historic/prehistoric site.
No Data	Noted on USFS site form, no information given.
Power Quest	Piled rock mounds.
Lithic Site	Primary and secondary obsidian flakes.

Total number of sites =	29 (10 Prehistoric, 19 Historic)
Sites with historic/prehistoric features =	4
Total loci =	25
Euroamerican settlement =	11
U.S. Government =	3 (1 Military, 2 Forest Service)
Logging/ Sawmill =	2
Cemetery =	4 (3 Native American, 1 Euroamerican)
Commercial =	2
Historic artifact =	5
Prehistoric/Lithic scatter =	4
Ethnographic resource procurement =	1[1]
Prehistoric religious =	1

[1] Resource procurement covers a wide range of activities, and should probably include "Lithic Scatters" because they are often associated with food getting activities in this context.

Table 9. Sites

Total Loci	25
Historic	19
Prehistoric	10
Total Sites	29

Table 10. Site Types

Euroamerican Settlement	11
U.S. Government	3
Logging/Sawmill	3
Commercial	3
Cemetery	4
Historic Artifacts	5
Prehistoric Artifacts	4
Ethnographic Procurement	1
Prehistoric Religious	1

There are four main areas where sites are grouped:

1. Buck Lake
   a. 8 - Historic Sites
   b. 1 - Prehistoric Sites

2. Confluence of Spencer Creek and the Klamath River
   a. 5 - Historic Sites
   b. 7 - Prehistoric Sites

3. Clover Creek
   a. 6 - Historic Sites

4. Aspen Butte
   a. 3 - Prehistoric Sites

Part II - Terrestrial Ecosystem

The Terrestrial part of this analysis is separated into a Vegetation Section, Landscape Section, and a Wildlife Section.

The Vegetation Section discusses forest communities, special status plants and communities, rangeland/grazing, and noxious weeds.

The Landscape Section discusses landscape issues, soil productivity, and distribution of late-successional forest.

The Wildlife Section discusses late-successional forest dependent wildlife species, Northern Spotted Owls, ponderosa pine associated wildlife species, and deer and elk.

Note: Most of the tables and figures for the Terrestrial Ecosystem part are consolidated at the end of the Vegetation Section, letter A. This was done because of the large number of tables. The readability of the document would be lessened by inserting so many tables in the text. Many of the tables are also referenced in several of the sections, therefore having most of the tables in one place will allow easy cross referencing.

Issue 5 and its related key questions is answered throughout the Terrestrial Ecosystem part of the analysis.

Issue 5: Forest/Range ecosystem health and resiliency has been altered in the watershed area.

Key Questions: What was the historic disturbance regime that shaped the ecosystems (landscapes and vegetative communities) in the Spencer Creek watershed? How has timber management activities, fire suppression and grazing altered the function, structure and composition of these ecosystems?

Key Questions: What are the trends for existing forest stands? What vegetative communities and areas within the watershed are most susceptible (least sustainable) to fire, drought, insects and diseases?

Vegetation Section

A. Vegetation

Introduction

The Vegetation Section discusses forest communities, special status plants and communities, rangeland/grazing, and noxious weeds.

Issue 6: Existing and recruitment levels of large dead standing and downed woody material have been altered.

Key Question: Has there been a change in historic levels, size, and distribution of downed woody material and snags?

Assumptions/Analytical Process

To answer the key questions above, determinations and inferences are made based upon historic data, interviews, literature reviews, and professional judgement. Oliver and Larson (1990, cited by Morgan 1994) in their discussion on historical ranges of variability suggest showing each successional stage by habitat type (plant association) present in the landscape. Such an analysis would provide insights into the relative abundance of different successional stages occurring in the landscape both past and present. This vegetation analysis attempts to do this based upon historic and existing vegetation data. Landscape and individual stand attributes, such as seral stage, patch size and arrangement, canopy closure, fuel loads, and species composition are determined from both historical and existing data for the different forest vegetation zones.

1899-1900 Data

For historic perspective, Leiberg's 1899-1900 description of the Cascade Forest Reserve, which includes the Spencer Creek watershed, is the oldest description available of the forested communities in Spencer Creek. His survey records vegetation conditions in the watershed prior to significant alternations in the watershed. Although Leiberg's descriptions are limited, he did quantify some of his information. For example, Leiberg estimated the amount of each township that was: Forested, Nonforested (bare, rocky, meadow, burned, water, etc.), Badly Burned, and Logged. Using this information, inferences can be made on what percent of the townships (Landscape), on the average, were early seral stage communities. In addition, Leiberg estimated the species composition of trees greater than 4 inches in diameter within each township. Again, inferences can be made based upon these estimates. Finally, Leiberg's written descriptions help illustrate the structure and composition of historic stands and the disturbance regime (fires) that shaped them. Figures 1 and 2, Table 11, and Map 11 are summaries of Leiberg's information.

1945 Data

To determine vegetation patterns in the 1940s, early aerial photos from 1940 to 1950 were used along with a 1945 Pacific Northwest Forest and Range Experiment Station inventory. Much of the 1945 inventory data was transferred into Graphical Information System and queries were made of this data. Using the 1945 inventory descriptions, the 1945 forested stands in the watershed were categorized into species groups and seral stages for comparison purposes (see Maps 12 and 13 respectively).

1987 to 1994 Data

The 1987 Pacific Meridian Resources data is used to determine existing landscape and individual stand attributes in the watershed. Because the satellite imagery was taken in 1987, it was necessary to update the information because of alternations that have occurred in the watershed since 1987. This was completed by field checking all stands that had been treated after 1987 and assigning them an updated Pacific Meridian Resources size/structure classification and canopy closure. This was done for federal lands only.

For a complete description on how 1899, 1945, and 1987 data was categorized into different seral stages, see Appendix 2. See Maps 14 and 15 for species groups and seral stages in 1994.

Data Limitations

1. Leiberg's 1899 to 1900 data was not descriptive enough to differentiate between mid and late seral stands. Therefore, for comparison purposes, mid and late seral stands are combined for 1899 data.

2. Leiberg's information is subdivided by township. The Spencer Creek watershed encompasses parts of eight different townships. The averages reported in this analysis are sometimes averages of the eight different townships combined.

3. The 1945 inventory is limited in two ways. First, much of the lower one-third of the watershed had been logged prior to the 1945 inventory (Table 12). Thus, data is from altered stands. Second, the description of the 1945 data is very general (See Appendix 2 and Table 12). Differentiation between mid and late seral stand was difficult and therefore, for comparative purposes, data from mid and late seral stands from the 1945 inventory should be combined.

4. Since the 1987 satellite inventory, private lands within the watershed have been significantly altered. Weyerhaeuser Company in particular has treated a large amount of their land within the watershed because of the rising insect mortality in their white fir stands. Although the 1987 Pacific Meridian Resources data for private lands has not been updated, the 1987 data still classifies most of Weyerhaeuser Company's lands as early, early-mid, or mid seral with little or no late successional

stands. Since 1987, on private lands, the trend has been an increase in early and early-mid stands and a decrease of mid seral staged stands (personal observation). Therefore, the 1987 Pacific Meridian Resources data probably reports more late and mid seral forest and higher canopy closure on private lands than was actually present in 1994.

Analysis Discussion

Historic Conditions

Climate

The forests on the landscape today reflect past geological and climatological events; natural disturbances; and the influence of Native Americans, European- American settlers, and the inhabitants of today (Agee 1993). Before discussing the detailed disturbance regimes within Spencer Creek, emphasis needs to be placed on the climate of the area and its role in shaping the existing ecosystems. Long term climatic processes possibly more than anything else have shaped the vegetative ecosystems within the watershed. Over the past 5,000 to 10,000 years, climatic shifts in the Inland west have resulted in areas changing from glaciers to complex vegetation associations (Johnson et al. 1993, cited in Morgan 1994). Barnosky et al. (1989) and Brubaker (1991, both cited in Agee 1993) state modern species assemblages have appeared only in the last 5,000 years. Covington et al (1994b) states that ponderosa pine arrived in the inland west only 2,000 years ago. Agee (1993) refers to studies done by Henderson and Peter (1981) and Stuiver and Quay (1980) that discuss periods of global cooling that correspond with low sunspot periods. Estimated periods of global cooling were from 1280 to 1350, the Wolf minimum; 1420 to 1530, the Sporer minimum; and 1645 to 1715, the Maunder minimum. The periodic cooling subsequently affected all aspects of the vegetation patterns that occur on the landscape today. In addition, the periodic cooling affected the disturbance regimes that occur within and across these landscapes.

Therefore, it is imperative when discussing the historic disturbance regimes, for example lightening patterns, that one considers the impact that climatological events have on the regimes an area experiences. Changes in climatic patterns would result in a changes in lightning patterns. A change in lightning patterns would result in a change in disturbance intervals and responding vegetation. While climates are normally long-term stable type patterns, disturbance regimes are viewed as annual, decadal, or century type patterns or cycles (for example, fire return intervals).

Disturbance Regimes

Disturbance is an integral process in the function of natural ecosystems. Management of forest ecosystems must take into account disturbance regimes by a variety of agents (Agee 1993). The natural disturbance regimes that have helped shaped the ecosystems within Spencer Creek include fire, wind, ice and freeze damage, water (wet and dry cycles), erosion, insect and disease outbreaks, and effects caused by humans (see Table13).

Prior to European-American settlers, fire starts by lightning or Native Americans was the main disturbance that shaped the various ecosystems in Spencer Creek. For at least 10,000 years before Europeans arrived, Native Americans altered fire regimes by more frequent ignitions (Covington et al. 1994b). In regards to the Spencer Creek watershed, Leiberg (1899) states that "The age of the burns chargeable to the era of Indian occupancy cannot in most cases be traced back more than one hundred and fifty years." Leiberg repeatedly refers to badly burned and light underburns in all of the townships within and surrounding the Spencer Creek watershed (See Map 11). In fact, Leiberg (1899) found almost the entire Cascade Range and Ashland Reserve marked by fire.

Insects and pathogens have played important roles in the forests of the region. Outbreaks were a natural phenomena of inland forests wherever favored tree hosts grew in abundance (Mason and Wickman 1988, 1993; Wickman 1992, all cited in Covington 1994b). Endemic levels of root diseases, for example annosus, tomentosus,

TABLE 13. Disturbance Agents and their Impact on Shaping the Existing Ecosystems in Spencer Creek

DISTURBANCE		IMPACTS ON ECOSYSTEMS	REMARKS
Fire	- Lightning	High	
	-Native Americans	High	
Human	-Forest Management	High	Last 80 years
	-Grazing	Moderate to High	Last 100-150 years
	-Fire Suppression	High	Last 80-90 years
Wind		Low	
Ice and Freeze Damage		Low	
Water		Low	
Erosion		Very Low	
Insect Outbreaks		Moderate	
Disease		Low	Small isolated areas

laminated, and armillaria, were present and individual or tree group mortality caused increased biodiversity within stands (Hessburg et al. 1993 cited in Covington 1994b). In mixed conifer forests, western pine beetle (*Dendroctonus brevicomis*) attacked stressed ponderosa pine and mountain pine beetle (*D. ponderosa*) attacked lodgepole pine, but the extent of the attacks was more limited (Hessburg et al. 1993, cited in Covington 1994b). In the ponderosa pine climax forests, western pine beetle attacks were continuous but localized except in the tension zone between forest and shrub steppe where trees were subjected to increased stress (Hessburg et al. 1993, cited in Covington 1994b). Mistletoes were present but kept in check by recurring fire (Covington 1994b).

Miller and Keen (1960) cite a very early study that was done in the Klamath Basin that involved about 1,250,000 acres and lasted from about 1921 to 1952. A summary of that particular study indicated that losses from western pine beetle ranged from 0.4 percent of the stand per year up to 3.5 percent per year during this 31 year period. Studies on the Rogue National Forest and in northern California during this same time period showed similar ranges. On the average, losses from western pine beetle ranged from 200 to 400 board feet per acre with peak years exceeding 1,000 board feet per acre (Miller and Keen 1960). The studies indicate a cyclic pattern of outbreaks. They also indicate that peak outbreaks were almost always preceded by low precipitation levels. Western pine beetle mortality normally occurs in small, isolated clumps and individual trees over a wide area (Miller and Keen 1960). The size of the clumps is generally less than one acre.

Note: The discussion now focuses on how the historic disturbance regimes have been altered and the subsequent result of these alternations to the vegetative communities that occur in the Spencer Creek watershed. Because disturbance agents affect vegetative communities differently, the discussion is separated into the five forest vegetation zones that have been identified in the watershed (See Map 5).

Mixed Conifer Zone and Ponderosa Pine Zone

It does not seem appropriate to separate the 520 acres of the ponderosa pine zone from the mixed conifer zone in this discussion. This is because of their interrelationship in this particular watershed and the nondefinitive line between the two zones. The plant communities within the mixed conifer and ponderosa pine zones in Spencer Creek watershed were both historically shaped by fire and are discussed jointly because the repeated fires resulted in similar vegetative structures, species compositions, and functions.

Historic Disturbance Agents

The disturbance agent that had the most historic influence on ecosystems within the mixed conifer and ponderosa pine zone was fire (Agee 1993). Within the Spencer Creek watershed, historic insect epidemics from bark beetles (*Dendroctunus spp.*, *Ips spp.*, and *Scolytus ventralis*) moderately influenced the forests within this zone (Miller and Keen 1960). Root rots and diseases (*Heterobasidion annosum*, *Armillaria ostoyae*, and *Leptographium wageneri*; blackstain) likely caused small-scale disturbances within the watershed in this zone (Scharpf 1993). Indian paint fungus (*Echinodontium tinctorium*) was also an important small-scale disturbance within this zone.

No significant windthrow events are known to have occurred within the watershed except for minor events involving a small number of trees.

McNeil and Zobel (1980, cited in Agee 1993) found an average fire-return interval of 9 to 42 years along an elevational gradient from about 1,350 m (4,500 feet) to 1,550 m (5,170 feet) elevation in Crater Lake National Park (see Map 1). This same study found few fires that burned the entire area (it left patches unburned) and there was variation based upon a number of factors, including extent and intensity of previous fires, aspect, slopes, and vegetation. At Oregon Caves, several fires appeared to stop at the lower elevation boundary of the white fir/herb plant community possibly in response to high cover of green herbage with high fuel moisture (Agee 1991a, cited by Agee 1993). Based upon this study, as well as others by Weaver (1985), Bork (1985), and Agee (1991, cited in Agee 1993), the fire-return interval for the mixed conifer zone within the Spencer Creek watershed probably ranged from 10 to 60 years.

Both Native American and lightning ignitions were important sources of fire in white fir forests (Agee 1993). Native Americans burned these forests regularly and somewhat altered the successional development of the vegetative communities (Gruell 1985, cited by Covington 1994b). Within both the mixed conifer and ponderosa pine zone the intensity of these historic fires was usually low because the frequent fires repeatedly removed understory ladder fuels and consumed the forest floor fuels (Kilgore and Taylor 1979, cited in Agee 1993). .

Within the Spencer Creek watershed, USDA Forest Service records from 1961 to 1992 and Oregon Department of Forestry records from 1979 to 1994 show a combined total of 142 fires (see Table 14). Of the 142 recorded fires (including 40 human caused fires), 41 lightning fires (29 percent) occurred in the mixed conifer zone. Most of the fires were less than one acre. A few fires were 1 to 3 acres in size. The largest fire within the zone occurred in 1992, the Big Buck fire, which was 67 acres in size. Almost all lightning fires have been immediately extinguished so that fires in the last 60 to 80 years have had little to no role in shaping the present day vegetation.

In regards to *Dendroctonus spp.*, investigations into the biology and control of western pine beetle (*Dendroctonus brevicomis*) began in the early 1900s (Miller and Keen 1960). Miller and Keen (1960) began monitoring bark beetle problems within the Klamath Basin during the 1920s and 1930s, inferring that there were concerns even then about tree mortality within ponderosa pine forests. In 1940 and 1941 Weyerhaeuser Company implemented tests of a sanitation-salvage type prescription designed by Keen and others to help reduce losses from bark beetles (Miller and Keen 1960).

Historic Seral Stages

Table 15 displays the 1945 estimate of seral stages for the mixed conifer and ponderosa pine zone within the watershed. Approximately 55 percent of the mixed conifer zone was either mid or late seral in 1945. Prior to 1945, the amount of mid and late seral forest was probably slightly higher because much of the lower part of the watershed had been harvested to some degree in the 1930s and 1940s. Leiberg's (1899) data (Figure 1) for just township T.38S.R6E., which lies almost entirely within the watershed and much of it in the mixed conifer zone, indicate that forested areas (classified as mid or late seral in this analysis) composed about 69 percent of the township.

Based on historical disturbance agents that occurred in these forests, early seral stands within the Spencer Creek watershed and within the mixed conifer and ponderosa pine zones probably composed about 5 to 25 percent of the area at any one time. This was likely due mostly to historic fire patterns. Many fires occurred that were low intensity and the seral stage present prior to the fire remained after the fire

Historic Structure

The lower elevation mixed conifer forests, with a large component of ponderosa pine, were open and parklike in the mid-nineteenth century (Agee 1993; Leiberg 1899; Beale 1858, cited by Covington and Moore 1994a). The typical fire in ponderosa pine forests had little effect on the herbaceous components of the ecosystem other than removing the cured material (dry, combustible) above ground. Removing the accumulated needles and above ground portions of the shrubs generally aided (increased) the grasses and forbs (Weaver 1951b and Biswell 1973, cited in Agee 1993). Periodic, low intensity fire maintained a cyclic stability in fuel loads (van Wagtendonk 1985, cited by Agee 1993) and understory plant biomass, and maintained a dominance of pines in the overstory (Agee 1993). Ponderosa pine has a competitive advantage in the presence of fire that it loses in a fire-free environment (Agee 1993). The lower part of Spencer Creek watershed was likely dominated by large open growth ponderosa pine with canopy closure in many areas probably less than 50 percent. Historically, as elevation increased in the mixed conifer zone, the ponderosa pine stand component was reduced, while the white fir and understory brush component increased (Agee 1993). The cooler, moister conditions found at the higher elevations of Spencer Creek's mixed conifer zone resulted in longer fire intervals. Longer fire intervals favor less fire tolerant species which out compete the pine in cooler environments. At the upper elevations of the mixed conifer zone in Spencer Creek, the average canopy closure likely exceeded 50 percent (aerial photo interpretation).

Historic fuel loads and snag levels were likely different in the lower versus higher elevations of the mixed conifer zone in Spencer Creek due to different fire regimes. Leiberg (1899), Langille et. al. (1903), and Munger (1917), all cited by Hopkins et al. 1993, indicate that large woody material in ponderosa pine stands was essentially absent. This was likely the case in the lower part of the Spencer Creek watershed. Leiberg (1899) talks about "a mere thin sprinkling of pine needles" on the forest floor of historic ponderosa pine forests. Photo series for quantifying natural forest residues (Blonski and Schramel 1981, and Maxwell and Ward 1980) are excellent guides, but can be somewhat misleading because of the past fire suppression policies in the "natural stands" that were monitored, particularly the ponderosa pine stands. The duff depths reported in these "natural stands" likely exceeded the historic levels reported by Leiberg. Foran (pers. comm. 1995) speculates that historic ponderosa pine forests residue levels probably contained less than 20 tons per acre of duff and litter combined. Foran (pers. comm. 1995) also stated that ground fires generally remain on the forest floor with very limited mortality of the residual trees when tonnage levels are below 20 tons per acre of duff and litter combined. He further stated that when tonnage levels exceed 20 tons per acre, mortality from a fire substantially increases in the trees. In summary, Foran speculated that ponderosa pine dominated forests in the lower parts of Spencer Creek watershed probably contained less than 20 tons per acre of duff and litter combined.

In regards to snags in the lower part of the watershed, Munger (1917, cited in Hopkins et al. 1993) indicated that fires killed about three percent of the 30 plus trees per acre over 12 inches diameter at breast height per acre in the "Yellow Pine" (Ponderosa Pine) country. Munger further indicated that insects killed about one tree per acre and that root pathogens also added to the snags in a stand. Spire tops (top killing of trees), although less common today, were quite common in the historic stands at the turn of the century (Munger 1917, cited by Hopkins et al. 1993). Munger (1917, cited in Hopkins et al. 1993) indicated that 10 to 15 percent of the "yellow pine" (Ponderosa pine) trees had spire tops. Hopkins et al. (1993) old growth definition for ponderosa pine forests indicates a snag level of 3 snags per acre greater than 14 inches diameter at breast height. Miller and Keen (1960), in a 1,250,000 acre study within the Klamath Basin, found during a 31 year period (1921 to 1952) that losses (potential snags) from western pine beetle ranged from 0.4 percent of the stand up to 3.5 percent of the stand per year.

In the upper elevations of the mixed conifer zone in the Spencer Creek watershed, fuel loads and the number of snags were probably higher because of longer fire return intervals, cooler environments, and more productive soils. Hopkins et al. (1993) in their old growth definition for grand fir/white fir forests indicate a large woody debris component of 3 to 6 eight foot pieces at least twelve inches in diameter per acre. Blonski and Schramel (1981), in "natural stands" where fires have likely been suppressed, showed that total residue levels (excluding duff) in mixed conifer forests commonly contained 10 to 30 tons per acre with some areas containing as much as 40 to 50 tons per acre.

In regards to snag levels in the upper mixed conifer zone, Hopkins et al. (1993) estimated 2 to 12 snags per acre greater than 14 inches diameter at breast height.

Historic Composition

Much has been written about the historic composition of mixed conifer and ponderosa pine forests. Agee (1993) states that white fir forests have a gradient of community development patterns associated with the fire regime gradient. As fire-return intervals lengthen (likely due to a cooler, wetter climate) there is a tendency to have higher proportions of white fir in the overstory. The mixed-conifer successional model of Kercher and Axelrod (1984, cited in Agee 1993) predict that as elevation increases from 1,500 to 1,800 meters (5,000 to 6,000 feet), ponderosa pine is reduced from 60 percent to 5 percent of the basal area; while white fir, which covers only 5 percent of the basal area at 1,500 meters (5,000 feet), increases to over 60 percent at 1,800 meters (6,000 feet). This pattern of development was likely the case for the mixed conifer forests in Spencer Creek and is supported by Leiberg's (1899) observations.

Leiberg's (1899) data (See Figure 2) give some idea of what the species composition was historically within the townships surrounding Spencer Creek. For example, Leigberg's data for townships 39S., R.5,6,&7E (the southern most townships and lowest elevations) indicated approximately 55 percent of the standing trees over 4 inches in diameter were ponderosa pine. One township to the north and slightly higher in elevation, in the same 3 ranges, the average ponderosa pine composition decreased to 38 percent. Finally, the two northern most townships and highest elevations in the watershed, that include some portions of Spencer Creek, had a ponderosa pine composition of 5.5 percent. The white fir composition within these same townships is pretty much inversely related to the ponderosa pine composition according to Leiberg's data. In the same order and township and ranges listed for ponderosa pine, white fir composition went from 4.3 percent to 6 percent, to 42 percent.

Most of the shrubs in the mixed conifer and ponderosa pine zone have adapted to periodic burning either through an endurer or evader strategy (Agee 1993). Endurer are those plants with a life-history strategy of resprouting following a fire (manzanita) or survive the effects of a fire (mature, thick-bark ponderosa pine). Evaders are those plants with a life-strategy in which long-lived propagules (seeds) are stored in the soil (such as snowbrush) or canopy (lodgepole pine) and germinate after fire.

Changes in Historic Disturbance Regimes- Changes in Seral Stages/ Vegetative Structure/ Composition

Changes in Historic Disturbance Regimes

Forest health concerns have arisen more within the ponderosa pine and the lower/ dryer mixed conifer zone than any other zone within the Spencer Creek watershed as a result of interruptions and alternations to historic disturbance regimes. In many inland forests, timber harvesting and fire suppression have altered the vegetative structure and composition of vegetative communities (Covington et al. 1994b.) The costs and risks of inaction are potentially greater than the costs and risks of restoration treatments (Covington et al. 1994b).

Presently in the Spencer Creek watershed, forest management activities including timber harvesting, grazing, and ongoing fire suppression policy are the predominant disturbance agents. Forest management activities within the watershed have likely altered historic insect (*Dendroctonus spp.* and *Scolytus ventralis*) cycles by changing the composition of forested stands. In addition, forest management activities have likely increased the incidence of *Heterboasidion annosum* (Scharpf 1993). White pine blister rust (*Cronartium ribicola*), a disturbance introduced into western forests in the early 1900s (Scharpf 1993), is significantly impacting western white pine and sugar pine within this zone of the Spencer Creek watershed.

Changes in Seral Stages

Table 15 displays a breakdown by seral stage of stands within the mixed conifer and ponderosa pine zone. There are virtually no late successional ponderosa pine stands left in the lower part of the Spencer Creek watershed. Most private lands in the lower part of the watershed contain second growth ponderosa pine, Douglas-fir, and white fir ranging from 6 to 18 inches diameter at breast height. The largest concentrations of late successional stands occur on federal lands in the upper two-thirds of the watershed beginning in Section 4 of T.39S., R.5E., on BLM-administered lands. As result of timber harvesting, early seral stage stands have increased from historic levels. Almost all the private land within Spencer Creek has been classified mostly as early, early-mid, or mid seral in the mixed conifer zone (See Table 16).

Changes in Structure

Within the Spencer Creek watershed itself, the greatest change in structure has been:

1. The reduction in large (greater than 20 inches diameter at breast height), old ponderosa and sugar pine within the forest communities and the availability of smaller pines (between 8 to 20 inches diameter at breast height) that could develop into large pine.

2. An increase and dominance of white fir in the understory because of fire suppression and harvesting. In many areas, where the overstory pine or Douglas-fir has been removed, it is not uncommon to find stands composed almost entirely of white fir.

Fire exclusion has not allowed the thinning or pruning of the trees or the top kill of shrubs that previously occurred with frequent fires. Because of past harvesting prescriptions in Spencer Creek where the larger older pines were the first trees removed (due to their high value), it is not uncommon to find one old growth ponderosa pine stump in a small, second growth stand of white fir containing 500 to 1000 stems per acre. Within this second growth stand of white fir, ponderosa pine and sugar pine compose less than 10 percent of the stand.

Covington and Moore (1994a) cited a number of changes in forest structure (tree density, cover, age distribution) in southwestern ponderosa pine forests that have been blamed for many forest management problems of today. Some of these same changes in forest structure are evident in mixed conifer and ponderosa pine forest in the lower parts of Spencer Creek. Changes include:

- ♦extremely dense patches of saplings and pole-sized trees
- ♦reduced tree growth and increased mortality, especially of the oldest trees

- ♦decreased decomposition rates
- ♦stagnant nutrient cycles
- ♦increased insect and disease related mortality
- ♦decreased herbaceous and shrub forage quality and quantity
- ♦higher fuel loads
- ♦increased ladder fuels due to dense sapling and pole patches
- ♦greater canopy closure
- ♦reduced diversity on both a stand and landscape level
- ♦higher severity and destructive potential of wildfires
- ♦decreased streamflow and on-site water balances
- ♦less wildlife habitat for species dependent on herbaceous vegetation
- ♦lower esthetic values.

Figures 3 and 4 display the existing canopy closures of the Mixed Conifer Zone and Ponderosa Pine Zone. In the ponderosa pine zone, canopy closure lies between 11 and 40 percent. In the mixed conifer zone, canopy closure lies between 26 and 55 percent. It is likely that much of the increase in canopy closure within the mixed conifer zone that would be due to fire suppression has been offset by timber harvesting.

In regards to changes in snag and down wood levels in the mixed conifer zone, the BLM has completed some inventory work of existing stands within unmapped Late Successional Reserves. The BLM northern spotted owl habitat inventory surveys in these areas indicate total fuel loadings of approximately 44 tons to the acre of duff and litter. Within these same areas, approximately 18 snags per acre with an average diameter greater than 20 inches diameter at breast height were found. It should be noted that the BLM surveys included both mixed conifer as well as some shasta red fir forests and were completed in stands that had received some past treatments.

The Northwest Forest Plan stipulates that approximately 120 lineal feet of down material greater than 16 inches in diameter and 16 feet long must be left in the Matrix. This equates to approximately 150 to 200 cubic feet of down wood greater than 16 inches. Meeting this guideline within the Spencer Creek watershed in most of the mixed conifer zone should be attainable in most areas that still contain a component of large trees. There are areas that have been scarified, piled, and burned where down logs are lacking. It also should be noted that increasing mortality in the watershed over the past few years has maintained high levels of snags (pers. obs.). Meeting the snag requirements stipulated within the Northwest Forest Plan (40 percent optimum cavity habitat) should be attainable with the exception of species dependent upon large pine snags.

Changes in Composition

The greatest change as a result of fire exclusion and timber harvesting within Spencer Creek watershed has been the dramatic increase of shade-tolerant/fire-intolerant species like white fir and a decrease in shade-intolerant/fire-tolerant species like ponderosa pine, and Douglas-fir. It is common within the watershed to find small, second growth white fir areas that have resulted from fire exclusion that are almost exclusively white fir (less than 5 percent of the stand composed of ponderosa pine or Douglas fir). It is also common to find within these same second growth white fir stands (10 to 20 inches diameter at breast height) ponderosa pine and sugar pine snags where mortality has occurred in the last 10 years. As a result of severe competition combined with drought and insect activity, whatever remnant pine occurs in these second growth and late successional stands is continuing to die out. The result of these relationships is very little second growth ponderosa pine and sugar pine recruitment into the large size class. Exceptions to this would be the numerous clear-cuts within the mixed conifer zone that have been replanted mostly with ponderosa pine. Most of the clear-cuts contain trees less than 10 inches diameter at breast height.

The mixed conifer and ponderosa pine zones experience severe frosts during the growing season. Seedlings and saplings of Douglas-fir and white fir, are most vulnerable to such damage. Without a protective canopy, new growth and often entire trees are killed during extreme frosts. The large clear-cuts in the watershed have been planted with frost-resistant species (ponderosa and lodgepole pine). These plantations have a lower species and structural diversity than the original forest.

Agee (1993) states that the dominance of the understory by shade tolerant tree species has actually reduced species richness and the amount of cover of shrubs and herbs. This corresponds with Pase (1959, cited by Agee 1993) and (Covington 1994a) that total understory forb and herb production is inversely related to tree crown cover. Agee (1993) states that there has been a decline of perennial grasses in ponderosa pine plant associations over time. Livestock grazing since the late 1800s has reduced perennial grasses while encouraging annual grasses, such as cheatgrass (*Bromus tectorum*).

Very little is known about aspen populations within the watershed. Increases in conifer populations as well as fire suppression have lead to the loss of aspen stands throughout the Inland West (Schier 1975; DeByle 1985, cited by Covington 1994b). Further losses have occurred because aspen parklands have been converted to meadows for livestock grazing, with others degraded from logging and continual and intense recreational use (Deble 1985, cited by Covington 1994b). Within Spencer Creek, aspen patches reportedly occurred around Buck Lake, along wet areas, and along streams and meadows near Spencer Creek.

Changes in Function

The function of frequent fires in controlling the spread of root pathogens is still not well understood. However, because root pathogens spread by root-to-root contact, more open stands would tend to have a somewhat greater resistance to spread than densely stocked stands. Without preventive measures (such as putting borax on the stumps or planting resistant species), the spread of *H. annosum* is accelerated somewhat by harvesting.

Future Trends In The Mixed Conifer and Ponderosa Pine Zone

Successional patterns in Eastern Oregon Cascade ponderosa pine forests have been documented by West (1969) and Morrow (1985, both cited by Agee 1993). Morrow (1985, cited by Agee 1993) suggests that the arrangement of ponderosa pine clusters 0.025 to 0.35 hectares (0.06 to 0.88 acres) in size and subsequent regeneration of these clusters was determined by the fire-return interval. An extended fire-free interval would allow trees within the sapling stage to survive a subsequent fire. Morrow concluded that continuous fire protection, such as occurred in the twentieth century would erode both the spatial and temporal pattern of these ponderosa pine forests that were once shaped by fire. Covington and Moore (1994b) conclude that structural changes have shifted the fire regime in ponderosa pine-dominated ecosystems from frequent, low-intensity surface fires to high-intensity crown fires. Crown fires have created increasingly larger openings (1,000 to 5,000 acres). Covington and Moore (1994b) further state that logging has resulted in forests that are as open as presettlement forests but lack their large, old trees and native bunchgrass understory.

The trend discussed above is apparent within the Spencer Creek watershed. Within the mixed conifer and ponderosa pine zone in Spencer Creek, the resilience of many of the stands to continuing natural disturbance agents such as drought, insects, diseases, and fire has been reduced. In some areas of the watershed that were once dominated by large ponderosa pine, species composition and stand structure has been altered. The altered stands now contain a high percentage of white fir that are showing a high incidence of mortality from the fir engraver beetle. The sustainability of some of these white fir stands over the long term appears to be in doubt. As a result, the corresponding function that these stands are presently serving (for example as northern spotted owl habitat) are also threatened by on going insect related mortality as well as increased risk of stand replacing wildfires.

Without some type of reduction in the density of the understory within the Spencer Creek watershed, white fir will continue to propagate and regenerate itself in the understory (seed in). This could result in stress and further insect attack on both the white fir and residual pine. Also, without density and species composition control, there will most likely be increases in fuel loadings. When fires do occur, they will likely be of higher intensity. This could result in a subsequent loss of any residual large, old growth pine and recruitment second growth pine. While insect-caused mortality is part of the natural disturbance regime, current levels of infestation threaten many of the remaining pines in high stem density areas. Mortality caused by fir engraver beetles can become a stand replacing event in some areas (Rock Cherry Nanny Watershed Analysis 1994). This trend can occur over larger contiguous areas.

Forests composed of high stem densities, combined with drought, soil compaction from logging equipment, and insect attacks may increase the spread of root pathogens in the future. Single specie stands are more susceptible to the spread of root pathogens. Past overstory removals of the pines have left high density areas of second-growth stands of almost 100 percent white fir that are highly vulnerable to insects and diseases.

The incidence of white pine blister rust appears to be increasing in the sugar pine and western white pine of the watershed.

Timber management on private lands within the mixed conifer and ponderosa pine zone in the Spencer Creek watershed has been very intensive the past 2 to 3 years in order to salvage as well as prevent increasing levels of mortality as a result of the fir engraver beetle (Sokol, pers. comm. 1994). Weyerhaeuser Company has intensively thinned their stands leaving residual ponderosa pine at lower densities with less than 40 percent crown closure. Recruitment of larger, older pine greater than 20 inches diameter at breast height will likely not occur, except in riparian zones, for decades or centuries in much of the lower part of the Spencer Creek watershed.

Table 15 summarizes the changes and possible trends that have occurred in the mixed conifer zone.

Lodgepole Pine Zone

Observations of the lodgepole pine stands within the Spencer Creek watershed indicate occasional understory components of white fir, which implies that the climatic climax species within portions of this zone may be white fir.

Historic Disturbance Agents

Climax lodgepole pine forests rarely grow for a century without a major disturbance by fire or insects (Agee 1993). Within the Spencer Creek watershed, the two most common historical disturbance agents within the lodgepole pine forests were most likely fire and mountain pine beetle (*Dendroctonus ponderosae*). Leiberg (1899) found the marshy areas on the eastern portion of Buck Lake "burned in recent times are now reforested with a thin growth of lodgepole pine". Leiberg's 1899 map (Map 11) clearly indicates a large burned area with low tree density north of Buck Lake that extended out of the watershed. The burned area also extended south of Buck Lake about one-half mile. Aerial photos from 1940 to 1950 indicate bands of lodgepole pine along the upper portion of Spencer Creek above Buck Lake (Desolation Swamp Area) and also along a tributary draining into Spencer Creek just below the mouth of Buck Lake.

The magnitude of natural fires within the lodgepole pine zone range from slowly burning logs across the forest floor to crown fires (Agee 1993). Fire frequency is not well documented for these forests (Agee 1993). Within Crater Lake National Park, Agee (1981b, cited by Agee 1993) estimated a fire-return interval of about 60 years based on scanty data. In a nearby area, Chappell (1991, cited by Agee 1993) estimated a fire return interval of 39 years for a red fir forest adjacent to a flat dominated by climax lodgepole pine forest. Agee (1993) speculates that the average fire-return interval within the lodgepole pine zone is probably in the range of 60 to 80 years, with areas surrounded by higher productivity forests at the lower end of the range. This fire return interval range of 60 to 80 years seems reasonable for lodgepole pine forests within Spencer Creek as these stands lie at the upper end of the mixed conifer zone which has a fire-return interval of anywhere from 10 to 60 years (See mixed conifer zone discussion).

Within the Spencer Creek watershed, USDA Forest Service records from 1961 to 1992 and Oregon Department of Forestry records from 1979 to 1994 show a combined total of 142 fires (See Table 14). Of the 142 recorded fires (including 40 human caused fires), 4 (3 percent) lightning fires occurred in the lodgepole pine zone. All 4 of the fires were less than one acre. Almost all lightning fires have been immediately extinguished so that fires in the last 60 to 80 years have had little to no role in shaping the present day vegetation.

Historic Seral Stages

Table 17 displays the seral stages of the lodgepole pine zone in 1945. Many of the "thin growth of lodgepole pine" areas around the Buck Lake area that Leiberg (1899) discussed had likely matured into mid or late seral forest by 1945. Approximately 97 percent of the lodgepole pine areas were either mid or late seral in 1945.

Historic Structure

The structure of lodgepole pine forests can vary depending upon past disturbances. Agee (1993) states that most lodgepole pine stands that have been surveyed have multiple age classes (Agee 1981b, Stuart et al. 1989; both cited by Agee 1993), either from forest fires or mountain pine beetle attacks that have removed some but not all of the mature stems. Within the Spencer Creek watershed, aerial photos from 1940 to 1950 indicate mostly a single layered stand with scattered larger trees along the edges. The 1940 to 1950 photos indicate that canopy closure likely exceeded 55 percent in most of the lodgepole pine forests. Prior to 1940, based upon Leiberg's 1899 information, the canopy closure was likely less because the stands were younger.

No historic information is available on snags and fuel loadings in lodgepole pine forests for Spencer Creek. However, old growth definitions for the Lodgepole Pine Series (Hopkins 1993) indicate a snag level of five snags greater than 12 inches/acre and a down wood component of 12 to 20 eight foot pieces at least 10 inches in diameter.

Agee (1993) states that mountain pine beetles in low productivity stands tend to strike in epidemic proportions after trees are large enough to sustain brood populations after a period of sustained low radial growth (Mason 1915, Waring and Pitman 1980, Stuart 1984, all cited by Agee 1993). Cole and Amman (1980, cited by Agee 1993), found similar patterns in the Rocky Mountains, where beetle attack may be linked to stand age (greater than 80 years), tree size (diameter at breast height greater than 20 cm or 8 inches), and thick phloem (greater than 2.5 mm or 1 inch).

Historic Composition

Leiberg (1899) found within the Alpine-Hemlock subtype, a portion of which lies within the Spencer Creek watershed, areas that were over 90 percent lodgepole pine and were almost invariably a result of a past fire. Lodgepole pine is a prolific seeder and is capable of self-perpetuating itself quite easily. Whether a lodgepole pine stand self perpetuates and maintains its composition is dependent upon a number of factors. These factors include whether a later seral shade tolerant species like white fir, shasta red fir that reproduces after low intensity fires, or mountain hemlock can establish itself in the understory within the microclimate constraints such as frost pockets and/or wetter sites (higher water table). Leiberg's estimates show the highest composition of lodgepole pine occurring in T.37S.,T.6E. (23 percent) (see Figure 2).

Historic Function

Because of their susceptibility to bark beetles after a certain age and size, snags as well as down wood within the lodgepole pine zone contribute to the diversity of cavity nesters. Agee (1993) states that stems killed by beetles will normally fall within a 5 to 10 year period.

Changes in Historic Disturbance Regimes - Changes in Seral Stages/ Vegetative Structure/ Composition /Function

Changes in Seral Stages

Leiberg's map (see Map 11) clearly displays a deforested area around Buck Lake, both north and south of the lake. Based upon Leiberg's description and the data presented in Table 17, the greatest amount of mid and late seral area in the lodgepole pine zone probably occurred around 1940 to 1950. Prior to this, much of the lodgepole forest that Leiberg described as being burned was still developing and would have likely been categorized as early-mid. Since 1950, harvesting has modified the seral stages to the point where approximately 46 percent is now mid or late seral.

Changes in Structure

The structure of lodgepole forests within Spencer Creek have probably changed only moderately, with the exception of those areas that have been harvested. Lodgepole pine areas on federal land within the watershed have commonly been harvested in small patches using seed tree or clearcut prescriptions. These patches have been replanted or have reseeded to lodgepole pine. These patches serve as early seral habitat in the area. Harvesting of these stands leaves fewer snags and less down woody material than would have been left after a natural fire or insect epidemic. Stands that have not been harvested appear to have similar structural components (snags, large woody debris, canopy closure) to historic stands. However, maintenance of large snags and/or woody debris within the lodgepole pine zone is difficult because of the high demand for lodgepole pine firewood and the easy accessibility of these areas to the public.

Figure 5 displays the existing canopy closure in the lodgepole pine zone. Presently, about 84 percent of this zone has less than 55 percent crown closure and about 16 percent has greater than 55 percent crown closure.

Changes in Composition

Composition of these stands has changed somewhat due to fire exclusion and the increase in understory shade tolerant species like white fir. Lodgepole pine is still the dominant species in many of the stands. Data from a 1945 inventory (see Table 18) indicates that there was approximately 4,930 acres in the watershed where lodgepole pine dominated over 50 percent of the cover. In contrast, the 1994 satellite data indicates approximately 2,866 acres where lodgepole is the dominant species.

Changes in Function

With the exception of the areas that have been harvested and are now early seral habitat, only moderate changes have occurred in the function of these forest communities.

Future Trends In The Lodgepole Pine Zone

No significant changes are foreseen within the lodgepole pine zone. In areas where mature lodgepole pine occurs (greater than 80 years old), and particularly in dense patches, future outbreaks of mountain pine beetle will most likely occur, particularly if drought conditions continue.

One of the greatest challenges within the lodgepole forests in the Spencer Creek watershed will be to maintain sufficient snag and recruitment trees considering the high demand for lodgepole pine firewood. Excessive cutting and removal of snags as well as additional impact from vehicles to retrieve the wood is reducing snag levels and compacting soils, especially in riparian areas.

Table 17 summarizes the changes and possible trends that have occurred in the lodgepole pine zone.

Shasta Red Fir Zone

Historic Disturbance Agents

Over its range, the most important large scale disturbance factor in the red fir zone is fire (Agee 1993). Lightning has been the primary cause of fires in the red fir zone in recent decades (Agee 1993) and probably was historically as well. Agee (1993) reveals a variety of fire intensities within the red fir zone ranging from stand replacement fires to cool underburns. Fire-return interval studies vary widely for different red fir forests. Probably the most applicable studies to the Spencer Creek watershed were completed by Zobel (1980, cited in Agee 1993) and Chappell (1991). They completed studies at Crater Lake National Park and found a mean fire-return interval in shasta red fir forests of 42 years and 39 years respectively. They also found a wide variability in fire-free intervals at the Crater Lake study site. Fire-free intervals ranged from 15 to 157 years.

Within the Spencer Creek watershed, USDA Forest Service records from 1961 to 1992 and Oregon Department of Forestry records from 1979 to 1994 show a combined total of 142 fires (See Table 14). Of the 142 recorded fires (includes 40 human caused fires), 48 lightning fires (34 percent) occurred in the shasta red fir zone. All the fires were less than 1 acre and most were less than 0.25 acres. Almost all lightning fires have been immediately extinguished so that fires in the last 60 to 80 years have had little to no role in shaping the present day vegetation.

Wind, although at a smaller scale, is another important disturbance factor in red fir forests (Taylor and Halpern 1991, cited in Agee 1993). Within the Spencer Creek watershed, many of the red fir forests occur along highly exposed ridge lines and lee slopes (Surveyor Mountain Area) where wind velocities are highest.

In Spencer Creek watershed, the most prevalent small-scale disturbance agents that have likely occurred in the red fir zone included Indian paint fungus (*Echinodontium tinctorium*), fir engraver beetle (*Scolytus ventralis*), annosus and armillaria root rots (*Heterobasidion annosum* and *Armillaria* spp.), and pine beetles (*Dendroctonus* spp). Annosus and armillaria seldom attack the root tissues to the extent that the host is killed directly (Scharpf 1993). Scharpf further states that losses from annosus and armillaria in true firs are mainly the result of rot at the base of the tree, increased susceptibility to insect attack, and increased windthrow. Root pathogen agents normally cause small irregular shaped openings in the canopy. In addition, if the opening is large enough and the pathogen prevalent enough, these small openings would serve as an early seral habitat in which species resistant to the pathogen could establish.

Historic Seral Stages

Within the red fir zone, Table 19 displays a historic seral stage breakdown based upon 1945 data. Most of the shasta red fir zone is located on federal lands and had not been significantly altered prior to 1945. Based upon the 1945 data, approximately 79 percent of the shasta red fir zone was either mid or late seral stage whereas 20 percent was either early or early-mid seral stage.

Historic Structure

The small patch structure of red fir forests is widely recognized (Agee 1993). The stand replacement fire, although present in many red fir forests, may not be the dominant disturbance factor (Agee 1993). Fires of lower severity appear to make up most of the recently monitored fires (Kilgor and Briggs 1972, van Wagtendonk 1986, Chappell 1991, all cited in Agee 1993). Red fir, if old enough (greater than 100 years old), tends to be a dominant residual; with its thick bark it is better adapted to fire than any of its associates like lodgepole pine, mountain hemlock, western white pine, and white fir (Chappell 1991). As a result of some tolerance to fire, stand development in red fir forests can result in multilayered canopies. In addition, because of shasta red fir tolerance of shade, a number of observers of red fir forests indicate that they are self-perpetuating late-successional forests with continuous regeneration producing uneven-aged multistoried canopies (Osting and Billing 1943; Parker and Peet 1984; Barbour and Woodward 1985, cited in Chappell 1991). On the north slopes of Surveyor Mountain within the Spencer Creek watershed, it is not uncommon to find large old growth red fir trees 300 years and older with a dense well established understory of second growth, 80 to 100 years old, that most likely came in after a fire.

Early seral species within the Red Fir Zone that often colonize sites after a fire include lodgepole pine and western white pine, with ponderosa pine in the lower part of the zone. Shasta red fir is also well adapted to colonizing sites after a fire (Chappell 1991).

Aerial photos from 1945 indicate that canopy closure in most red fir forests probably exceeded 55 percent historically in the Spencer Creek watershed, except in areas that experienced large fires. Once red fir stands overtop seral brush species, and the canopy closes, the canopy can remain closed for centuries without some type of large-scale disturbance. Even with small scale disturbance, red fir is capable of quickly filling in gaps to maintain canopy closure (Chappell 1991).

Generalizations about the impact of fire on fuels in this zone are difficult due to the variability of fire behavior in this forest type (Agee 1993). A stand replacement fire will clearly create a great deal of woody fuel, whereas a light underburn may consume forest floor fuel without affecting the overstory, resulting in a net loss of dead fuel after fire (Agee 1993). In "natural stands" where fires have likely been suppressed, Blonski and Schramel (1981) showed that total residue fuel levels (excluding duff) in red fir forests commonly contained 10 to 20 tons per acre with some areas as high as 30 to 40 tons per acre in late successional stands.

No actual quantifiable data were obtained to speculate on historic snag levels within shasta red fir stands. Historic levels were likely similar to snags levels within white fir forests (2 to 12 snags per acre greater than 14 inches diameter at breast height) because they have many of the same pathogens. For example, both species are susceptible to fir engraver beetles and annosus root rot. Recent personal observations of nonentered shasta red fir stands within the watershed indicate that 2 to 12 snags per acre greater than 14 inches diameter at breast height is a reasonable estimate.

Historic Composition

Forests in the red fir zone often form nearly pure stands, but because they normally occur between forests of higher and lower elevation, they commonly have a wide variety of associates (Agee 1993). Within the Spencer Creek watershed, these associates include: mountain hemlock, western white pine, lodgepole pine, Douglas-fir, ponderosa pine, and white fir. Leiberg's (1899) descriptions (See Figure 2) give some idea of what the species composition was historically in Spencer Creek. As elevation increased in the Spencer Creek watershed, composition of shasta red fir increased as well. Leiberg's data indicate that T.38S., R.6E. contained about 10 percent shasta red fir. One township to the north at a higher elevation, T.37S., R.6E., the township contained 18 percent shasta red fir. The largest areas of shasta red fir occur on the upper, northern slopes of Surveyor Mountain and the upper northeast slopes near the wilderness boundary. In many areas, stands of almost 100 percent shasta red fir were present.

Changes in Historic Disturbance Regimes/ Changes in Seral Stages/ Vegetative Structure/ Composition/Function

Changes in Historic Disturbance Regimes

The most significant change to the historic disturbance regime has been the intensive forest management that has occurred within this zone in the past 50 years. Forested stands have received a variety of harvesting prescriptions, including, salvage only, overstory removals, shelterwoods, clearcuts, thinnings, and seed tree cuts (See definitions in glossary). In addition, almost all lightning fires have been immediately extinguished so that fires in the last 60 to 80 years have had little to no role in shaping the present day vegetation.

The corresponding relationship between harvesting and its impact on the spread of root pathogens such as armillaria, annosus, or phellinus is not well understood. Species resistant to the pathogen often need to be replanted around the infected site to isolate the pathogen. The area then needs enough time for the pathogen to use all susceptible host material, including old stumps and roots, before the infection dies down or out. In the case of phellinus, it sometimes takes 50 years. Annosus root disease is being found with greater frequency than before in the logged pine forests of California (Scharpf 1993). These findings are applicable to the Spencer Creek watershed as well. The surface of freshly cut stumps and basal wounds are prime infection centers for spores of Annosus. Once the spores have landed, they grow down into the roots and eventually colonize the stump and its root system (Scharpf 1993). The fungus can survive for as long as 100 years as a saprophyte in the roots of large infected stumps and trees (Dickman and Cook 1988). Newly planted seedlings, advance regeneration, and residual trees around these infected stumps can then be infected through root contact which can subsequently lead to mortality of the live trees. Thus, harvesting activities within the Spencer Creek watershed have most likely increased the incidence of annosus root disease. The extent of the increase appears to be small and hard to determine. Prevention through applying borax to fresh stumps and planting resistant species appear to be the main treatments to arrest the spread. Partial cutting in root rot centers within shasta red fir stands has likely increased the risk of blowdown in the watershed.

The introduction of white pine blister rust (*Cronartium ribicola*) has significantly impacted the western white pine composition in the red fir zone (Scharp 1987).

Historic disturbance regimes by insects has also been somewhat impacted by forest management activities (such as harvests and/or fire suppression).

Changes in Seral Stages

Table 19 shows that within the watershed in the red fir zone there has been a reduction in mid and late successional stands with an increase in early and early-mid seral stages. Within the wilderness boundary, early seral stands within the red fir zone have probably decreased with a corresponding slight increase in mid and late seral stands from of fire exclusion policies. Most of the remaining late seral habitat in the red fir zone is located on federal lands.

Changes in Structure

Agee (1993) states that most red fir forests have not experienced major alterations in forest structure due to the fire suppression policies of this century. He further states that there have probably been minor landscape-level shifts (less area of early seral communities) in the forest mosaic due to the absence of fire. The period of fire absence is approaching twice the average fire-return interval found in several studies, but each of these studies also showed ranges of fire-free intervals longer than what has occurred with the current fire exclusion policies. These generalizations by Agee (1993) are more applicable to red fir forests within wilderness boundaries, inaccessible areas, and stands where entries have been made to capture mortality or to lightly thin the trees.

The greatest changes in structure to shasta red fir forests within the Spencer Creek watershed are due to harvesting operations. Most private land in the watershed has been logged, including those within the red fir zone (personal observation). These areas are currently in either the early or mid seral stage and are no longer late successional. Many of the stands on federal lands within the red fir zone were selectively cut leaving a portion of the original canopy. Although the historic structure may have been changed through harvesting, past selective cutting practices on federal lands have left some remnant of the original structure, including large old growth. In addition, because shasta red fir continuously regenerates itself in small openings and gaps, many of the partial cut areas on federal land have started to restore some of the structure that was lost through harvesting. Figure 6 indicates that the canopy closure exceeds 55 percent in approximately 48 percent of the shasta red fir zone. Of all the different vegetation zones within the watershed, the shasta red fir zone contains the highest existing canopy levels.

A common stand structure found today within the watershed in the lower part of the red fir zone is an occasional large, old growth pine with a very dense understory of shasta red fir 10 to 20 inches in diameter. The large, old growth pine almost always shows evidence of a historic fire. The understory is commonly 80 to 100 years old with canopy closure at almost 100 percent (compared to the historic average of 50 to 70 percent) (aerial photo interpretation). This successional pattern and structure has been permitted to develop partly due to fire suppression policies.

In regards to changes in snag and down wood levels in the shasta red fir zone, the BLM has completed some inventory work of existing stands within unmapped Late Successional Reserves. The BLM northern spotted owl habitat inventory surveys in these areas indicate total fuel loadings of 44 tons to the acre of duff and litter. Within these same areas, approximately 18 snags per acre with an average diameter greater than 20 inches diameter at breast height was found. It should be noted that the BLM surveys included both mixed conifer as well as some shasta red fir forests and were completed in stands that had received some past treatments. The Northwest Forest Plan stipulates that approximately 120 lineal feet of down material greater than 16 inches in diameter and 16 feet long must be left in the Matrix. This equates to approximately 150 to 200 cubic feet of down wood greater than 16 inches. Meeting this guideline within the Spencer Creek watershed in most of the shasta red fir zone should be attainable in most areas that still contain a component of large trees. There are areas that have been scarified, piled, and burned where down logs are lacking. It also should be noted that increasing mortality in the watershed the past few years has maintained high levels of snags (personal observation). Meeting the snag requirements stipulated within the Northwest Forest Plan (40 percent optimum cavity habitat) should be attainable in the shasta red fir zone.

Changes in Composition

Because red fir is somewhat self-perpetuating (Chappell 1991), overall species composition has not changed substantially within the red fir zone in the Spencer Creek watershed. With the exception of areas that have been clearcut and planted with pine, early seral species of this zone probably compose less of the communities than they did historically, particularly the larger diameter western white pine and ponderosa pine. There are at least three observable reasons for this: Past harvesting prescriptions called for the removal of much of the high valued pine; fire exclusion within these stands the past 80 to 90 years has inhibited regeneration of both pine species in the gaps the fire would have produced; and fire exclusion has increased the density of mid seral stands with shade-tolerant species (like shasta red fir and white fir) with corresponding mortality of pine species due to competition and increased insect activity. In addition, white pine blister rust appears to be causing a moderate level of mortality of younger western white pine in the watershed (pers. obs.).

In areas that have not been harvested or have only been lightly thinned, and where fire has been excluded, stem densities are presently very high. As trees compete for limited resources (for example light, water, and nutrients), some trees out compete others. Suppressed trees are more susceptible to disease and insect attack. There is evidence of increased levels of fir engraver beetle attacking shasta red fir within the watershed, particularly on drier sites (pers. obs.). Part of the increase in activity of the fir engraver beetle is most likely due to the low precipitation levels the watershed has experienced in the last 6 of 7 years.

Future Trends In The Red Fir Zone

Within the wilderness boundary, no significant changes are foreseen within the ecosystems in the red fir zone. The proportion of early seral habitat may decrease slightly as past openings begin to close in and fires are continually suppressed. Without some type of prescribed natural fire program in the wilderness, if future fires within this zone occur they may likely be of higher intensity because of past and present exclusion policies, increases in fuel loads, denser canopies, and increases in ladder fuels (Agee 1993 and Covington et al. 1994b).

Outside the wilderness boundary, there will probably be no significant continuous areas of late-successional stands on any private land in the future. The Northwest Forest Plan stipulates how federal land within the forest matrix is to be treated. Implementation of the Forest Plan within the watershed should maintain existing mid and late seral communities. On federal land within the watershed and within the red fir zone, areas of mid and late seral forests should slowly increase with the continued development of areas currently containing early-mid and mid seral communities. The greatest immediate threat to existing mid and late seral untreated stands is from the continuing fir engraver beetle attacks and potential stand-replacement fires. The drier southern sites are more susceptible both to fire and insects than the cooler wetter north slopes.

One of the most significant trends in the red fir zone is the loss of large western white pine throughout the entire zone and large ponderosa pine in the lower part of the zone (pers. obs.). Loss is occurring due to harvesting, insects, and/or disease. As mentioned earlier, recruitment of western white pine and ponderosa pine into the red fir zone is dependent upon disturbance regimes. It is difficult to obtain regeneration of these pine species without an opening in the canopy. Personal observation of existing stands that currently contain scattered large ponderosa pine and western white pine indicate that many of these larger trees are presently stressed and at risk due to the severe competition from a dense understory of shasta red fir that was at one time probably less dense due to periodic fires. Trend is expected to continue without some type of density control.

The slight increase in fir engraver beetle activity should help reduce stand densities and provide sufficient snag habitat. On the other hand, the increase in fir engraver activity serves as a warning sign that the trees are probably stressed due to high stem densities and the drought condition. Whether or not this activity will reach epidemic proportions is being monitored by the USDA Forest Service and the Oregon Department of Forestry. Observations in the red fir forests within the Sierra Nevada indicate that fir engraver beetles can reduce tree densities by over 30 percent and, in some instances, fir engraver attacks can be stand-replacing events. Similar effects could be expected in the same forest types of other areas, including those in Spencer Creek watershed.

Table 19 summarizes the changes and possible trends that have occurred in the Shasta red fir zone.

Mountain Hemlock Zone

Historic Disturbance Agents

Fire is the primary large-scale disturbance agent in the mountain hemlock zone (Agee 1993). This is likely true for the mountain hemlock zone within the Spencer Creek watershed. Windthrow in mountain hemlock zones is usually minor and mainly occurs on ridgetops, and is often common in root rot areas. Laminated root rot (*Phellinus weirii*) has been found to cause doughnut-shaped rings of mortality several acres in size in mountain hemlock forests (McCaughley and Cook 1980, cited in Agee 1993). No data are available to indicate that root pathogens nor insects significantly impacted the structure and composition of mountain hemlock forests with the Spencer Creek watershed. Shasta red fir can be a significant component of mountain hemlock forests and is more susceptible to insects such as the fir engraver beetle (*Scolytus ventralis*) and other root rots (*Heterobasidion annosum*).

Fire-return intervals for mountain hemlock forests of the Oregon Cascades are not well documented (Agee 1993). In the central Oregon Cascades, Dickman and Cook (1989, cited in Agee 1993) found that at least half of their 18,000 hectare (45,000 acres) study area had burned during the last 500 years, suggesting that fire is infrequent in these forests. Agee and Smith (1984, cited by Agee 1993) found that south-facing slopes are much more likely to burn than north-facing slopes within the mountain hemlock zone. This is significant in regards to the Spencer Creek watershed because most of the mountain hemlock zone is on southwest facing slopes in the watershed. Fahnestock and Agee (1983, cited in Agee 1993) estimated a fire return interval in the Subalpine Type of 800 years. Based upon these studies, the mountain hemlock zone within the Spencer Creek watershed probably had a fire-return interval ranging from 400 to 1,000 years with southern slopes burning more often than northern slopes. Agee (1993) states that most fires within the mountain hemlock zone are stand-replacement events because of the lack of fire resistance in the dominant tree species.

Within the Spencer Creek watershed and in the mountain hemlock zone, USDA Forest Service records from 1961 to 1992 show 6 fires (all lightning) occurring during the 32 year period. All of the fires were less than 0.25 acres. Note that in 1994, there were numerous lightning fires reported within the Mountain Lakes Wilderness Area but the data were not available in the Geographical Information System yet. Almost all lightning fires have been immediately extinguished so that fires in the last 60 to 80 years have had little to no role in shaping the present day vegetation.

Historic Seral Stages

Within the mountain hemlock zone, Table 20 shows a seral stage breakdown based upon 1945 data. Approximately 70 percent of the mountain hemlock zone was either mid or late seral according to the 1945 data. In addition, the 1945 data indicate that early and early mid seral stands composed approximately 27 percent of the mountain hemlock zone.

Historic Structure

Mountain hemlock and shasta red fir are the main climax seral species within the mountain hemlock zone. The major early seral specie within the mountain hemlock zone is usually lodgepole pine. Because most fires are stand replacement events in this zone (Agee 1993), the stand structure was most likely single storied and/or even-aged. The overall structure of mountain hemlock forest will tend to be even-aged and/or somewhat even-sized with a fairly uniform canopy.

The presence of lodgepole pine in the mountain hemlock zone is usually due to fire (Agee 1993). Lodgepole pine commonly invades openings along with herbs and forbs. The larger the opening, the longer it takes for mountain hemlock to colonize the site. Mountain hemlock becomes the dominant understory species beneath the 80 to 100 year old lodgepole pine. By age 250, after the lodgepole pine overstory is killed by repeated bark beetle attacks, mountain hemlock will dominate the overstory. Agee (1993) further states that once the mountain hemlock canopy closes, it may remain closed for further centuries. Mountain hemlock's long life span may allow it to dominate the site until the next major disturbance (Agee 1993).

Aerial photos from 1945 indicate canopy closure in the mountain hemlock zone exceeded 40 percent over most of the zone with the exception of the nonforest rock areas on the exposed ridges.

There are no records on the historic snag level within this zone. In addition, little is known about the historic fuel loads within the mountain hemlock zone. However, with the infrequent disturbance that this zone has incurred, future inventories could determine a historic range of large woody debris. Blonski and Schramel (1981), in "natural stands" where fires have likely been suppressed, showed that total residue fuel loads (excluding duff) in mountain hemlock forests contained 10 to 20 tons per acre--somewhat lower than the more productive mixed conifer and shasta red fir zones. Jahns (1994) reviewed an unpublished paper by Russ Graham of the Forestry Science Laboratory in Moscow, Idaho where Graham attempted to link minimum large woody debris levels to habitat types in Idaho and Montana. Jahns 1994, recognizing a similarity in climate and soils between the east slopes of the Cascade and the west slope of the Northern Rockies, attempted to find analogs in the plant associations that Hopkins (1979) identified on the Winema National Forest. Using analogs of Grahams work in the Rockies and applying it to the mountain hemlock forests east of the Cascades, Jahns (1994) speculated that the lodgepole and mountain hemlock plant associations were similar to the Abies Lasiocapo/Vaccinium (subalpine fir/huckleberry) Rocky Mountain Habitat Type. The large woody debris level for the Abies Lasiocapo/Vaccinium (subalpine fir/huckleberry) Rocky Mountain Habitat Type ranged from 7.0 to 11.4 tons per acre of 3 inch and greater large woody debris. Jahns 1994 infers that similar levels of large woody debris could be found in the mountain hemlock zone in the Spencer Creek watershed on the Winema National Forest. Blonski and Schramel's (1981) estimate for material 3 inches in diameter and greater is approximately 12.2 tons per acre in the mountain hemlock zone. This corresponds reasonably close to Jahns (1994) speculation. In summary, historic fuel loads in the mountain hemlock zone were likely less than the mixed conifer and shasta red fir zone due to a combination of environmental factors such as less productive soils, cooler sites, and shorter growing seasons.

Historic Composition

Leiberg (1899; see Figure 2) gives some idea of what the species composition was historically. For example, Leiberg stated that T.37S., R.6E. (which contains much of the Mountain Lakes Wilderness Area) consisted of mountain hemlock (20 percent), lodgepole pine (22 percent) and shasta red fir (18 percent). Components of ponderosa pine (10 percent), Douglas-fir (3 percent), sugar pine (6 percent), white pine (0.9 percent) and Englemann spruce (5 percent) were also found. Note that Leiberg's estimates are for an entire township and only a portion of the watershed fall within the township where the percentages are quoted. Based upon Leiberg's data, the remainder of the watershed contained very little mountain hemlock historically.

Changes in Historic Disturbance Regimes/ Changes in Seral Stages/ Vegetative Structure/ Composition/Function

The function, structure, and composition of the mountain hemlock zone probably has been the most stable and least impacted by the influence of humans. Most of the current mountain hemlock forests within the Spencer Creek watershed occur in the northeast portion and the Mountain Lakes Wilderness Area.

Changes in Disturbance Regimes

Because of its inaccessibility, the main influence humans have had on this zone is fire exclusion. As stated earlier, all lightning fires that have occurred within the Mountain Lakes Wilderness Area and subsequently the mountain hemlock zone have been extinguished and limited to less than 0.25 acres in size. Little if any of the mountain hemlock zone has been impacted by timber harvesting operations. Some grazing has occurred in the mountain hemlock zone but impacts have been minimal.

There probably has been little change in how other historic disturbance agents such as root pathogens, insects, and windthrow have impacted mountain hemlock stands within the Spencer Creek watershed. However, in areas where a significant component of shasta red fir exists within the zone, fir engraver activity has likely increased over the past 50 years due to drought conditions and fire suppression with corresponding affects on snag densities, canopy closure, and coarse downed wood levels.

Changes in Seral Stages

Table 20 shows the current percentage of each seral stage within the mountain hemlock zone (3 percent early, 41 percent early mid, 31 percent mid and 21 percent late seral). This estimate is probably more accurate than the 1945 estimate because of better stand attribute information for classifying purposes. The percentages listed in Table 20 indicate that there has been a drop in mid and late seral stands from 70 to 52 percent. The reason for the decrease is likely due to more accurate inventory information. The area lies mostly within the wilderness, and no management other than fire exclusion has occurred in these stands in the past 50 years. Early seral stands in the mountain hemlock zone have decreased with a corresponding increase in early mid seral stands (Table 20). This increase could be due to inventory error or as a result of fire suppression. This decrease of early seral stands is expected to continue until a stand-replacing fire abruptly increases early seral habitat.

Changes in Structure

As a result of fire exclusion, mountain hemlock forests have probably experienced a slight increase in canopy closure, stem density, and large woody debris since 1900. Figure 7 displays the present canopy closure breakdown within the mountain hemlock zone. About 57 percent of the mountain hemlock zone has canopy closures between 26 to 55 percent. Aerial photos indicate that irregular shaped openings occur within the mountain hemlock zone and further monitoring and inventory could indicate whether they are root rot pockets (*Phellinus weirii*), older spot fires, or some other unknown factor (such as soils) inhibiting reforestation.

Changes in Composition

Species composition has probably changed slightly over time to include a higher percentage of mountain hemlock and shasta red fir and less lodgepole pine. This is likely due to a decrease in early seral conditions where lodgepole tends to colonize.

Changes in Function

The function of mountain hemlock stands and their role as wildlife habitat is discussed in the wildlife sections. Dickman and Cook (1989, cited by Agee 1993) discuss an interrelationship between fire and its control of the spreading of phellinus in mountain hemlock forests. However, so little data are available about phellinus in the watershed that no determination can be made at this time.

Future Trends In The Mountain hemlock zone

No significant changes are foreseen within the mountain hemlock zone ecosystems. Without some type of large scale natural disturbance, the percentage of early seral stage within the mountain hemlock zone may slowly decrease. The stand-replacing wildfires that once occurred at long intervals will most likely still occur, but the intervals will probably be longer and the size of the fire may or may not be larger because of increases in fuel loads. Slight increases in fuel loads and somewhat denser canopies can also be expected. The greatest potential impact to this zone could come from increases in global warming, which is controversial in used (Mitchell et al. 1990, cited in Covington 1994b).

Table 20 summarizes the changes and possible trends that have occurred in the mountain hemlock zone.

Summary

Historic Range of Variability

To summarize the issue of forest ecosystem health, the concept of historic range of variability is used. Morgan et al. (1994) state that the historic range of variability characterizes fluctuations in ecosystem conditions or processes over time. Morgan et al. (1994) further state that the essential function of a description of historical range of variability is to define the bounds of system behavior that remain relatively consistent over time. Historic range of variability should be assessed over a time period characterized by relatively consistent climatic, edaphic, topographic, and biogeographic conditions (Morgan et al. 1994). For forests, the time should encompass multiple generations of trees, and should be at least a few centuries (Morgan et al. 1994). In practice, the time period is constrained by the ability to look backwards through time. Steele (1994, cited by Morgan et al. 1994) suggested a time frame of 100 to 400 years to be appropriate for interpreting secondary successional dynamics. Hann et al. (1993, cited by Morgan et al. 1994) suggested at least 100 years for the analysis.

The historic range of variability can become a reference for determining a range of desired future conditions. Where the range of desired future conditions is defined relative to the historical range of variability, it is useful as a baseline for monitoring (Morgan et al. 1994). For the Spencer Creek watershed, a historic picture has been portrayed in regards to historic landscape and stand conditions. A number of landscape attributes (seral stage and patch size) and individual stand attributes (structure, composition, canopy closure, down logs, etc.) have been altered within the watershed. An attempt is made in each synopsis below to assess just how much each attribute has been altered and whether the alterations are within, near, or outside an upper or lower limit of historic range of variability. In most instances, the lower and upper limits of variability cannot be defined, but are estimated from historic data and professional judgement.

Fire

Almost all lightning fires have been immediately extinguished so that fires in the last 60 to 80 years have had little or no role in shaping present day vegetation.

Late Successional Stands

Late successional stands have decreased through harvesting. The largest decrease in late successional stands has occurred in the lower elevations of the Ponderosa Pine and Mixed Conifer Zones. Only 2.5 percent of the remaining late successional stands occur on private lands, the rest are located on federal lands. It is anticipated (Sokol 1995) that private land will not provide late successional habitat in the future as most stands will be managed through the mid seral stage then harvested. In addition, the structural components that form late successional stands, such as large live trees, large snags, and large downed logs (in some zones), are not well represented on private lands. Because many of the federal lands within the watershed have only been partially cut in the past, some of the stands classified as mid seral and all those classified as late seral in this analysis presently contain functional late successional structural components, such as large live trees, large snags, large downed logs, and sufficient canopy closure. These components in turn are providing the necessary functional habitat for late successional dependent species. In summary, late successional stands within the watershed are most likely below the lower limit of historic range of variability.

Large Pine (Recruitment and Residual)

Within many of the forested communities, particularly in the Ponderosa Pine Zone, Mixed Conifer Zone, and lower part of Red Fir Zone, many of the large old growth pines (ponderosa pine, sugar pine, and western white pine) have been harvested and the composition of the understory is dominated by shade-tolerant true firs. The recovery of a pine component from the existing residual understory in many areas (excluding plantations) is threatened by the successional development of dense shade-tolerant true firs. Maintenance of any residual old growth and second-growth pine is also threatened by this same successional development of second-growth true firs. In summary, the composition of second growth and large old growth pines are most likely below the lower range of historic range of variability in some areas.

Composition of true firs in Ponderosa Pine and lower part of Mixed Conifer Zone

Stand structure and species composition were once controlled by low intensity, frequent fires, particularly in the Ponderosa Pine and Mixed Conifer Zones. As a result of fire exclusion and timber management practices, some areas have increased in canopy closure and contain a high percentage of shade-tolerant true firs that are highly susceptible to insects and disease (Sampson et al. 1994), and also provide ideal ladder fuels that increase the probability that ground fires will become stand-replacement fires. The pine component within these stands is one of the most threatened structural components within the watershed. In summary, composition of true firs in the Ponderosa Pine Zone and lower part of the Mixed Conifer Zone are most likely above the upper range of historic range of variability.

Fir Enraver Beetle Activity

Fir engraver beetle mortality has increased in the watershed, not only in the dense mid-seral true fir stands, but in late successional stands as well. Most of the mortality is occurring on the drier sites (south slopes and/or low elevation) in the Mixed Conifer and Red Fir Zones. The drought and densely stocked single specie stands are contributing to the increase in activity. In summary, fir engraver beetle activity is likely within the historic range of variability, but towards the upper limit. This is because the watershed has most likely never experienced such a high composition of true firs in forested areas.

Stands Within the Watershed Most Likely Within Their Historic Range of Variability.

Stands within the wilderness boundary, the Mountain Hemlock Zone, the upper elevation of the Red Fir Zone, and the Lodgepole Pine Zone appear to be the most stable and least altered stands within the watershed. Sampson et al. (1994) state that high-elevation subalpine forests that historically burned at intervals greater than 100 years have been altered to a lesser extent than open-pine stands at lower elevations. In the long term, not allowing natural disturbance agents like lightning fires to work within the wilderness area as well as these other high elevation zones could impact forest communities. Continual fire suppression within these stands may encourage further canopy closure, less patch development within the landscape, and possibly increases in insect and root pathogen development.

Root Pathogens and White Pine Blister Rust

Root pathogens are present within the watershed. Although not completely understood, single specie management in densely stocked stands normally encourages the spread of root pathogens. Forest management activities have resulted in an increase in annosus root rot (*Heterobasidion annosum*) (Scharpf 1993). This increase has likely occurred in partially cut true fir stands within the watershed. In summary, root pathogen activity is probably increasing toward the upper range of historic variability due to forest management activities.

White pine blister rust appears to be significantly impacting populations of western white pine and sugar pine. Recruitment and maintenance of sugar and western white pine in the densely stocked true fir understories are becoming increasingly imperative although the blister rust appears to be limiting these pine species to the understories. Blister rust was introduced and therefore is naturally above any historic range of variability.

Map 16 displays broad forest health and tree mortality zones.

TABLE 11. Seral Stage Comparison Between Leiberg's 1899 Estimates, 1945 Data and Updated 1994 Data

Leiberg's Classifications	Leiberg[1] (1899)	Seral Stage	1945 Data[2]	1994 Data
Non Forest [3]	11.4%	Non Forest	3.5%	4.3%
Non Forest Burned [4]	6.7%	Early	3.5%	24.8%
Badly Burned	17.0%	Early Mid	30% [5]	35.6%
Forested [6]	64%	Mid	43.4%	20.4%
		Late	19.4% [7]	14.8%
		Mid and Late	63.8% [8]	35.2%

[1] The percentage listed for Leiberg's data are averages for the 8 townships surrounding and within the Spencer Creek Watershed

[2] Data based on 1945 Klamath County survey transferred into GIS

[3] Includes marshes, grassland, pasture land, water

[4] Leiberg had a nonforest-burned category which has been separated out from other nonforest categories

[5] Of the 16,340 acres in early mid category, 87.6% (14,157 acres) had been harvested prior to 1940. Almost exclusively private land in lower part of watershed.

[6] Basically included all stands > 4" in diameter. Somewhat comparative to 1945 and 1994 Mid and Late data combined.

[7] Of the 10,528 acres in late seral stage, 15% (1,210 acres) had been harvested prior to 1940.

[8] The 1945 data did not differentiate between mid and late seral stages so the percentages of mid and late seral classes should be combined for comparison to 1994 data.

TABLE 12. 1945 Seral Stage Classification of Vegetation Within Spencer Creek Watershed[1]

CATEGORY	ACRES	PERCENT
Non Forest	1,898.69	3.5%
Early[2]	1,914.81	3.5%
Early Mid (Harvested)[3]	14,156.99	26.0%
Early Mid (Non Harvest)	2,183.00	4.0%
Mid (Non Harvest)	23,528.00	43.4%
Late (Harvested)[3]	1,209.81	2.2%
Late (Non Harvest)	9,317.90	17.2%
	54,209.20	

[1] Classification of 1945 inventory data into either mid or late was based upon a very limited description of the vegetation. Therefore, total forested area in mid and late seral stages should be combined for quantitative comparison, as was done in Appendix 2. Generally, all vegatation classified as greater than 6 inches dbh was classified as either mid or late.

[2] Early seral stage for 1945 data was all areas "nonstocked" or "deforested" from historic fires.

[3] Acres Harvested prior to 1945 =
14,156.99
+ 1,209.81
15,366.80 = 28.3% of the watershed was harvested prior to 1945 Data Set

Table 14. Summary of USFS and ODF Fire Records for the Spencer Creek Watershed[1]

FREQUENCY

Zone[2]	USFS 1961-1992 75 Fires No. per zone in( )	ODF 1979-1994 67 Fires No. per zone in( )	Combined Data 142 Fires no. per zone in( )
Nonforest	4% (3)	0% (0)	2% (3)
Mixed Conifer	17% (13)	42% (28)	29% (41)
Lodgepole pine	3% (2)	3% (2)	3% (4)
Shasta red fir	47% (35)	1% (13)	34% (48)
Mountain Hemlock	8% (6)	0% (0)	4% (6)
Human Caused	21% (16)	36% (24)	28% (40)
Lightning Starts			
Per year	1.8 per year	2.9 per year	3 to 4 per year
Human Starts			
Per year	0.5 per year	1.6 per year	1.2 to 1.9 per year

SIZE

USFS	59	lightning fires (total)	ODF	43	Lightning fires (total)
	56	less than 0.25 acres			most below 1/2 acre
	3	between 0.25-9.0 acres		1	fire (Big Buck - 67 acres)
USFS	16	human caused fires (total)	ODF	24	human caused fires (total)
	14	less than 0.25 acres			most below 1 acre
	2	between 0.25-9.0 acres		9	of the 24 human caused fires 9 were in T.39S., R. 7E, Section 29 which is at the mouth of Spencer Creek -Weyerhaeuser Campground

[1]It is reasonable to assume that fires that started outside the watershed historically entered and shaped the landscape inside the watershed. The data presented above is only for those fires that started within the Spencer Creek watershed.

[2]Human caused fires are not separated out by zone. All fires occurring within the zones listed are lightning fires.

Table 15. Changes in Seral Stages & Stand Attributes Within Mixed Conifer and Ponderosa Pine Zone

Seral Stage	Historic Level Percent	Present Level Percent	Trend	Cause of Change
Non Forest	1%	1%	-------------------	----------------
Early	3%	31%	Private Up Federal Down	Harvesting ROD
Early Mid	41%	43%	Private Up Federal Down	Harvesting ROD
Mid	30%	18%	Private Up Federal Slightly Up	Harvesting ROD
Late	25%	7%	Private Down Federal Slightly Up	Harvesting ROD
Mid and Late	55%	25%	---------------------	-----------------
Stand Atttribute	**Historic (1945)**	**Present**	**Trend**	**Cause of Change**
Species Composition	See Leiberg Figure 2	PP, SP, IC, DF < WF	PP Down DF Down SP Down IC Down WF Up SRF Up [1]	Harvesting Bister rust Fire suppression
Patches	Irregular - shaped by fire/disease	Square / Rectangular Shaped by ownership	Private - CC/HPC Federal LPC	Harvesting ROD
Down Wood & Fuels	Lower part of zone less than upper part of zone. See written discussion.	Approximately 14 tons per acre on unmapped BLM LSR's [2]	On Federal Land: At least 120 feet of 16 inch logs.	ROD
# of Snags/Acre	No Data: See written discussion	See written discussion On unmapped BLM LSR's 18 snags/acre [6]	Federal slightly Up	Insect Activity
Canopy Closure	Lower part 40-60%[3] Upper part > 55%[3]	85% < 55% crown closure 15% > 55% crown closure	Private Down Federal =	Harvesting ROD / Harvesting

Table 15. Changes in Seral Stages & Stand Attributes Within Mixed Conifer and Ponderosa Pine Zone (Continued)

Insect Activity	Slight	Moderate [5]	Increasing [5]	Harvesting Species Comp Densities PPTN levels
Diseases	Slight	Slight to moderate [4]	Increasing [4&5]	Densities Species Comp Harvesting Blister Rust

Up = Increasing Down = Decreasing = = Stable

LP-Lodgepole pine MH-Mountain hemlock SRF-Shasta red fir PP-Ponderosa pine WF-White fir WWP-Western white pine IC-Incense cedar

CC-clearcuts HPC-heavy partial cuts LPC - light partial cuts LSR - Late successional reserve

[1]For natural regenerated stands or residual stands - not plantations
[2]Estimate is for all material 3" in diameter and greater in unmapped BLM LSR's that have received some past treatments.
[3]Estimate is based on aerial photos.
[4]Scharpf (1993)
[5]Covington et al. (1994b)
[6]For unmapped LSR's on BLM land (1993)
[7]Based upon professional judgement and personal observation
[8]Hopkins 1993

TABLE 16. Breakdown of Seral Stage by Ownership Within Spencer Creek Watershed

Seral Stage	Ownership and Acres			
	Other	USFS	BLM	TOTAL
Early Shrub	1,717.42	899.64	204.13	2,821.19
Early Tree	6,813.27	2,678.09	1,118.87	10,610.23
Early Mid	10,606.23	5,624.37	3,072.38	19,302.98
Mid	2,107.61	6,220.85	2,720.12	11,048.58
Late	198.18	6,394.96	1,427.09	8,020.23
Grass	1,827.42	190.15	58.04	2,075.61
Rock	40.04	222.16	12.01	274.21

Table 17. Changes in Seral Stages & Stand Attributes Within Lodgepole Pine Zone

Seral Stage	Historic (1945) Level Percent	Present Level Percent	Trend	Cause of Change
Non Forest	1%	3%	-------------------	-------------
Early	0%	14%	Private Up Federal Down	Harvesting ROD
Early Mid	2%	37%	Private Up Federal Down	Harvesting ROD
Mid	88%	36%	Private Down Federal Up	Harvesting ROD
Late	9%	10%	Private Down Federal Up	Harvesting ROD
Mid and Late	97%	46%	-------------------	----------------
Stand Attribute	**Historic (1945)**	**Present**	**Trend**	**Cause of Change**
Species Composition	LP > WF	LP > WF	WF Up	WF understory increasing
Patches	Irregular / Fire and Insects	Small clearcuts / ownership patterns		Harvesting
Down Wood & Fuels	See written discussion 12-20 eight foot pieces / 10" in diameter [8]	No Data	Up	Firewood demand Timber Sales
# of Snags/Acre	5 snags/acre greater than 12"DBH [8]	No Data	Down	Firewood demand Timber Sales

Table 17. Changes in Seral Stages & Stand Attributes Within Lodgepole Pine Zone (continued)

Canopy Closure	Majority > 55% [3]	84% < 55% crown closure 16% > 55% crown closure	Federal land =	ROD
Insect Activity	Low to Moderate	Low to Moderate	Low to Moderate	Continuing Drought
Diseases	Low	Low	Low	

Up = Increasing Down = Decreasing = = Stable

LP-Lodgepole pine SRF-Shasta Red Fir MH-Mountain Hemlock SRF-Shasta red fir PP-Ponderosa pine WF-White fir WWP-Western white pine IC-Incense cedar

CC-clearcuts HPC-heavy partial cuts LPC - light partial cuts LSR - Late successional reserve

[1] For natural regenerated stands or residual stands - not plantations
[2] Estimate is for all material 3" in diameter and greater in unmapped BLM LSR's that have received some past treatments.
[3] Estimate is based on aerial photos.
[4] Scharpf (1993)
[5] Covington et al. (1994b)
[6] For unmapped LSR's on BLM land (1993)
[7] Based upon professional judgement and personal observation
[8] Hopkins 1993

TABLE 18. Dominant Species Groups 1945 Data Versus 1994 Data

1945 Vegetation Type	1945 Acres (percent)	1994 Vegetation Type	1994 Acres (percent)
Subalpine	641 (1.2%)		
Mt. Hemlock and Shasta red fir	14,531 (27%)	Mt. Hemlock	606 (0.6%)
		Shasta red fir	5,402 (5.0%)
Ponderosa pine	25,062 (46%)	Ponderosa pine	8,547 (8.0%)
Lodgepole pine	4,930 (9%)	Lodgepole pine	2,868 (2.6%)
White fir	4,537 (8.4%)		
Douglas-fir	1,336 (2.5%)	Mixed Conifer	31,492 (29%)
Rock	no data	Rock	274 (0.3%)
Grass	1,548 (2.9%)	Grass	2,098 (1.9%)
Shrubs	1,274 (2.4%)	Shrubs	2,864 (2.6%)
Water	350 (0.6%)	Water	3 (0.002%)

Table 19. Changes in Seral Stages & Stand Attributes Within Shasta Red Fir Zone

Seral Stage	Historic (1945) Level Percent	Present Level Percent	Trend	Cause of Change
Non Forest	1%	1%	-------------------	-------------
Early	4%	17%	Private Up Federal Down	Harvesting ROD
Early Mid	16%	20%	Private Up Federal Down	Harvesting ROD
Mid	65%	24%	Private Down Federal Up	Harvesting ROD
Late	14%	38%	Private Down Federal Up	Harvesting ROD
Mid and Late	79%	62%	-------------------	---------------
Stand Attribute	**Historic (1945)**	**Present**	**Trend**	**Cause of Change**
Species Composition	See Leiberg Figure 2	WWP,LP,PP < SRF,WF [1]	WWP Down PP Down SRF Up WF Up	Blister Rust Harvesting Fire Suppres-sion
Patches	Irregular - Shaped by Fires, Root Disease, Insects	Square, Rectangular CC	Private CC & HPC Federal LPC	Harvesting ROD
Down Wood & Fuels	See Written Discussion	See Written Discussion- On unmapped BLM LSR's 14 tons per acre [2&6]	On federal land: At least 120 feet of 16" logs or greater	ROD
# of Snags/Acre	See Written Discussion	See Written Discussion- On unmapped BLM LSR's 8 snags/acre [6]	Federal Sightly Up	Insect Activity
Canopy Closure	>55% [3]	52% of the watershed < 55% crown closure 48% of the watershed > 55% crown closure	Private Down Federal =	Harvesting ROD

Table 19. Changes in Seral Stages & Stand Attributes Within Shasta Red Fir Zone (Continued)

		48% > 55% crown closure		
Insect Activity	slight	slight to moderate [4&7]	Up [4&7]	Harvesting species comp. densities PPTN levels
Diseases	slight	slight to moderate	Up [5]	Densities species comp. blister rust harvesting

Up = Increase Down = Decrease = = Stable

LP-Lodgepole pine SRF-Shasta Red Fir MH-Mountain Hemlock SRF-Shasta red fir PP-Ponderosa pine WF-White fir WWP-Western white pine IC-Incense cedar CC-clearcuts HPC-heavy partial cuts LPC - light partial cuts LSR - Late successional reserve

[1] For natural regenerated stands or residual stands - not plantations
[2] Estimates for all material 3" in diameter and greater in unmapped BLM LSR's that have received some past treatments.
[3] Estimates based on aerial photos.
[4] Scharpf (1993)
[5] Covington et al. (1994b)
[6] For unmapped LSR's on BLM land (1993)
[7] Based upon professional judgement and personal observation
[8] Hopkins (1993)

Table 20. Changes in Seral Stages & Stand Attributes Within Mountain Hemlock Zone

Seral Stage	Historic (1945) Level Percent	Present Level Percent	Trend	Cause of Change
Non Forest	3%	4%	-------------------	-------------
Early	23%	3%	Slightly Down	Fire Suppression
Early Mid	4%	41%	Slightly Down	Fire Suppression
Mid	70%	31%	Slightly Up	Fire Suppression
Late	0%	21%	Slightly Up	Fire Suppression
Mid and Late	70%	52%	--------------------	----------------

Stand Attribute	Historic (1945)	Present	Trend	Cause of Change
Species Composition	No Data	No Data	LP Down MH Up SRF Up [7]	Fire Suppression
Patches	No Data	No Data	Slightly Down [7]	Fire Suppression
Down Wood / Fuels	See Written Discussion 7-12 tons/acre [2]	See Written Discussion Not much change from historic because of "Wilderness" allocation	Slightly Up [7]	Fire Suppression
# of Snags/Acre	No Data	No Data	Slightly Up Shasta red fir[7]	Fire Suppression Increased Densities

Table 20. Changes in Seral Stages & Stand Attributes Within Mountain Hemlock Zone (Continued)

Canopy Closure	> 40% [3]	73% of watershed < 55% canopy closure 27% > of watershed > 55% canopy closure	Slightly Up	Fire Suppression
Insect Activity	Slight	Slight	= Stable	
Diseases	Slight	Slight	Slightly Up [7]	Densities

Up = Increase Down = Decrease = = Stable

LP-Lodgepole pine SRF-Shasta Red Fir MH-Mountain Hemlock SRF-Shasta red fir PP-Ponderosa pine WF-White fir WWP-Western white pine IC-Incense cedar CC-clearcuts HPC-heavy partial cuts LPC - light partial cuts LSR - Late successional reserve

[1] For natural regenerated stands or residual stands - not plantations
[2] Estimate is for all material 3" in diameter and greater in unmapped BLM LSR's that have received some past treatments.
[3] Estimate is based on aerial photos.
[4] Scharph (1993)
[5] Covington et al. (1994b)
[6] For unmapped LSR's on BLM land (1993)
[7] Based upon professional judgement and personal observation
[8] Hopkins (1993)

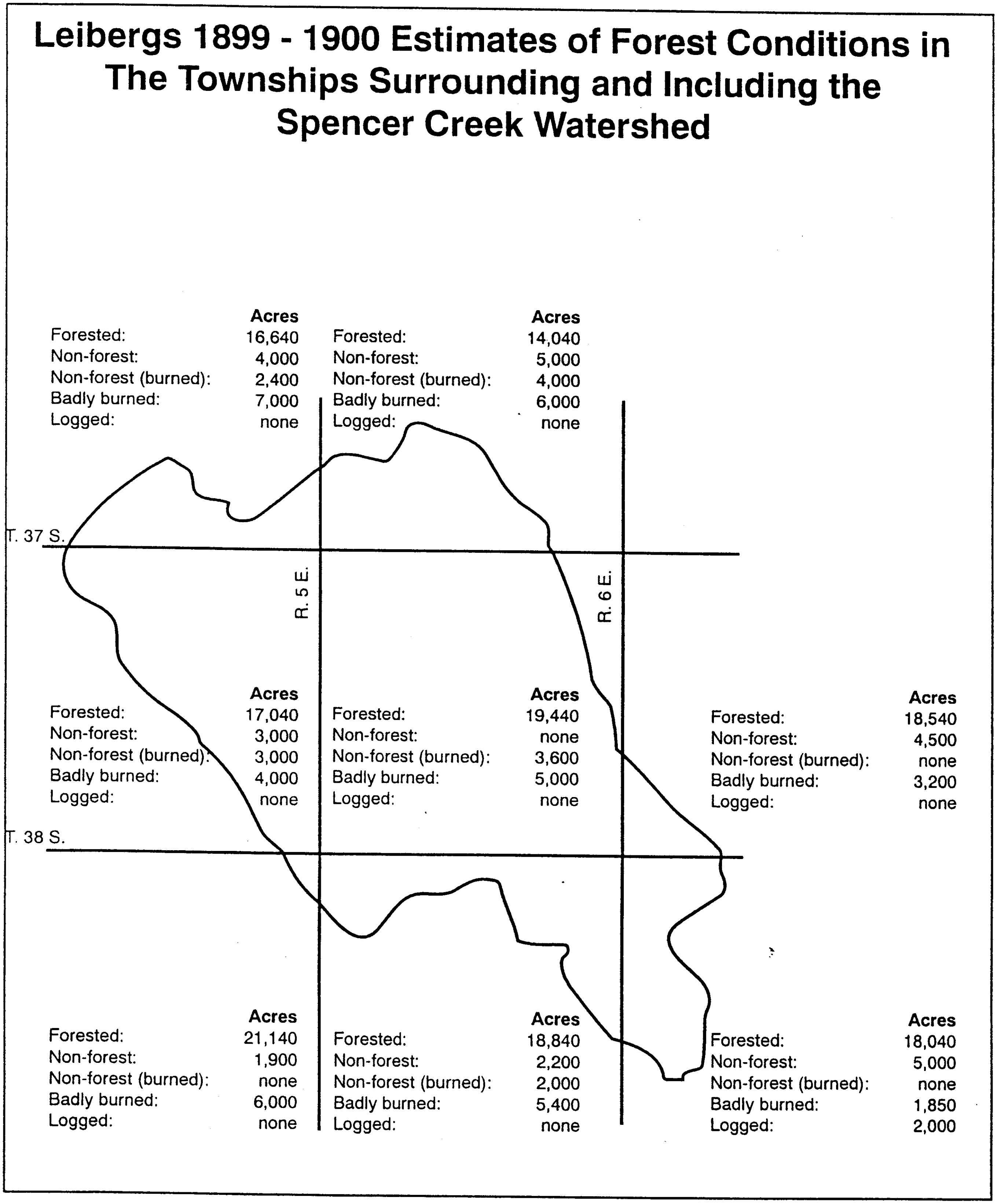
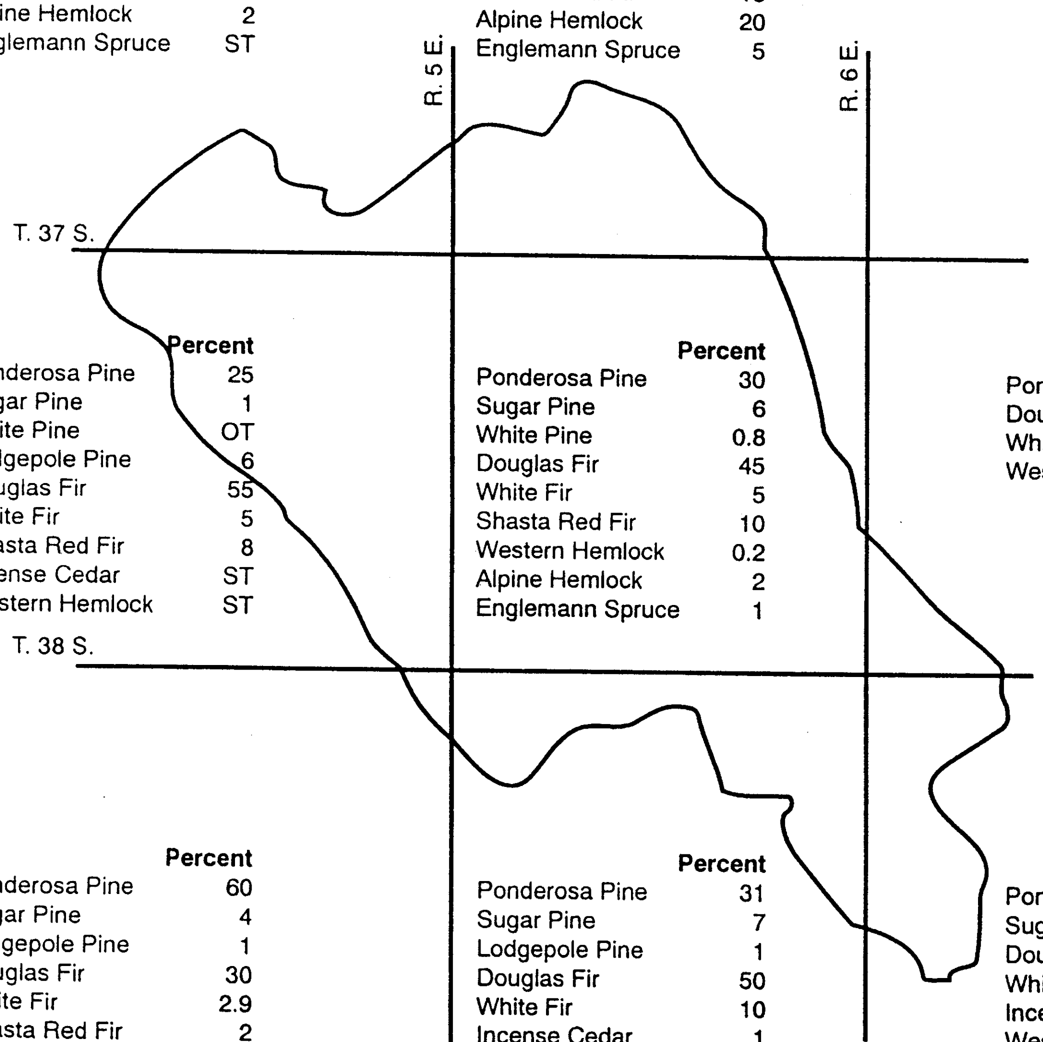


Figure 1. Leiberg's 1899-1900 Estimates of Forest Conditions in the Townships of Spencer Creek

Leiberg's 1899 Estimate of Tree Species Compostion in the Townships that Include Spencer Creek Watershed



	Percent
Ponderosa Pine	1
White Pine	5
Lodgepole Pine	3
Douglas Fir	15
White Fir	64
Shasta Red Fir	8
Western Hemlock	2
Alpine Hemlock	2
Englemann Spruce	ST

	Percent
Ponderosa Pine	10
Sugar Pine	0.6
White Pine	0.9
Lodgepole Pine	23
Douglas Fir	3
White Fir	20
Shasta Red Fir	18
Alpine Hemlock	20
Englemann Spruce	5

	Percent
Ponderosa Pine	25
Sugar Pine	1
White Pine	OT
Lodgepole Pine	6
Douglas Fir	55
White Fir	5
Shasta Red Fir	8
Incense Cedar	ST
Western Hemlock	ST

	Percent
Ponderosa Pine	30
Sugar Pine	6
White Pine	0.8
Douglas Fir	45
White Fir	5
Shasta Red Fir	10
Western Hemlock	0.2
Alpine Hemlock	2
Englemann Spruce	1

	Percent
Ponderosa Pine	60
Douglas Fir	30
White Fir	8
Western Juniper	2

	Percent
Ponderosa Pine	60
Sugar Pine	4
Lodgepole Pine	1
Douglas Fir	30
White Fir	2.9
Shasta Red Fir	2
Incense Cedar	0.1

	Percent
Ponderosa Pine	31
Sugar Pine	7
Lodgepole Pine	1
Douglas Fir	50
White Fir	10
Incense Cedar	1

	Percent
Ponderosa Pine	73
Sugar Pine	3
Douglas Fir	13
White Fir	7
Incense Cedar	0.2
Western Juniper	3

Figure 2. Leiberg's 1899 Estimates of Tree Species Composition in the Townships of Spencer Creek

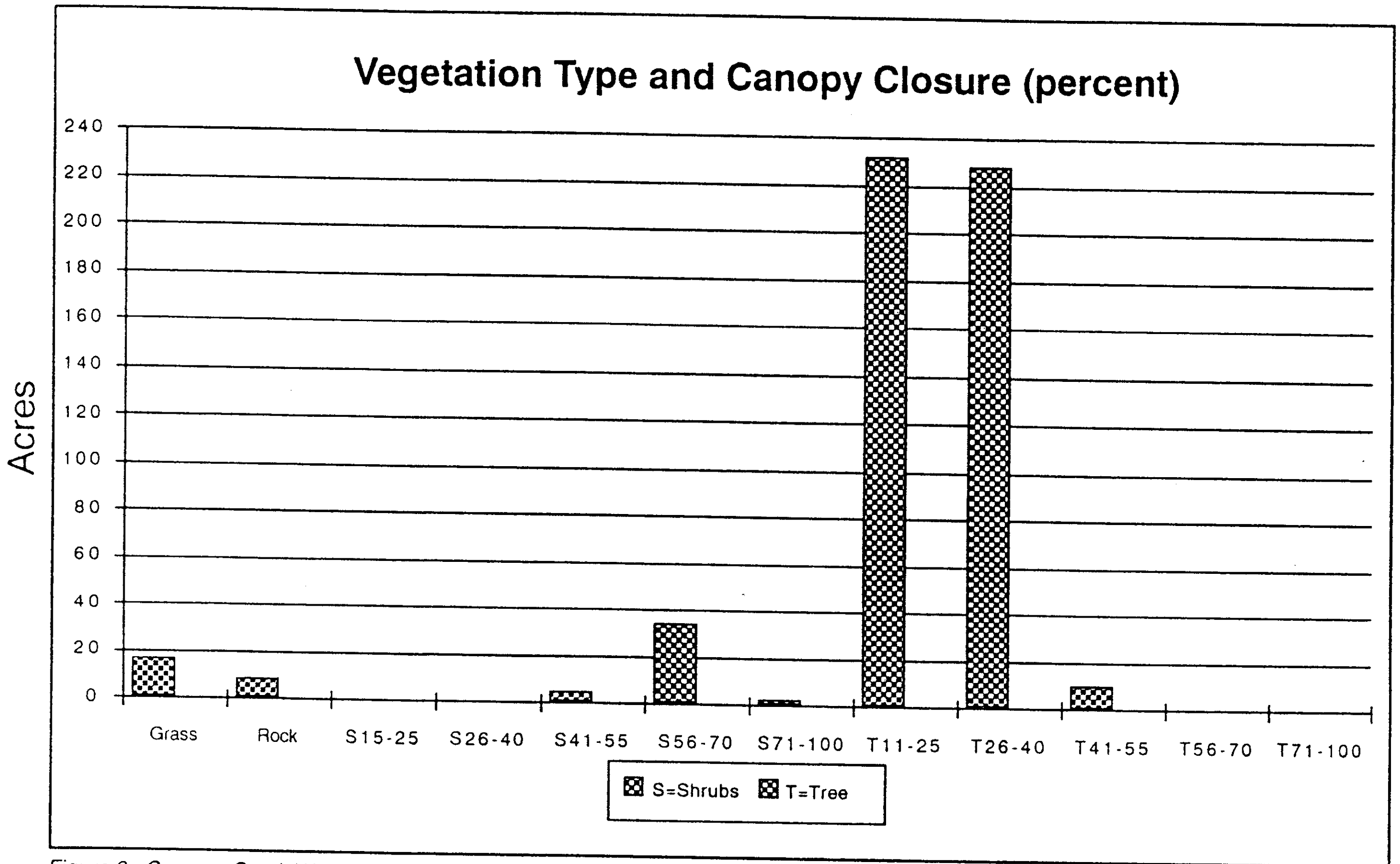


Figure 3. Spencer Creek Watershed - 1994 Ponderosa Pine Zone Canopy Closure

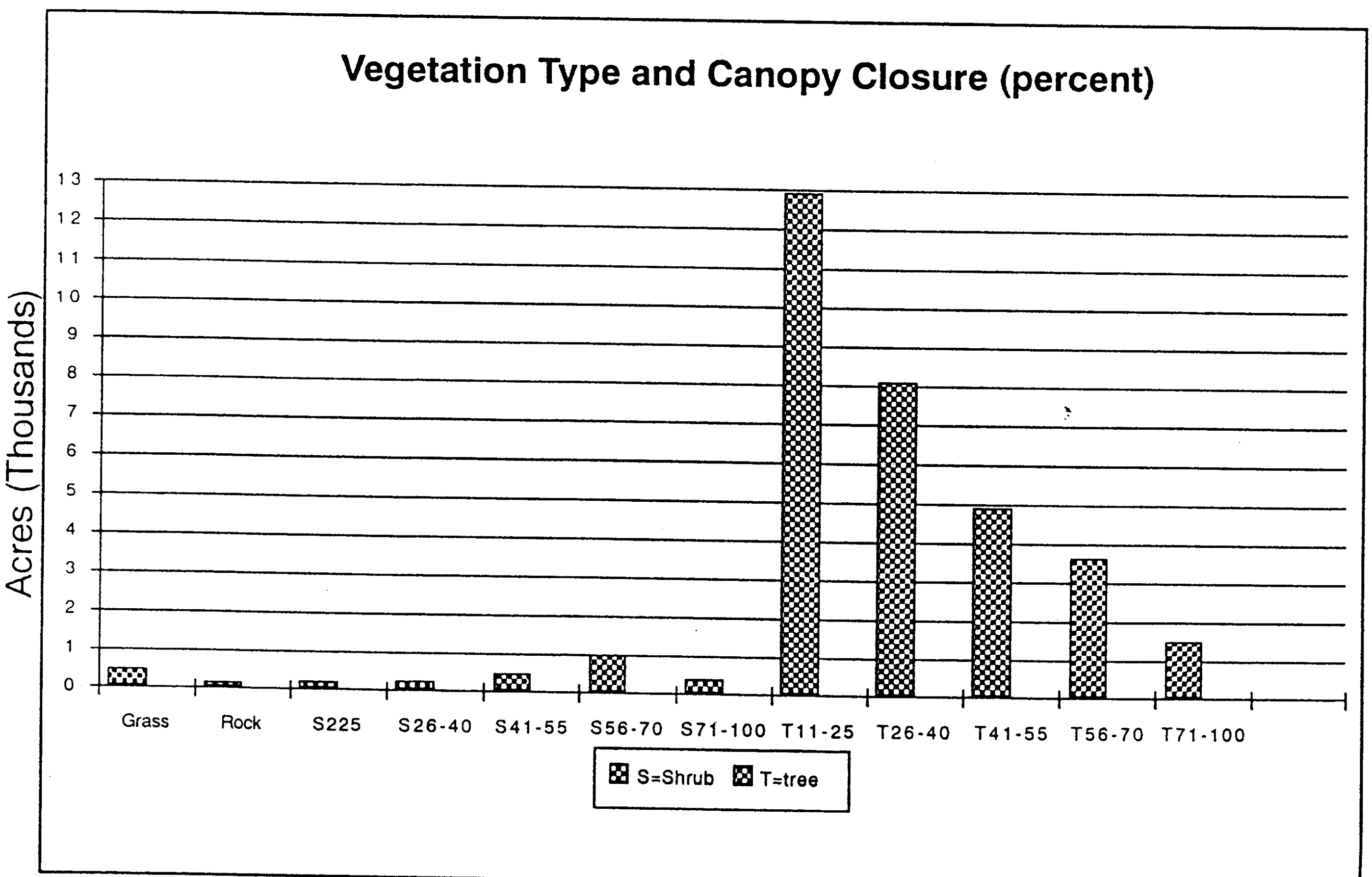


Figure 4. Spencer Creek Watershed - 1994 Mixed Conifer Zone Canopy Closure

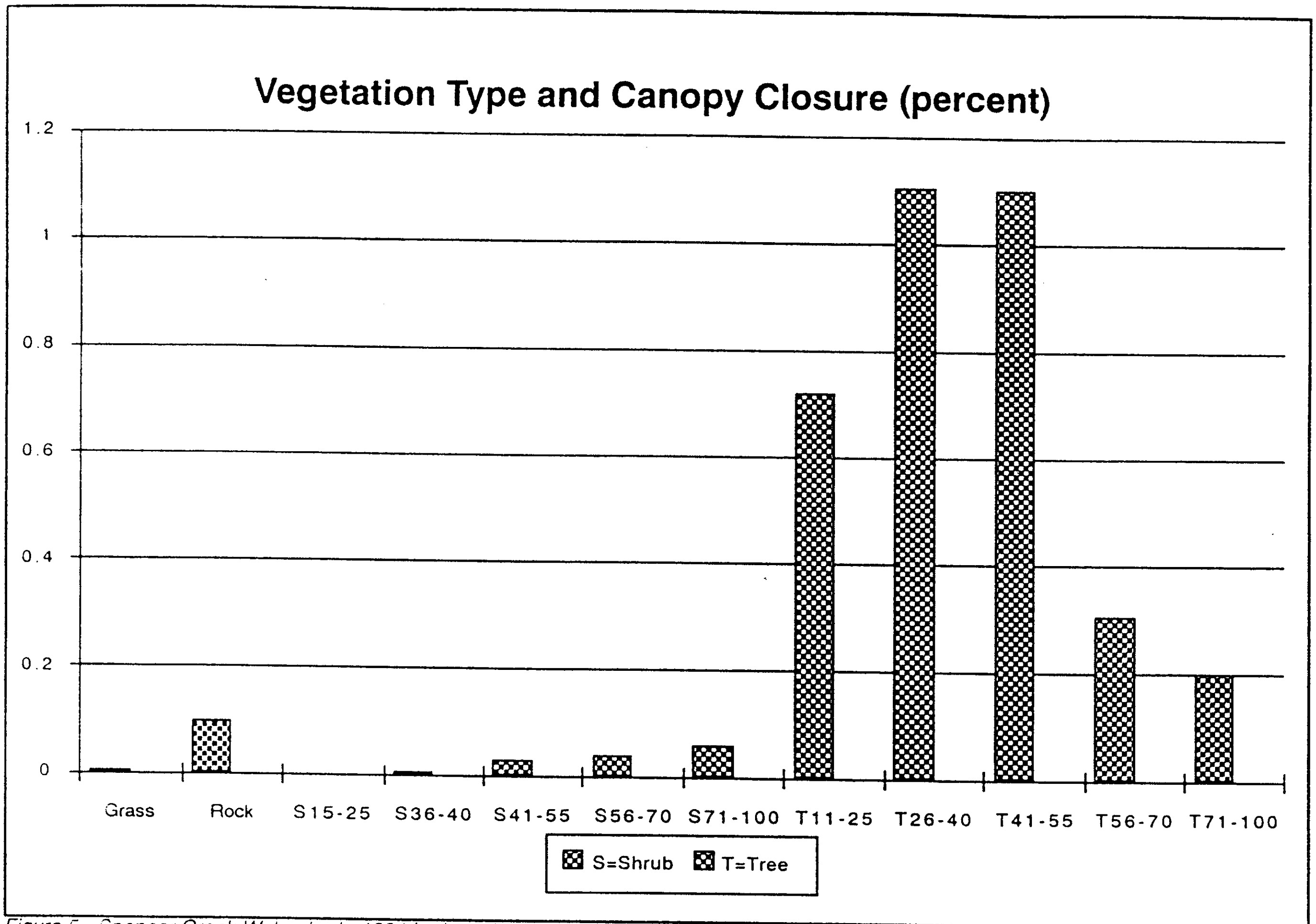


Figure 5. Spencer Creek Watershed - 1994 Lodgepole Pine Zone Canopy Closure

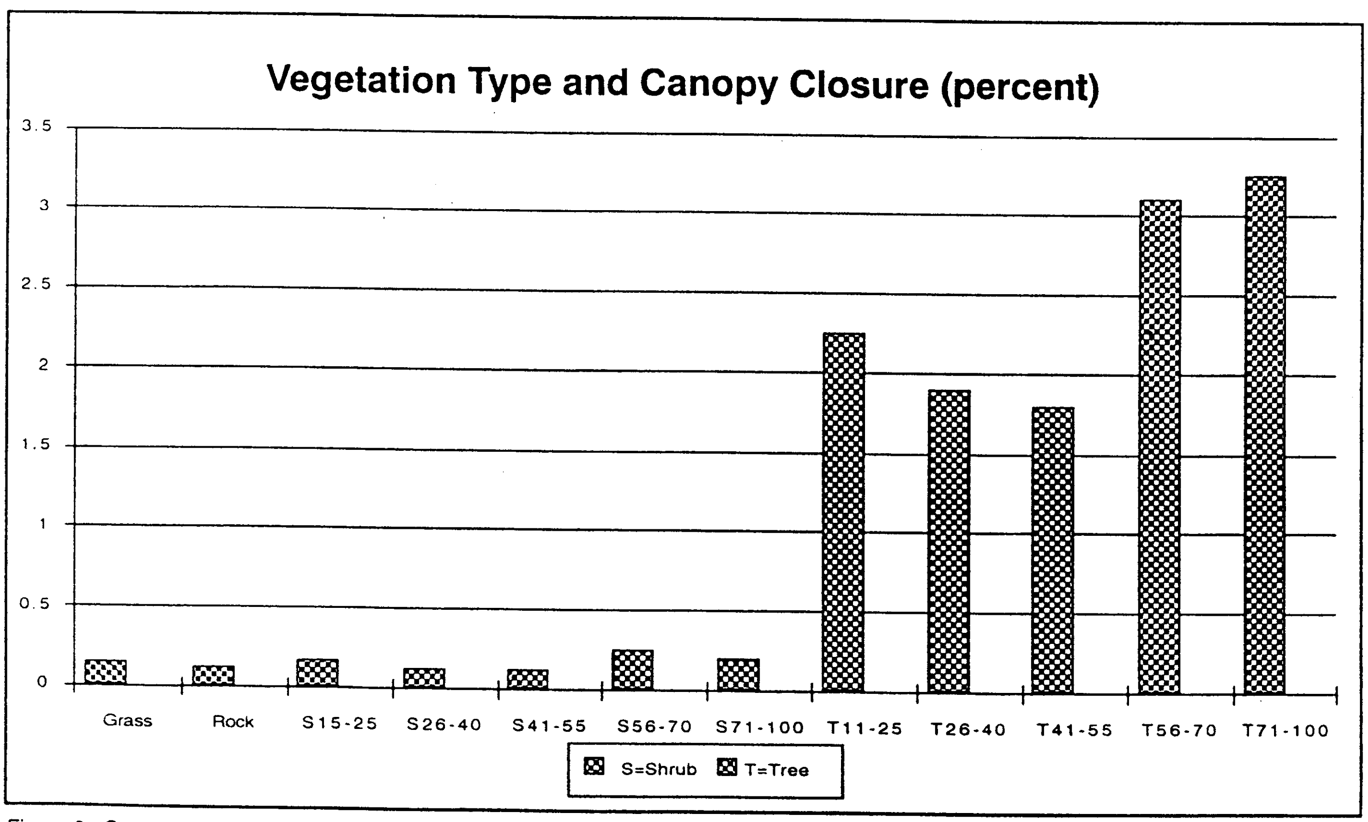


Figure 6. Spencer Creek Watershed - 1994 Shasta Red Fir Zone Canopy Closure

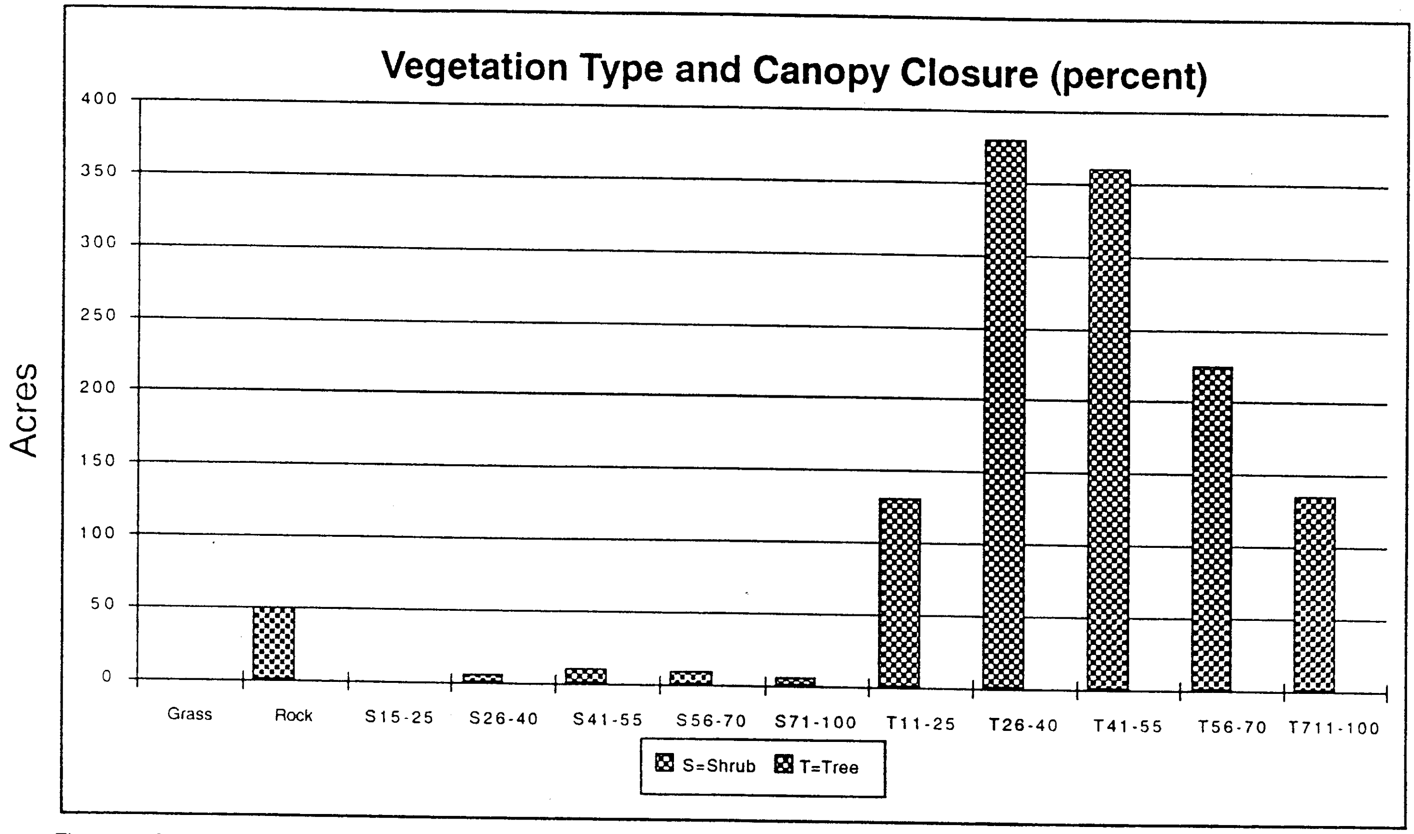


Figure 7. Spencer Creek Watershed - 1994 Mountain Hemlock Zone Canopy Closure

B. Special Status Plant Species Including Threatened, Endangered and Sensitive Plant Species

Issue: 7 Habitat for Federally listed, proposed or candidate species, State listed species, USDA Forest Service Region 6 Sensitive species and BLM Special Status Species of plants has been altered.

Key Questions: Where does occupied and/or potential habitat occur? What is the condition of this habitat for plant species determined to be a high priority for analysis?

Key Question: How have these species and/or their habitat been affected by past management activities?

Key Question: Where does occupied and/or potential habitat occur for those species which require protection buffers as stated in the Record of Decision for the Northwest Forest Plan?

Historic Conditions

Little is known concerning the historic distribution of special status plant species within the watershed. Many special status species are naturally rare within the communities in which they occur, or are restricted to particular, uncommon habitats even if they are abundant within those habitats. Species are classified into one of the special status categories when human activities alter relative abundance and species composition of plant communities or further reduce the abundance of uncommon habitats.

Process of Change

The primary changes in the watershed are the result of human activity, and include timber harvest, livestock grazing, fire suppression, road construction, and water diversion for irrigation. Timber harvest can change the environmental conditions, such as relative humidity and exposure to sunlight, at a site that will affect the ability of individual species to survive or compete in the affected area. Livestock grazing can change relative abundance of species and species composition through selection of more palatable species for consumption, and trampling and compaction of soils. Fire suppression can change relative abundance of species and species composition by favoring fire intolerant and shade tolerant species relative to species adapted to the natural fire regime. Fire suppression can also change vegetation structure if large fuel loads are allowed to accumulate, which can result in an unnaturally high intensity, possibly stand-replacing, wildfire. Road construction can contribute to fragmentation of habitat and decrease interior forest habitat through an increase in edge conditions throughout the watershed. Water diversion for irrigation can change the amount, geographic distribution and seasonal distribution of water thereby, changing habitat conditions in affected areas with resulting changes in species composition and relative abundance.

Current Conditions

Table 21 shows potential habitat documented or suspected in the watershed area for vascular plant species on the Regional Forester's Sensitive species list that are on the Winema National Forest, and for BLM special status plant species documented or suspected in the Klamath Falls Resource Area. Surveys from 1990 to 1994 covered approximately 90 percent of the non-wilderness portion of the National Forest-administered lands, and 1989 to 1994 surveys covered 2,850 acres of BLM-administered lands in the watershed area. Both green-flowered ginger (*Asarum wagneri*) and Newberry's gentian (*Gentiana newberry*) were located during these surveys. The range of these two species on National Forest lands is thought to be fairly well known, but surveys on BLM lands included only those areas that have been proposed for timber harvest or other management actions in the past.

Table 21. Regional Forester's Sensitive Plant Species List For The Winema National Forest And Bureau Of Land Management Special Status Plant Species For The Klamath Falls Resource Area

Species	Status	Documented In Area ?	Potential Habitat	Occurance [1]
Allium bolanderi		No	Dry rocky or clay soils, openings in brush or woodlands	Unlikely
Arabis suffrutescens var. horizontalis	C2, OC	No	Gravelly, rocky, pumice slopes, high elevations	Possible in Mtn. Lakes Wilderness
Arnica viscosa	3C	No	High elevation rocky sites	Possible in Mtn. Lakes Wilderness
Asarum wagneri	OC, BS	Yes	LP and fir forests, open canopies, rocky sites	Widespread in area
Astragalus applegatei	LE	No	Moist meadows	Possible hist. site near Keno
Astragalus peckii	C2, OC	No	LP/bitterbrush openings, sagebrush, pumice soils	Unlikely, no habitat
Botrychium pumicola	C1, OC	No	LP basins, high elevations, slopes, pumice soils	Unlikely, No pumice
Calliergon trifarium		No	Fens with standing water often submerged	Possible no past surveys
Calochortus greenei	C1	No	Dry, brushy hillsides on clay soils	Possible
Calochortus longebarbatus var. longebarbatus	C2, OC	No	Dry-moist meadows, edge of LP/PP woodlands	Unlikely, not found on KRD
Castilleja chlorotica	C2, OC	No	Gravelly slopes/summits, PP/LP openings, 5000'+	Unlikely
Cicuta bulbifera		No	Swamps, marshes	Possible, hist. site
Collomia mazama	C2, OC	No	Mesic LP & fir forests partial canopies, mid elev.	Unlikely, outside range
Eriogonum diclinum	3C	No	Dry, rocky ridgetops, sandy-gravelly slopes & flats, serpentine soils	Unlikely
Eriogonum procidiuum	C2, OC	No	Volcanic slopes, basalt flows, pine woodlands 4,200-8,200	Unlikely
Gentiana newberryi	AS	Yes	Moist-wet meadows, mid-high elevations	Muddy sp./ Buck Lake
Haplopapus whitneyi var. discoideus		No	Open, high elevatiion, rocky slopes	Possible in Mtn. Lakes Wilderness
Hieracium bolanderi		No	High elevation slopes in the Cascades	Possible in Mtn. Lakes Wilderness
Limnunthes floccosa ssp. bellingeriana	C2	No	Spring wet depressions and flats with rock, clay soils	Possible
Mimulus jepsonii		No	Openings in LP/PP forests, residual soils, E. Cascades	Unlikely
Mimulus pygmeaus	C2, OC	No	Spring-wet depressions & flats, intermittent stream beds	Possible, tiny annual
Mimulus tricolor		No	Moist flats, vernal pools, pools, wet clay soils	Unlikely, not found on KRD
Penstemon glaucinus	C2,OC	No	LP/WF forests, high elevations	Unlikely

Table 21. Regional Forester's Sensitive Plant Species List For The Winema National Forest And Bureau Of Land Management Special Status Plant Species For The Klamath Falls Resource Area

Perideridia erythrorhiza	C2, OC	No	Spring-moist meadows edge of mixed conifer forestconifer forest	Possible, difficult to I.D.
Perideridia howellii		No	Moist slopes & meadows, streamsides	Unlikely
Rorippa columbiae	C2, OC	No	Gravelly streambeds, lakeshores	Possible, hist. site
Silene nuda ssp. insectivora	AS	No	Spring-moist meadows, low elevations	Unlikely, outside range
Thelypodium brachycarpum	3C, AS	No	Sagebrush openings, meadows in PP forests, streamsides	Possible, hist. site

LE - Listed as endangered by the USFWS under the Endangered Species Act
C1 - Category 1 candidate for Federal listing
C2 - Category 2 candidate for Federal listing
3C - Taxa found to be more abundant or widespread than previously believed and/or which have no identifiable threats
OC - State of Oregon Candidate for Listing
BS - U. S. Bureau of Land Management sensitive species in Oregon
AS - U. S. Bureau of Land Management assessment species in Oregon
LP - Lodgepole pine
PP - Ponderosa pine
WF - White fir
KRD - Not found on the Klamath Ranger District to date
WIN - Not found on the Winema National Forest to date
Hist. site - Historical Sighting on District or in nearby areas
Mtn. Lakes - If present, most likely to occur in the Mountain Lakes Wilderness

[1] Probability of occurrence in the watershed area, based on the known distribution and habitat requirements of species, past survey data, and the likelihood of detection of species during past surveys in the area.

Green-flowered Ginger

Green-flowered ginger is a low growing aromatic perennial herb whose primary habitat has been described as the understory of moist, shaded mixed conifer, white fir, and red fir forests (King 1989). However, it has also been documented in ponderosa pine stands at 3,100 feet elevation, in subalpine boulder fields at 8,400 feet elevation (Baldwin and Brunsfield 1991), and in open canopy lodgepole pine (dry) forest (see below). This apparently large ecological amplitude make potential habitat for green-flowered ginger difficult to predict for any given area. Its range currently appears to be totally within Oregon and includes documented populations in Klamath, Jackson, and Douglas counties in the southern part of the state (Oregon Natural Heritage Program 1993).

In the Spencer Creek watershed, green-flowered ginger occurs in lodgepole pine (dry) and white and Shasta red fir forests, often where canopy closure is less than 60 percent, or some type of small opening has occurred. Populations are often scattered-patchy and may extend over large areas. Over 50,000 plants have been reported on National Forest lands, but this is probably an underestimate. Surveys on BLM lands have detected numerous, low density populations ranging in size from 4 plants to approximately 200 plants, mostly in the understory of mature red fir and mixed conifer forests. Ginger plants are generally absent from clearcuts and shelterwood cuts, and may have been eliminated from some areas by past harvesting. Canopy closure resulting from fire suppression may also be a threat in some portions of the watershed area. Observations on National Forest lands indicate that the species seems to thrive in open lodgepole pine stands where firewood cutters have been active.

Newberry's Gentian

Newberry's gentian occurs in high elevation, alpine meadows of the Cascade Mountains of Oregon from the Three Sisters area south into northern California (Eastman 1990). In Oregon, the species been documented in Deschutes, Klamath, and Lane counties (Oregon Natural Heritage Program 1993).

In the Spencer Creek watershed, Newberry's gentian occurs in moist to wet tufted hairgrass-dominated (*Deschampoia cespitosa*) meadows associated with Muddy Springs and Buck Lake. Documented sites to date are all on National Forest lands. Populations are large, with several thousand individuals each. All of the known sites are grazed annually by cattle. The site just north of Buck Lake is grazed especially heavily. Grazing does not appear to significantly impact the species since flowering rates are high on all sites. However, quantitative monitoring has not been conducted to confirm these observations.

Other Special Status Species

Many of the other species listed (see Table 21) as possibly occurring in the area would most likely be found either on high elevation slopes within the Mountain Lakes Wilderness, or within the Riparian Reserves of the Northwest Forest Plan. If present, red-root yampa (*Perideridia erythrorhiza*), pygmy monkey flower (*Mimulus pygmaeus*), Bellinger's meadowfoam (*Limnanthes floccosa species bellingeriana*), Green's mariposa lily (*Calochortus greenei*), and thelypody (*Thelypodium brachycarpum*) may occur outside protected areas. Red-root yampa grows in low elevation spring-moist meadows and at the edges of mixed conifer woods. Pygmy monkey flower occurs in spring-wet depressions in shrublands, as well as riparian areas. Bellinger's meadowfoam grows near the edges of low elevation spring-moist meadows. Green's mariposa lily occurs on dry, brushy hillsides on clay soils. Thelypody is found in salt desert shrub and sagebrush shrublands and openings in ponderosa pine forests.

Trends

To the extent that human activities continue to affect species abundance, relative abundance of species, and the distribution of uncommon habitats, the abundance and distribution of special status plant species would be reduced within the watershed. This would result in contributing to an increased level of concern and/or to the need to list individual species. As a result, management activities will be constrained to conserve the species, and/or the species will eventually be extirpated.

Survey and Manage Species

Historic Conditions

Little is known concerning the historic distribution of the Northwest Forest Plan's survey and manage species within the watershed. Survey and manage species are species that are primarily associated with old-growth conifer forests in the Pacific Northwest. This type of habitat was once more abundant than at the present time (see the vegetation section). Therefore, it might be assumed that the survey and manage species were once more abundant and widespread within the watershed.

Process of Change

The primary cause of the decrease in old growth conifer forest in the watershed has been the harvest of timber. Timber harvest has removed the structural components of the forest that comprise old growth habitat, including large trees, down and dead woody material, standing dead snags, a multilayered canopy, and a closed tree canopy. The disturbance to the substrate and alteration of environmental conditions also can affect species composition and relative abundance of species in the understory community, where most of the survey and manage species occur. Livestock grazing can also affect the understory community through selection of more palatable species for consumption, and trampling and compaction of soils.

Current Conditions

Surveys for lichens, fungi and bryophytes have not yet been conducted on any lands within the watershed. None of the survey and manage species of lichens, fungi, bryophytes, or vascular plants included in Table 3C of the Northwest Forest Plan are known to occur within the watershed area. Populations and/or potential habitat may be present for some of these species. Five of the fungi species were located during a survey on National Forest lands in an area outside the watershed in the Klamath Ranger District. These include *Sarcodon imbricatum, Phaeocollybia scatesiae, Cantharellus cibarius, C. Subalbidus, and C. Tubaeformis*. All five species are associated with late successional habitats.

Trends

To the extent that human activities continue as they have in the past, old growth conifer forest will continue to be fragmented and reduced in distribution. Consequently the survey and manage species associated with these forests will also become less abundant and less widely distributed. As a result, concern for some of these species may increase, and some may become classified into one of the special status species categories. Management activities may then be constrained to conserve the species, and/or the species will eventually be extirpated. With implementation of the Northwest Forest Plan old growth conditions on federal land would be expanded over the long term. Therefore, trends for survey and manage species on these lands would be expected to remain static or increase in the long term.

Other Species of Interest

Historic Conditions

Little is known concerning the historic distribution of these plant species within the watershed.

Process of Change

The processes of change are the same as those described at the beginning of the Special Status Species section. See that section.

Current Conditions

Buxbaum's sedge (*Carex buxbaumii*) occurs in the Muddy Spring meadow. This rare sedge (Oregon Heritage Program List 3) is fairly widespread in distribution, but is usually rare where found.

Pacific yew (*Taxus brevifolia*) is known to occur in the Crystalline Springs drainage on Nation Forest lands, and in a seep area on the northeast slope of Surveyor Mountain in T.39S., R.6E., Section 9 on BLM-administered lands. The species is at the eastern edge of its range in Klamath County, where it occurs in relatively small, disjunct populations.

Trends

To the extent that human activities continue as they have in the past, these species could become less abundant and less widely distributed. As a result, concern for some of these species may increase, and some may become classified into one of the special status species categories. Management activities may then be constrained to conserve the species, and/or the species will eventually be extirpated.

Plant Communities of Interest

Historic Conditions

Little is known concerning the historic distribution of these relatively uncommon plant communities, except where they are mentioned during early descriptions of the major forest types (see the Vegetation section). Probably the distribution of these communities has changed little, but the effects of human activities since Euroamerican settlement noted below were not present.

Process of Change

The processes of change are the same as those described at the beginning of the Special Status Species section. See that section.

Current Conditions

White bark pine communities occur on the upper elevation peaks of the Mountain Lakes Wilderness, the largest being on the south-facing slope of Aspen Butte. This community has not been significantly affected by human management actions since it is remote and included in a designated wilderness area. Fire suppression would be the one possible exception to the area being unaffected by management actions.

Lodgepole pine/huckleberry/forb swamp communities occur in the Desolation Swamp, Muddy Springs, and Tunnel Creek areas. The portion of the wetland area at Tunnel Creek formerly owned by Weyerhaeuser Company has had the lodgepole pine stands clearcut. The area was evaluated as a potential Area of Critical Environmental Concern by the BLM, but was not recommended because integrity of the site had been compromised by the timber harvest on the privately owned portion, and the continued private ownership of that portion. However, the BLM portion of the area has been designated a Special Botanical Area in the BLM Resource Management Plan to give special management attention to the plant communities present.

Wetland shrub communities with willow, red-osier dogwood, huckleberry, and spirea occur north of Buck Meadow and at Crystalline Springs. A similar wetland shrub community with mountain alder, bog birch, and willow with sedges in the understory occurs at Tunnel Creek.

Moist to wet meadows dominated by tufted hairgrass and few flowered spikerush are present north and west of Buck Lake and in the Muddy Springs area.

Trends

All of these communities, except the high elevation white bark pine community, have been affected by livestock grazing to some extent. Grazing has the potential to affect plant species composition and the relative abundances of plant species. Generally, as grazing intensity increases, structural and species diversity decreases towards those characteristic of the earlier seral stages, which include higher components of annual grasses and forbs. These effects would be expected to continue in these communities to the extent and intensity that they are utilized for livestock grazing.

Summary

The populations of special status species, other species of interest, and plant communities of interest appear to be stable. Little is known about the Survey and Manage species at this time. Many of the species and/or communities are reserved in lands allocated as wilderness, Riparian Reserves, and future disturbance is unlikely. Further surveying for and monitoring of these species should improve management recommendations in the future.

C. Rangelands

Note to Reader: This entire section also addresses the first key question of Issue 5 found at the beginning of the Terrestrial Section.

Issue 2: Forage utilization patterns in the watershed are uneven.

Key Questions: How has the condition of the rangeland vegetation (grass, forbs, and herbs) been altered? What is and has been the livestock utilization patterns and amounts within the watershed?

Introduction and Assumptions/Analytical Process

This discussion is broken into several portions. The first section is a summary of historic conditions regarding the potential natural vegetation communities that may have been present in the area. Since there is little quantitative, historic, or watershed specific information available, much of this is informed conjecture. It is believed to accurately reflect conditions within this watershed. This section deals only with the herbaceous portions of the vegetation communities which would be available as livestock forage. Forest ecosystem/plant communities are discussed elsewhere in this document.

The second section is a discussion on the current plant community conditions; also from the herbaceous perspective. Much of this is based on field observations made during the fall of 1994 (on BLM-administered and Weyerhaeuser Company lands) and the 1993 USDA Forest Service "Range Analysis Narrative". (Note: Descriptions of "rangeland condition" relating to forested areas can be confusing. Most descriptions of range condition compare the existing vegetation, which is presently at some point on the successional continuum, with the "Potential Natural Community" [see Glossary]. Implicit in the descriptions of rangeland communities is that the later seral stages or Potential Natural Community are better forage providing community aggregations than those in earlier seral stages. The opposite is true for forest dominated by herbaceous vegetation in the earlier seral stages (meaning more forage is available for livestock; Smith 1989).

Section three on the processes of change is broken into several portions. The first portion is a general discussion of how grazing can impact or alter the conditions and characteristics of the types of vegetative communities found in the watershed - both upland and riparian. This general discussion is important as there is little watershed-specific information available about herbaceous vegetative changes. This general section discusses the grazing related processes that have undoubtedly caused changes within the watershed. The next portion deals with actual utilization patterns and grazing intensity, based on field observations made during the fall of 1994 (BLM-administered and Weyerhaeuser Company lands) and the USDA Forest Service "Range Analysis Narrative".

Reference Maps 3 and 10, as necessary, to understand the locations discussed in this section.

(Note: Due to the roaming nature of grazing animals, like cattle, an analysis of the effects of grazing does not fit discretely into the Terrestrial or any other section. This section covers both upland and riparian areas as it pertains to grazing livestock.)

Analysis Discussion

Historic Conditions (PNC)

Upland

Note: Much of the information about plant communities is found in various other sections in this analysis, particularly in the vegetation discussion of the Vegetation section. (Please reference those sections.

The historical documentation of rangeland conditions in this watershed are rare. Evidence of extensive past fires is noted in Leiberg's 1899 report on Forest Resources; this indicating areas that would have been dominated by herbaceous vegetation for a period of time and thus grazed. These may well be the areas noted previously that were grazed by itinerant sheep herds. Many of these fire affected areas, particularly at the higher elevations, would also have been dominated by dense shrub stands which would effectively prohibit significant livestock use (Vegetation discussion in the Vegetation section for more on fire). Leiberg notes in his report that little if any logging had taken place, but unfortunately makes no mention of whether livestock grazing was occurring. He does make note of significant amounts of grassland and meadow, obviously areas where grazing could have occurred. Much of the lower portions of the watershed (currently owned mostly by Weyerhaeuser Company) were historically open ponderosa pine stands with a grassland understory. These areas were dominated by rhizomatous grasses (see glossary) and sedges in the moister areas and/or bunchgrasses in the drier areas (Shiflet 1994).

Historically, the ponderosa pine dominated ecological sites (at Potential Natural Vegetation) in the watershed (currently BLM-administered and Weyerhaeuser Company owned lands), including the drier portions of the Mixed Conifer Zone, had an open "park like" structure. This park like structure included scattered big trees with a mix of grass and shrub understory species maintained by a frequent fire regime. Dominant understory species were probably Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Agropyron spicatum*), Ross sedge (*Carex rossii*), and/or antelope bitterbrush (*Purshia tridentata*), depending on actual ecological site characteristics. Each of these species would have comprised between 10 to 50 percent of the communities composition at Potential Natural Community, for those ecological sites to which each is adapted (USDA -Soil Conservation Service 1989).

Riparian

The "wet" meadow plant communities throughout the watershed have probably been among some of the most heavily used by livestock. These meadows, although variable in Potential Natural Community plant composition, would be typically dominated by tufted hairgrass (*Deschampsia caespitosa*), with lesser amounts of various other sedges (particularly Nebraska sedge - *Carex nebraskensis*), rushes (primarily Baltic rush - *Juncus balticus*), and other grasses. Past grazing pressure has probably decreased the amounts of hairgrass (a preferred forage species) and increased the amounts of rushes, sedges, and other more grazing tolerant grass species, such as reedgrass (*Calmagrostis spp.*) and Kentucky bluegrass (*Poa pratensis*). At Potential Natural Community, these meadows should be comprised of 50 to 65 percent hairgrass, with the rest of the composition a mix of numerous other species at no more than 5 to 8 percent each (USDA -Soil Conservation Service 1989).

Current Conditions

Upland

No watershed specific rangeland condition information is available for the BLM- administered and Weyerhaeuser Company owned lands in the mid to lower portions of the watershed. General observations of these areas tend to correlate with the USDA Forest Service information (found later in this section) on sites of similar ecological potential (for example, the higher elevation, moister areas). Undoubtedly, cattle grazing has and is inhibiting or altering the successional progression within most vegetative types by selectively suppressing many of the palatable, native herbaceous plant species that dominate early to mid successional stages. However, extensive harvesting of trees with related mechanical impacts to the vegetation and soils have wielded far more significant pressures than livestock grazing on placing the plant communities in early seral states. This is because the majority of the watershed contains forest ecological sites that have potential natural communities defined primarily by the mature tree species that would dominate at climax. The relatively light grazing currently occurring within the forest dominated ecological sites will not permanently keep these communities in a perpetual state of herbaceous dominated or early seral condition.

Within the ponderosa pine dominated ecological sites in the lower watershed, general qualitative field observations made in 1994 indicated that all of the expected Potential Natural Community dominant herbaceous species, except for possibly Ross sedge, make up only a fraction of the current vegetative composition. Increaser plant species (plants that become more abundant under grazing pressure) such as bottlebrush squirreltail (*Sitanion hystrix*), bulbous bluegrass (*Poa bulbosa*), Sandbergs bluegrass (*P. sandbergii*), rabbitbrush (*Chryosthamnus spp.*) and other less desirable species have all increased in relative abundance.

Within these lower and drier portions of the watershed, present rangeland conditions (that is value for foraging livestock) are generally fair to good, with some intermingled areas of poor condition. The primary poor condition sites are those areas that are dominated by exotic herbaceous species like medusaehead grass (*Elymus caput-medusae*), cheatgrass (*Bromus tectorum*), and various non-native forbs. These areas are located in the lowest portions of the watershed, that is near the mouth of Spencer Creek. The historic "openness" and accessibility to grazing animals of these areas coupled with the availability of water has undoubtedly lead to season long use for many decades and deteriorated the sites. Additionally, the condition of these areas may have been caused by poor sheep herding practices, that concentrated grazing and trampling pressure or by continuously bedding sheep bands on these areas. These areas have deteriorated ecologically due to past practices and, given the dry conditions and thinner soils present, will probably remain that way even if livestock were to be totally removed. (Note: the 1994 use pattern mapping showed little livestock use in these areas. There are few forage attributes to attract cattle, and the grazing lessee actively and regularly pushes the cattle into the higher portions of the Grub Springs allotment during the grazing season).

In 1994, field observations indicated that the upper elevation, moister upland portions of the watershed have a large component of Ross sedge and long-stolon sedge (*Carex pensylvanica*) present as the dominant herbaceous cover species. This would include the Red Fir, Lodgepole Pine, and Mountain Hemlock Zones, as well as some portions of the Mixed Conifer Zone. Although both sedges are site-adapted native plants, Ross and long-stolon sedge are known to be species that increase with grazing and timber harvest disturbances. These species also tolerate ground fires and rebound quickly after fire (Johnson 1993). Field observations in 1994 indicate that both species, in combination, are probably at higher composition levels than would be found under Potential Natural Community conditions, as described in applicable USDA Forest Service plant association descriptions (USDA Forest Service 1979). Although both species would be considered as low to moderately palatable forage species, they have been observed to be utilized by cattle in the area to a substantial degree and are considered to be key forage species on many of the moderate to higher elevation upland areas within the watershed.

A forage production inventory was performed as part of the USDA Forest Service "Range Analysis Narrative" for the Buck allotment. That analysis, done in 1993, contained the following observations regarding the upland conditions on the National Forest lands:

"The general range condition of the allotment is quite good as indicated by the lack of erosion, noxious weeds and annual vegetation. Most of the native perennial vegetation communities are still intact and relatively vigorous..... Excessive utilization of shrubs by grazing livestock does not appear to be a problem on the allotment. The key to achieving appropriate levels of utilization in the vegetation types present on the allotment is improving distribution of grazing livestock not reductions in allotment capacity..."

From the "Permanent Transect Summary" section, the report notes:

"...The lodgepole pine/huckleberry communities are much more variable in terms of vegetation rating from poor to good but are in good shape with respect to soil stability. Trend estimates for these communities were level."

Riparian

Although specific field data for riparian/ wetlands south of the National Forest boundary is unavailable, cursory field observations indicate that hairgrass is probably below Potential Natural Community composition levels. Other species, including the ones listed previously in the wet meadow discussion, above Potential Natural Community levels for most meadows in the watershed. Most sites, however, appear to be ecologically healthy and have not deteriorated to the point that the meadows are dominated by plant species that are either undesirable, noxious, and/or not conducive to a healthy functioning ecosystem. This is confirmed for National Forest lands in the "Range Analysis Narrative", summarized later.

A "Proper Functioning Condition" determination was performed in June 1994 by a BLM interdisciplinary team of resource specialists on two sections of Spencer Creek. Both sites were on BLM-administered lands and located north of the Spencer Creek Hookup road. One was a 1/2 mile reach just north of the Hook-Up road and another 1/2 mile reach about 1 mile above the first site. Both areas were rated as in "Properly Function Condition" with "Upward" or "Stable" trends. Although the Proper Functioning Condition is not inclusive of every possible function or attribute of a riparian area, and is a subjective "professional" evaluation, it nonetheless indicates that the conditions are in an acceptable state at present.

A Weyerhaeuser Company watershed analysis identified areas of livestock related erosion concern. These areas were located mostly in the lower 5 miles of the Spencer Creek drainage, along the riparian corridor, with a short section of concern in the lower reaches of the Clover Creek drainage zone (Weyerhaeuser 1994). Weyerhaeuser Company's analysis of the erosion problems (that is, mostly fine sediment in the creek) found that although cattle grazing contributed to the problem, it could not be precisely quantified. They attribute 86 percent of the fine sediment problem to the roads in the watershed that are parallel to or in the stream channels. What cattle do contribute to the sediment problem in the creek system is predominantly attributed to the intense grazing occurring on Buck Lake. There are smaller amounts of cattle grazing and trampling on Weyerhaeuser Company owned meadows in the lower portions of Spencer creek also contributing to the problem.

The forage production inventory performed as part of the USDA Forest Service "Range Analysis Narrative" for the Buck allotment, done in 1993 contained observations regarding the riparian conditions on the National Forest lands. In summary:

"...The general range condition of the allotment is quite good as indicated by the lack of erosion, noxious weeds and annual vegetation. Most of the native perennial vegetation communities are still intact and relatively vigorous. The abundance of transitory forage produced as result of timber harvesting has probably served to help maintain the vigor of the meadow, riparian and lodgepole pine vegetation types by providing additional forage for grazing livestock and wildlife. The general trend of the allotment, however, is probably level to downward as a result of the laissez-faire style of livestock management currently being implemented on the allotment. As the situation now exists livestock are allowed to utilize the allotment in the way that they always have. This results in utilization levels in the meadow and riparian vegetation types exceeding the 50 percent maximum level allowed for in the forest plan. In addition, the average residual vegetation height after the grazing season in these community types is probably less than the four inches suggested in the forest plan for riparian areas susceptible to erosion... The key to achieving appropriate levels of utilization in the vegetation types present on the allotment is improving distribution of grazing livestock not reductions in allotment capacity..."

From the "Permanent Transect Summary" section, the report also notes:

"...the hairgrass meadows and bluegrass riparian areas are generally in good condition with respect to both vegetation and soil stability. Site estimates of trend are generally level to downward primarily as a function of current management levels resulting in heavy utilization of the vegetation resource which may create the opportunity for the invasion of undesirable plant species.... The rush and hellebore community types rated either very poor or fair with respect to vegetation and fair with respect to soil stability. Trends for these community types were down for both vegetation and soil stability. Interpretation of condition and trend data for the 3-step clusters sampled must be accepted with caution for two reasons. First the forage rating guide we were given to summarize the data obtained was developed for the Central Oregon pumice region, hence it's applicability to the high Cascades may be somewhat suspect. Second, two of the sites sampled were not adequately represented by any of the communities described in the forage rating guide. The few-flowered spikerush and California false hellebore communities were the closest. It may be that these two communities (clusters) are in better ecological condition than indicated in the analysis when evaluated against more appropriate community descriptions."

Process of Change

General Upland Condition Considerations. Currently, there is debate over the definition of overgrazing. There is a difference in grazing pressure that results in secondary succession and grazing that results in destructive changes or deterioration of site potential. Changes in grazing regimes may result in relative decrease of some plants and increase of others as a direct or indirect effect of grazing. The plants that decrease may be overgrazed, but the range as a whole is not necessarily overgrazed. In fact, vegetation change may enhance the value or productivity of vegetation for some uses. For example, sheep could be used to graze shrubs to allow more grass growth for wildlife forage. A range should be referred to as overgrazed only when grazing is done in such a way that site potential will deteriorates, which is undesirable for all uses in the long run (Smith 1989). For example, within ponderosa pine/ Idaho fescue sites (similar to the Potential Natural Community type dominant in the lower Spencer Creek watershed) heavy grazing pressure on the understory vegetation can shift, apparently irreversibly, the vegetation structure to domination by cheatgrass and other undesirable grasses and forbs (Franklin and Dyrness, 1973).

Grazing animals, including wildlife and livestock, influence plant communities in several ways. First and foremost is through defoliation of the plants (Vavra et al. 1994). In addition, the mechanical action of hoof trampling also has effects on the constitution and temporal makeup of plant communities. Trampling effects can include the actual physical injury to seedlings and mature plants, compaction of the soil, and other impacts of variable intensity depending on the concentration of animals and specific site characteristics (Heady 1975). This is particularly true in areas of higher livestock concentrations, such as open meadows and riparian areas. These type areas also are increasingly subject to detrimental hoof action due to the wetter soils being relatively more fragile (this subject is covered more completely in other sections of this analysis).

Grazing use has effects on the carbohydrate reserves of individual plants through the amount of foliage removed, the timing of that removal, and the frequency of removal. As Vavra et al. (1994) state in their summary, "Highly important to rangeland use is increased understanding that a defoliated plant may react more to competition from surrounding nondefoliated individuals than to the biomass removed from it". Site adapted plants that are grazed, and in particular those that are heavily grazed, have a comparatively reduced survival rate and a competitive disadvantage. This is a concept that is of utmost significance in understanding grazing use and its effect on plant community composition. Numerous studies have shown that if plants are stressed beyond their capabilities they will not survive. Thus, excessive grazing (which is defined here as heavy use or more; see also the Grazing Use Section) prevents normal development and will eventually result in the decline of useful rangeland vegetation, or range condition (Stoddard et al. 1975). Conversely, slight to moderate grazing often has little if any detrimental effects and can often allow moderately deteriorated sites to slowly progress to a higher ecological condition (Vavra 1994, Stoddart et al. 1975). The above general statements about grazing impacts are true for both upland and riparian/meadow areas within the Spencer Creek watershed.

As an overriding general statement about rangeland conditions within the watershed, the more an area has been opened up via timber harvest or fire, the more the available forage amounts have increased. Fewer trees generally means more grass. Although an absence of trees allows a general competitive advantage to remaining shrub and herbaceous species, it is probably the increase of light reaching the forest floor that most stimulates the increase in forage-producing species (Humphrey 1962). Conversely, the denser the tree canopy cover, the fewer forage species there will be. Similarly, the more areas are dominated by shrub cover, the less forage is available. Shrubs are vigorous in their competition with grass and forb species in the Spencer Creek watershed. Cattle are first and foremost grass eaters; shrubs and forbs make up proportionally very little of their diet (Heady 1975, Stoddart 1975). Since cattle are currently the only domestic herbivore in the watershed, grasses are disproportionately impacted.

The general secondary successional trend of all the vegetation types within the watershed, from an ecological site potential viewpoint, is from herbaceous (grass/forb) dominated "early seral" communities to shrub dominated communities (also considered "early seral") to a succession of coniferous tree communities culminating in a particular tree dominated climax seral stage (Potential Natural Community). (See the vegetation discussion in the Vegetation Section for more information on forest succession. The earliest communities are the most productive from a livestock grazing point of view, with the old growth forest communities being of minimal grazing value. Other important attributes of these communities are addressed in other sections.

Documented observations and research have shown dramatic differences in forage production in forest communities as they progress from early seral stages to late successional vegetative communities. For example, Covington and Moore (1994a) found that as the amount of basal cover of trees in ponderosa pine dominated ecological sites increase (17 square feet to 154 square feet), that there was a dramatic decrease in herbage production (1,134 pounds per acre to 114 pounds per acre). Similar effects would be expected in other forest vegetative ecological site types, like those found at all elevations within the Spencer Creek watershed.

After forest lands are entirely cut-over (or burned-over), most follow fairly uniform successional trends. Annuals and short-lived perennials immediately dominate the site. These are then followed by a perennial vegetative cover in 5 to 12 years. Much of that perennial cover is shrubby, and if the area is not reburned, a coniferous forest gradually will suppress and replace the brush if a seed source is available (Pechanec 1948). Pechanec was referring to Douglas-fir lands, but also stated that with this successional trend, the period during which cut-over or burned lands are grazeable is short. Only during the first 3 to 7 years is much forage available. Then it can be expected to dwindle because of the encroachment by shrubs and tree growth until in 11 to 15 years little grazing use is possible. This would be representative of the higher and moister portions of the watershed, including the Lodgepole pine, Red Fir, and Mountain Hemlock Zones. Additional observations, in areas similar to the mixed conifer zone, have shown that after opening similar forested areas in Washington State that were herbaceously dominated by pinegrass, good forage conditions lasted between 10 and 20 years (USDA-Forest Service 1994). However, in the lower and drier portions of the Spencer Creek watershed, including the Ponderosa Pine Zone and portions of the lower/drier Mixed Conifer Zone, the Covington and Moore (1994a) studies suggest that the successional process of going from grazeable grass areas to closed, non-grazeable areas would take 3 or 4 times (40 to 80 years) as long to occur. This is because of the limited moisture regime and resultant reduced vegetative response potential.

As a practical matter, the use of grazing animals to suppress or enhance certain types of vegetation has been used in this watershed in the past. Of note, is the use of cattle to suppress the herbaceous vegetation in tree plantations in order to give the young trees a competitive advantage and speed their maturity. Within the Ponderosa Pine Zone, particularly in the higher and moister areas, heavy grazing can favor the competitive advantage of shrubs at the expense of the grass cover (Franklin and Dyrness 1973). In addition, sheep have been used similarly to suppress shrubby, as well as herbaceous, vegetation in order to enhance commercial tree growth. This occurred primarily on private timber lands.

General Riparian Condition Considerations. Livestock grazing can be a compatible use in riparian areas when managed with multiple use land management objectives and when the functions of the riparian system (sediment filtering, bank building, water storage, aquifer recharge, energy dissipation), potential of the site, and needs of the riparian vegetation guide the development of the grazing management prescriptions.

Livestock grazing in riparian areas, however, may not always be entirely compatible with the other resource uses or the maintenance of other resource values. In riparian areas, where soils are unstable, the vegetation structures are fragile, threatened or endangered plants and/or animals are present, fisheries or recreation values are high, or municipal watersheds are involved special livestock management prescriptions must be applied. In some cases, the exclusion of livestock grazing may be the most logical and responsible course of action. That exclusion needs to be sufficient in time to achieve a level of recovery and stability that can support grazing in the context of the management objectives.

The compatibility of livestock grazing in riparian areas depends on the extent to which grazing management considers and adapts to certain basic riparian area ecological relationships. According to the BLM's Riparian Area Management Technical Reference 1737-4 (USDI-BLM 1989) "Grazing Management in Riparian Areas", the grazing effects on the following landscape characteristics should be understood prior to developing grazing management prescriptions in riparian areas:

- ♦ Natural functions of riparian ecosystems
- ♦ Growth, and reproduction of both woody and herbaceous plants on the site
- ♦ Dependency by other animals (mammals, fish, birds, and amphibians) on riparian areas
- ♦ Hydrologic and geomorphic conditions and processes
- ♦ Soils
- ♦ Water Quality

Part of the purpose of this watershed analysis is to make those analyzes and determinations and to make management recommendations based on that analysis; please see the appropriate sections of this document for more specific information.

The BLM's method of assessing whether a riparian-wetland area is properly functioning is through a process known a "Proper Functioning Condition" assessment. This process is thoroughly described in the BLM's Technical Reference 1737-9 (USDI-BLM 1993). This assessment was done on the portions of Spencer Creek within the BLM's administration and the results described previously.

Grazing

General

This discussion covers livestock use distribution and general utilization levels within the watershed area. Presently all livestock use is by cattle. Plant utilization by livestock, including mechanical impacts, is the primary "process of change" for livestock. Problems areas are where management actions should be focused, therefore the following narrative focuses on those areas.

A use pattern map was prepared in October 1994 by the BLM, for the lands in the watershed south of the National Forest boundary (Grub Springs and Buck Lake allotments). Utilization pattern mapping records and illustrates the use made by all grazing animals, up to the date of reading, for broad areas of the rangeland. Use is recorded within six utilization classes:

- ♦ No Use
- ♦ Slight Use
- ♦ Light Use
- ♦ Moderate Use
- ♦ Heavy Use
- ♦ Severe Use

Mapping the utilization patterns involves traversing the allotment or pasture to obtain a general understanding of how the vegetation has been utilized and the spatial patterns of the utilization. For analysis purposes, the patterns are delineated on a 7.5 minute U.S. Geological Service topographical map (also see Map 4) as broad zones of similar utilization impact. Such maps provide a key portion of the data necessary to make grazing management changes based on where problems exist and, as important, where they do not. Most of the specific observations which follow, except on the National Forest (or as otherwise noted), are based on the use pattern mapping. (Note: Information on the lands north of the National Forest boundary are covered at the end of this section and are based on the previously mentioned "Range Analysis".)

In general, utilization patterns of cattle grazing remain very constant over time, unless significant changes in management occur. It is believed that the 1994 use pattern map accurately represents the typical patterns of what occurred in the past and what could be expected in the future with the current grazing management systems.

On file in the BLM office is a copy of the small scale utilization map made in September of 1987, when livestock use levels were higher than at present. This map shows that approximately 10 to 15 percent of the Grub Springs allotment was heavily used, but none of the heavy use was within the Spencer Creek watershed. All of the use within the Spencer Creek watershed was listed as light to moderate. See Maps 3 and 10 for a visual display of the areas described.

Upland

As a general statement, the vast majority of the watershed area receives limited livestock grazing. Almost all areas in the uplands receive light, slight, or no use on dominant herbaceous plant species, even the more palatable ones. The majority of the area receives slight or no use. Little utilization by cattle is made on upland shrub species, although in some years, dry, late-season conditions can encourage cattle to begin eating some brush species. Easily observable grazing use made in the watershed tends to be in lower, moister areas (meadows and riparian areas) and around the watering facilities.

The October 1994 use map showed that, although a large amount of the forage intake comes off of the upland areas (because they make up 95 plus percent of the watershed) the areas where the utilization is most obvious is made in lusher meadow and riparian areas and/or around the scattered livestock watering areas. Given typical bovine behavior patterns, the observed distribution patterns, if not the levels of use observed in 1994, are probably typical of what has been made historically by cattle. Due to drought conditions 1994 was a poor growth year. Thus, utilization levels were probably proportionally higher in 1994 than would have been observed in an "average" year even though livestock numbers remained the same. In contrast, the number of cattle grazed in the lower portions of the watershed (Grub Springs allotment) are at a recent historical low, as described previously, resulting in overall lighter grazing pressure than found in the past.

An exception to the above use pattern discussions would have been with the sheep grazing of years past. Since sheep are typically herded, grazing patterns are largely dependent on the way the sheep herder moves the sheep. Sheep grazing levels and patterns of the past are unknown. Sheep grazing is not anticipated in the future. It is safe to say, that the past sheep grazing affected the vegetation in various ways and contributed to the current makeup and condition of the rangeland vegetation communities, particularly in the lower watershed.

Riparian

In the lower portions of the watershed (the Grub Spring allotment, below Buck Lake to the mouth of Spencer Creek), Weyerhaeuser Company lands receive the majority of the grazing use. The Weyerhaeuser Company's "Spencer Creek Watershed Analysis" included a map of "Sites with existing or potential surface erosion from hillslopes due to cattle activity" (Weyerhaeuser 1994). The primary emphasis of the Weyerhaeuser Company analysis is with soil erosion problems and potentials, which deals indirectly with vegetation use by livestock. The analysis listed several areas "...where soil erosion from cattle was present." The majority of the area (acreage) indicated by Weyerhaeuser Company as having cattle related erosion problems was within Buck Lake itself; the area which has, by far, the highest concentration of livestock in the watershed. This is a function of the lake being owned by a private cattle ranch.

At the mouth of Spencer creek, Weyerhaeuser Company constructed an exclosure in the late 1980s that precludes livestock (and recreationists) access to the riparian zone. The result has been a substantial improvements in conditions, which are evident by the increased herbaceous riparian vegetative cover and number of vigorous willows. The October 1994 utilization mapping found the area outside this exclosure, where not heavily disturbed by recreational vehicles, to still have moderate use levels with some patches of heavy use. The rangeland conditions in that area (that is, within 2 miles of the creek mouth) were also judged to be poor. According to the areas grazing lessee, he spends a large amount of his riding time pushing the cattle from the mouth of the creek back up into the watershed's upland areas. Cattle have a natural inclination, late in the season, to graze their way downhill to the mouth of the creek (and also towards Keno) where there is ample water and apparently adequate forage (Hinton pers. comm. 1995).

Within the central portions of the watershed, on lands that are intermingled BLM and Weyerhaeuser Company, the October 1994 use pattern mapping found several areas of relative grazing concern. In the Clover Creek drainage, immediately north of the Spencer Creek Hookup road (see Map 7), some small areas of heavy use were noted in the combination wet/dry meadow just north of the livestock exclosure. This area is on Weyerhaeuser Company lands and currently about 2/3 protected by an existing livestock exclosure, which has been in place for some years.

In Spencer Creek, observations of the 1/2 to 2/3 mile of the creek bottom above the Spencer Creek Hookup road (primarily BLM-administered with some Weyerhaeuser Company lands) showed utilization as moderate, with some spots of heavy use on the herbaceous riparian vegetation. Use on the riparian shrub species was estimated at light or less. This use occurred late in the season (August) and was higher than desired due to the drought conditions, which forced the cattle into to the creek bottom more than typical (Hinton pers. comm. 1995). The grazing lessee spent ample time riding and herding the cattle back to the upland areas. However, the cattle kept coming back to the creek bottom area which finally forced the lessee to totally remove his cattle in late August, 2 or 3 weeks earlier than his usual removal date. The cattle were moved before they were forced to graze the riparian shrubs. This segment of Spencer Creek has a relatively wide (100 plus yards in some places) and flat floodplain area that offers attractive late season vegetative characteristics. Information from the grazing lessee combined with the observation that the area is presently in good overall vegetative condition, indicates that cattle grazing in the area in the recent past was probably lighter than what was observed in 1994.

Patchy, light to moderate use of the herbaceous riparian/creekside vegetation was noted along scattered stretches of Spencer Creek in the 2 to 3 miles of creek below Buck Lake, and upstream from the area described in the previous paragraph. This Buck Lake segment of Spencer Creek is a mixture of USDA Forest Service and BLM-administered and Weyerhaeuser Company lands. Little use was noted on riparian or upland brush species. Much of this segment of the creek is narrow and rocky, with only occasional portions that have attributes that are attractive to grazing cattle.

Observations were also made on the Miner's Creek drainage. This is a small, intermittent tributary drainage of Spencer Creek, which converges with Spencer Creek about 1/3 of a mile south of the Spencer Creek Hookup road crossing. Some slight/light use levels were noted in and adjacent to the drainage in the lowest 1 mile of Miners Creek. Minimal cattle grazing use was noted above that point, except in the immediate vicinity of a private land stock watering pond located in the drainage just below one of the springs in the extreme upper reaches of the creek. This spring(s) is one of the primary perennial water sources for Miners Creek and is used largely by Charley Livestock Company.

The use in the Buck Lake private lands is as expected for an intensive livestock production operation. Utilization levels and other cattle related impacts are relatively high. Productivity of the area is also high due to its wet meadow characteristics and season-long growth potential.

Within the BLM's Buck Lake allotment use levels were largely slight use, light use, and no use in the majority of the area. The primary exception was light to moderate use levels within a mile or so of Buck Lake, with a few very small areas of heavy use. The one heavy use area of note was on the privately owned land in the upper portion of the Tunnel Creek meadow/swamp (immediately southwest of Buck Lake). Similarly, there is also moderate, to occasional heavy, use on noted within the drier, peripheral areas immediately adjacent to the Tunnel Creek meadow. It appears that the main bulk of the Tunnel Creek meadow/swamp gets little grazing use due to its very wet nature. Also noted was some moderate use in the vicinity of the Surveyor Creek campground (BLM) and east from there through a meadow "glade" (on private lands). Both of these areas are just outside of the watershed.

On the USDA Forest Service-administered (and intermingled Weyerhaeuser Company) lands, north of the National Forest boundary, utilization patterns have not been specifically mapped but observations and key area utilization information is available (Pruyn-Sitter 1995; USDA Forest Service 1993). As with other areas of the watershed, the "problem" areas are in the open, flatter, moister meadow and riparian areas. As the USDA Forest Service "Rangeland Analysis" notes, "[Current grazing management allows] ...utilization levels in the meadow and riparian vegetation types (to) exceed the 50 percent maximum level allowed for in the forest plan. In addition, the average residual vegetation height after the grazing season in these community types is probably less than the four inches suggested in the forest plan for areas susceptible to erosion" (USDA-Forest Service 1993).

The "Rangeland Analysis" gives the following general description of utilization patterns on the allotment:

"Little in the way of topographic features exist on the allotment to influence livestock utilization patterns other than steep slopes in the northeast corner of the Burton Butte Buck Meadow areas and the eastern end of the Buck Indian area and a few small isolated areas in both areas. If livestock congregate in the small canyon on the south end of Clover creek, they may drift off the allotment to the south if the canyon is not fenced. Other features related to topography which influence livestock utilization patterns on the allotment include the presence of dense shrubfields on many of the south and west facing aspects in the allotment. These shrubfields are composed of relatively unpalatable species as greenleaf manzanita and snowbrush which limit both livestock access and the amount of palatable forage produced in these areas. Depending upon the rate of snowmelt, many low-lying areas within the allotment are flooded or have saturated soils when the cattle are turned out. These areas include some of the meadows as well as areas within the lodgepole pine forests."

Specific meadow/riparian grazing utilization problem areas have been identified in the following USDA Forest Service areas: the meadow area directly north of Buck Lake, in the Muddy Springs area (west central allotment), Desolation Swamp (central allotment), along Spencer Creek just below Buck Lake to the exclosure, and within the upper reaches of Clover Creek (east central allotment). Due to the dry conditions of the last three years, the meadow area just north of Buck Lake has been receiving significantly more use than what has been noted in the past (Pruyn-Sitter 1995). In addition, the Muddy Springs area is usually the first area to reach the maximum utilization levels (that is 50 percent); an event which has occurred in mid-September the past few dry years. At that time the permittee usually begins removing his cattle, in bunches, from the specific problem areas.

Trends

USDA Forest Service. The following discussions is broken down by major land ownership. In summary, the "Range Analysis Narrative" (USDA Forest Service 1993) states that "The general range conditions are quite good as indicated by the lack of erosion, noxious weeds and annual vegetation. The general trend of the allotment, however, is probably level to downward as a result of the laissez-faire style of management...".

BLM. The following summary of BLM lands could also be applied to some extent to the USDA Forest Service-administered lands (with the exception of the xeric site discussion). The trend in forest community ecological conditions are expected to be upwards or positive in the years to come, due largely to the current federal land management policies of increasing the amount of federal lands exhibiting mid to late seral (old growth) conditions. From a livestock forage production perspective this would be a downward trend since forested communities in later seral stages tend to have less herbaceous vegetation than at earlier stages. Whether the reductions in the herbaceous component of these communities would be dramatic enough to force reductions in livestock use is not known for sure at this time. It is estimated though, that there would still be an ample forage base available to maintain the current, relatively limited, livestock numbers. This is, however, largely dependent on the amount of timber harvesting allowed over time.

Within the more xeric forested sites, the BLM emphasizes allowing the ponderosa pine dominated ecological sites (at Potential Natural Community) to reestablish their historic late-seral, open "park like" structure. This enhances livestock forage conditions since the dominant understory species for this type of forest community are palatable perennial grasses and shrubs. Pre-settlement conditions are not completely attainable due to the permanent inclusion of some new plant species, both exotic and native, that were present in the pre-European makeup of these plant communities. Other species were present, but have increased in range or abundance. Cheatgrass and bottlebrush squirreltail are examples of exotic and native plants, respectively, that were not present or rare in the past ponderosa pine communities. They are expected to persist in the future regardless of any changes in livestock management practices.

Riparian/wetland area long-term trends are expected to be largely static with some slightly ups and downs, depending on which areas are being considered and yearly conditions. Recent livestock use levels on BLM-administered lands have apparently allowed for the stabilization if not partial improvement of the riparian areas along the BLM-administered portions of Spencer and Miners Creeks. Although the historical conditions of these creeks can only be speculated on, the 1994 rating of the BLM-administered portions of Spencer Creek as properly functioning points out that the current grazing levels are largely compatible with the system.

Weyerhaeuser Company. Given the likely scenario that Weyerhaeuser Company lands will be managed for maximum timber production, the majority of their lands would be in early seral stages. This means that more than sufficient amounts of palatable herbaceous vegetation would be available on their lands for the numbers of cattle they currently allow to graze. With the historic low numbers of livestock being grazed on their lands at present, upland range conditions would be expected to improve over time. However, as noted for the BLM-administered lands, certain less desirable species will invariably become permanent components of the vegetation communities. The condition of the riparian/wetland areas is also expected to have an upward condition trend (due to the recent reduction in livestock use) with increased amounts of native sedges, grasses, willows, and other desirable species.

Charley Livestock Company. The condition trend in the Buck Lake area is expected to be static at best, with a probable downward trend due to the continued erosion problems associated with the intense livestock operations and the drainage system.

Summary

As a general statement, current grazing levels within the majority of the watershed are within appropriate levels and are not contributing to or aggravating significant ecological condition problems. The amount of forage made available from opening up timber stands far exceeds what is necessary for the number of cattle grazed, especially within the Grub Springs allotment portion of the watershed. It appears also, that the use of shrubs in both the upland and riparian areas is not a problem in this watershed. Where there are problems in upland areas, they are little related to current grazing.

There are, however, still areas of concern. The grazing related problems are all in riparian, meadow, and other wetland areas, but not all riparian/meadow/wetland areas have grazing problems. The biggest management concern is that virtually all of the water available for livestock is in riparian/wetland areas with the land owners/administrators preferring the grazing use in the dry, upland areas.

E. Noxious Weeds

Issue 8: Past and present land use activities may be contributing to the introduction, spread, and increasing density of exotic/noxious plant species.

Key Question: What exotic/noxious species are present in the watershed and what is their distribution?

Key Question: Where within the watershed is this a problem or a potential problem?

Key Question: Has the introduction of exotic/noxious plant species affected endemic populations of plants?

Key Question: What activities have been major contributors to the spread of exotic/noxious weeds in the watershed?

Historic Conditions

All of the noxious weed species that occur within the watershed are exotic (introduced) to North America, mostly from Eurasia. Therefore, these species were not present before Euroamerican settlement. Effects from these exotic species is therefore limited to post Euroamerican settlement.

Processes of Change

Many of the noxious weed species are well adapted to the environmental conditions associated with the disturbances that result from human activity. Some noxious weed species (such as knapweed from the Middle East) are even thought to have evolved with human disturbances as a primary selection pressure. The primary disturbances in the watershed that are associated with human activity include timber harvest, livestock grazing, road construction, and water diversion for irrigation. Disturbances associated with these activities include alteration of the soil surface and profile, compaction of soils, changes in microhabitat conditions, changes in fire frequency, and changes in hydrological regime. In addition to providing environmental conditions favorable for invasion by these species, human activities also provide dispersal mechanisms through machinery, equipment, livestock, and clothing and boots.

Current Conditions

Eight species of noxious weeds have been located on USDA Forest Service and BLM-administered lands within the watershed. Weed populations are primarily found in roadside habitats or past harvest units, and seem to be primarily associated with physical disturbance. The Winema National Forest Noxious Weed Environmental Assessment and the Klamath Falls Resource Area Integrated Weed Control Plan and Environmental Assessment address management of noxious weeds in the watershed area.

Along Dead Indian Memorial Road, a large population of spotted knapweed (*Centaurea maculosa*) has become established and has been spreading in recent years. St. Johnswort (*Hypericum perforatum*) is becoming established primarily along roadsides. Occasional individuals of diffuse knapweed (*Centaurea diffusa*), small populations of dalmatian toadflax (*Linaria dalmatica*), and patches of tansy ragwort (*Senecio jacobaea*) have also become established within the watershed.

Canada thistle (*Cirsium arvense*) has the potential to persist and spread after becoming established due to an extensive underground rhizome system. In addition to roadside patches, Canada thistle populations are known to be present in four harvest units on federal lands. Three of the units are recently planted clearcuts, and large thistle clones have developed in the open habitats. The fourth is an older unit where thistle plants are restricted to old skid trails and burn piles. A population of musk thistle (*Carduus nutans*) also occurs in the older unit, on similar microsites as the Canada thistle.

Bull thistle (*Cirsium vulgare*) is present on disturbed sites throughout the watershed area. It is often a dominant species in clearcuts, on landings, and on ripped units, where it persists for approximately 5 to 10 years following disturbance.

Trends

Human activity that physically disturbs a site provides the site conditions where noxious weeds have a competitive advantage relative to native species. In addition, most noxious weed species have been introduced intentionally or unintentionally by Euroamericans without the biological agents that may have reduced their ability to compete with other species in their areas of origin. Therefore, many of these species become established in areas disturbed by human activity, and are able to persist on the site since the biological control agents that may have defined their original successional role are absent. Invasion by noxious weeds and other exotic pest plants can reduce the diversity of plant communities and disrupt the ecological processes upon which these communities depend. These effects are expected to continue within the watershed to the intensity and extent that management actions create disturbed areas.

Summary

Many plant species and communities of concern have been affected by human activities. Changes in environmental conditions and the introduction of species can result in changes of species composition and distribution of both individual species and plant communities. Noxious weeds can affect the ecological processes that maintain native plant communities. Management actions are needed that are designed to reduce the level of disturbance usually associated with these activities, and designed to mitigate the impacts already present from past activities.

Landscape Section

A. Soil Productivity

Introduction

Both soil and non-soil factors influence soil productivity. Non-soil factors, such as geology, are not influenced by land management activities. Soil factors that can be modified by management activities include: structure; density; organic matter content and distribution; the amount, distribution, and continuity of soil pore space; soil moisture and temperature; the effective soil volume for root development and water, heat, and gas storage; nutrient content; and microbial activity. Determining the sensitivity of soils to management activities is an important first step in preventing or minimizing soil-related adverse effects and reductions in soil productivity.

Issue 5: Forest and range ecosystem health and resiliency has been altered in the watershed area.

Key Questions: Has long-term soil productivity declined within the watershed due to past management activities? If so, how?

Assumptions/Analytical Process

Using the Jackson County Soil Survey (SCS 1994) and the Winema National Forest Soil Resource Inventory (USDA Forest Service 1979), a soil map was created for the watershed. It was not included in this document due to its complexity, although copies are available in Geographical Information System upon request. Each soil present in the watershed was evaluated for its susceptibility to surface erosion, compaction, and displacement. Evaluation was based on specific soil factors and their contribution to the soil's physical ability to withstand land disturbing management activities.

The types of land management activities determined to have the most potential for impacting soils in this watershed are road building and timber harvest. These activities are addressed in this analysis. Although adverse impacts to soils have occurred from recreation activities, livestock grazing, and mining (gravel and cinder pit development), the effect of these activities do not have the cumulative extent and impact in this watershed as do road building and timber harvesting. Recreation, mining, and livestock grazing can have severe local impacts, particularly if the impact occurs in a riparian or wetland area; however, these impacts are best analyzed at the site-specific planning level.

No attempt was made to quantify the acreage in the watershed impacted by the various land management activities. Almost all of the forested land in the watershed outside of the Mountain Lakes Wilderness has been entered at least once for timber harvest. The type of harvest, design of the skid trail and road system, the soil conditions present during harvest, and the type of site preparation have varied. Records describing the types of management activities over time exist for federal land. Such records for private lands are not readily accessible. The extent to which soil productivity has been affected in the watershed by management activities has not been quantified, due to the lack of research on the subject conducted in the area and the lack of on-the-ground surveys with which to quantify the extent of impacted soils. This analysis discusses the likelihood of whether or not impacts have occurred, based on the type of activities commonly implemented and on the characteristics of the soils upon which they are implemented. Quantification of effects is expected to occur at the site-specific planning level.

An assumption was made that most of the privately owned forest lands will continue to be managed for intensive timber harvest.

Analysis Discussion

Historic Conditions

Because the watershed is comprised of gentle slopes and generally stable soils, it is likely that little erosion and virtually no land sliding occurred in undisturbed areas. Wildfire was the primary agent of disturbance prior to Euroamerican settlement (Hungerford et at. 1990; also see the Terrestrial section vegetation discussion). Fire has played an important role in the nutrient dynamics of the watershed soils, particularly in the ponderosa pine vegetative zone. Wildfire, when it occurred in the watershed, could have affected productivity in burned areas. Wildfire in the middle to upper portions of the watershed was likely a more severe, stand-replacing event, while fire in the lower portion of the watershed was probably less severe, due to a more frequent return interval that kept fuel loadings lower (see vegetation section).

Fire affects soil productivity because organic matter located on or near the soil surface is burned. Some nutrients are volatilized and lost to the atmosphere, but some nutrients are made more available with fire. Fire acts as a rapid mineralizing agent that releases nutrients instantaneously compared to natural decomposition processes, that may take years or decades (DeBano 1990). Wildfire would have resulted in the loss of soil cover in burned areas, which would have made the soil more susceptible to surface erosion. However, due to gentle slopes and the buffering action of riparian areas and wetlands, any erosion that occurred is assumed to have caused in significant off-site impacts.

The watershed has experienced grazing by cattle, sheep, and horses since the first recorded homestead was established in 1867 (see Social section for more information). The numbers of livestock are not well recorded, although it is known that sheep grazed throughout the watershed until the 1940s when cattle grazing became dominant in the upper to mid watershed. Sheep grazing occurred in the lower watershed into the 1970s (see Social section). Livestock grazing was dependent on the existence of openings in the forest canopy, which would allow for adequate forage production. Natural openings were likely more abundant in the lower watershed, where wildfire was more active. Thus, until openings were created by wildfire or human activities (timber harvest, creation of clearings through fire), much of the grazing was probably centered in the lower watershed where the least productive soils occur. The main impact from livestock grazing was probably loss of soil cover, although compaction and altered nutrient cycling likely occurred to a lesser extent. Because livestock numbers are currently at a 50 year low in the watershed, it is likely that the highest level of impact from livestock grazing has already occurred.

As of 1945, about 28 percent of the watershed had already been entered for timber harvest, mostly in the lower portion on private land. Harvest was mostly selective, with a system of roads and rail lines built to transport the logs. Limited harvest on Federal lands began in the 1940s, with activity peaking during the 1970s and 1980s. Within the last 40 years, various types of harvest have occurred, with varying intensities. Many areas have been entered two or more times, particularly in the ponderosa pine and mixed conifer vegetative zones (see Vegetation section). Throughout the watershed, yarding has been mostly ground-based, with an extensive network of skid trails and roads. Site preparation methods have also been varied. Tractor piling has been commonly used, with scarification, ripping, and broadcast burns also occurring. Activity during a wide variety of soil conditions has occurred, and prior to more recent changes in management direction, operating during wet soil conditions was probably a common occurrence.

To summarize, the condition of the various soil factors and, therefore, the productivity of soils in the watershed had already been adversely affected prior to 1945, particularly in the lower portion of the watershed. Peak activity in the watershed occurred in the 1970s and 1980s. High levels of activity continue on private lands. Recovery of soil factors from adverse impacts would have occurred to some extent through natural processes; however, many areas have been re-impacted several times in different ways. Thus, it is not likely that impacted areas have recovered to the extent that full site potential and soil productivity have been restored.

Current Conditions

The physical soil properties (factors) affecting site productivity include bulk density, organic matter content, porosity, and texture. The disturbances that impact soil factors include compaction, surface mixing and disruption (known as displacement), fire (primarily through loss of soil cover and consumption of organic matter), and soil erosion (Childs et al. 1989). Information about these soil factors was gathered to decide which soil factors determine the susceptibility of a soil to losses in productivity resulting from the disturbances associated with the two dominant land management activities in the watershed, timber harvest and road construction. A discussion of these soil factors and the effects of these disturbances on them is given below. A discussion of how these disturbances result from land management activities is given in the Process of Change discussion below.

Bulk density (the mass of dry soil per unit volume) is related to porosity (the volume of pores per volume of soil). Soil porosity, which is a function of pore size and distribution, influences soil-water relationships, aeration, and mechanical resistance to root penetration (Childs et al. 1989). Organic matter within the soil is an important source of nutrients for vegetation. Soil microbial populations slowly decompose the organic matter, releasing nutrients. Soil organisms also affect productivity by providing protection against pathogens, maintaining soil structure, and buffering against moisture stress (Amaranthus et al. 1989). Organic matter acts as a mulch to retain soil moisture and is key to maintaining good soil structure. The mulching effect of organic matter also reduces surface erosion by lessening the effect of raindrops, which tend to dislodge soil particles (Amaranthus et al. 1989). Soil texture (the relative proportions of sand, silt, and clay) determines certain soil characteristics such as soil structure. Management activities have no effect on texture, but they can affect the structure. Structure, in turn, influences soil characteristics such as water availability and movement, heat transfer, aeration, bulk density, and porosity (Childs et al. 1989).

Soil compaction is the process whereby soil pore space is reduced and bulk density is increased through physical pressure and vibration of the soil surface. Compaction results in reduced water infiltration and gaseous and nutrient exchange rates thus potentially reducing plant growth (Childs et al. 1989 and USDA Forest Service 1989). Physical resistance to root growth can occur with high bulk densities. Compaction can also cause short-term decreases in soil microbial populations (Childs et al. 1989).

Soil displacement is a process in which a portion or all of the surface soil is moved by mechanical action. This may affect plant growth (depending on the extent to which the soil has been moved or churned) through the removal of nutrients and soil organisms and by reducing available water and rooting depth (Childs et al. 1989). Displacement can result in the alteration or destruction of surface structure by reducing the amount of pore space and connectivity and the aggregation of individual soil particles into a larger group. If displacement occurs when the soil is wet, "puddling" may result, which can create a soil surface that is hard and sealed against water and gaseous exchanges.

Fire directly affects soil by consuming organic matter, altering nutrients, creating water-repellent conditions, decreasing infiltration rates, and removing soil surface cover (Hungerford et al. 1990, DeBano 1990, and Childs et al. 1989). Although fire generally causes short-term effects, it can create a harsh environment for reforestation. Where soils are shallow and have low natural fertility or are susceptible to erosion, fire can have a more significant effect on productivity.

Surface soil erosion (which includes sheet, rill and gully erosion, and dry raveling) is the detachment and downslope movement of individual soil particles or aggregates, It is caused by the energy of rainfall and running water acting on bare soils, or by surface disturbance on steep slopes. Freezing and thawing, especially on a daily basis, can cause considerable erosion on disturbed ground. This is particularly apparent in road cutbanks and areas with exposed soil. Removal of soil cover can greatly increase the potential for surface soil erosion (Baker and Jemison 1991).

To determine whether impacts to soil productivity have occurred, soils in the watershed were evaluated to determine whether they were susceptible to disturbance. If a soil is susceptible to a particular disturbance and that disturbance is known to have occurred on that particular soil, then it is probable that productivity has been adversely impacted to some degree. The susceptibility of soils in the watershed to compaction and surface erosion were assessed. The susceptibility of the soils to impacts from fire was not deemed critical to assessing current conditions because of its suppression in the watershed for many years and the currently low levels of prescribed fire activity. Also, in most areas organic matter is likely to be above pre-1899 levels (wildfire still occurred at that time; see Terrestrial section) and populations of microorganisms are assumed to have recovered from any past fires. Displacement susceptibility was not directly assessed. That is due to a lack of information on which particular soil factors affect a soil's susceptibility to displacement, and the interrelationship of displacement and compaction effects in much of the literature and information available. However, the Winema National Forest Soil Resource Inventory contains information relating a soil's displacement susceptibility to its coarse fragment (rock) content and slope. Based on this relationship, each soil's susceptibility to displacement was estimated and should be considered when planning land management activities.

The factors used to determine susceptibility to compaction and erosion were: runoff/erosion hazard (provided by the Jackson County and Winema National Forest soil surveys), hydrologic group, K factor, equipment hazard (provided by the Jackson County and Winema National Forest soil surveys), the overall soil depth, slope, percent of coarse fragments and the surface texture (0 to 11 inches). Refer to the Glossary for a definition of these terms.

The selection of factors for rating erosion susceptibility came from information contained in the Aquatic Section of this document and from the soil surveys, which utilize Universal Soil Loss Equation type assessments. The K factor (which is often determined using a nomograph incorporating soil texture, organic matter content, soil structure, and permeability) and slope are the dominant determinants for erosion susceptibility in this area and form the basis for the Universal Soil Loss Equation (see Appendix 4).

The selection of factors for rating compaction susceptibility was based on information contained in the Winema National Forest Soil Resource Inventory, the Jackson County Soil Survey, and an article entitled "Basic Soil Interpretations for Forest Development Planning: Surface Soil Erosion and Soil Compaction" (Carr, Mitchell, and Watt 1991). The dominant determinants for compaction susceptibility are coarse fragment content and surface soil texture.

It must be noted that the susceptibility rating is used to assess the risk that impacts to soil productivity have occurred from management activities in the watershed. Whether or not the adverse impact actually occurred is dependent on whether protective measures such as Best Management Practices were prescribed and followed.

A map of soils in the watershed was created and digitized into Geographical Information System, using the Jackson County Soil Survey and the Winema National Forest Soil Resource Inventory as base maps. The soils map for the watershed is located in the Geographical Information System electronic files. A list of soils and the acreage of each was derived from Geographical Information System. Values for the factors discussed above were obtained for each soil type from the two soil surveys. A list of the values for each factor and soil type is given in Appendix 4. The overall susceptibility rating for each soil type to productivity losses from compaction, displacement, and surface erosion is listed in Table 22. Susceptibility was ranked as being high, medium, or low. Acres in the watershed of each susceptibility

Table 22. Susceptibility Ratings for Surface Erosion, Compaction, and Displacement

Soil Type	Acres	Surface Erosion	Compaction	Displacement
10	295	L	M	M
11	2,138	L	M	M
129B	24	M	M	M
135E	2,466	M	M	M
135G	282	H	H	M-H
136E	701	M	M	M
137C	908	L	M	M
138C	3,518	L	M	M
13C	2,382	L	M	M
13E	106	M	M	M
145C	2,963	L	M-H	M
147C	5,985	L	M-H	M-H
202F	91	H	H	M-H
203F	118	H	H	M
204E	1,437	M	H	M
205E	2,025	M	H	M
4	449	H	L	L
6P	12	L	L	L
79E	199	M	M-H	M
80E	1,146	M	M-H	M
85A	1,665	L	H	M
99A	478	L	H	M
R1	5,850	L-M	M	M
R10	453	L	M	M
R11	613	L-H	M	M-H
R1R3	1,178	L	M	M
R2	109	H	M	M-H
R3	291	L	M	M
R4	5,524	L-M	M	M
R5	780	H	M	M-H
R6	2,285	L	M	M
R7	184	H	M	M-H
R8	3,629	L-M	M	M
R8R10	827	L	M	M
R9	712	H	M	M-H
X2	1,120	L-M	L-M	L-M

L = Low M = Moderate H = High

Table 23. Acres in Each Susceptibility Category for Surface Erosion and Compaction

Susceptibility Category	Surface Erosion (Acres)	Compaction (Acres)
High	3,158	16,272
Moderate	23,860	35,362
Low	25,007	462
Unclassified	1,228	1,228

rating for compaction and erosion are listed in Table 23. Maps 17 and 18 display the distribution of soils in each rating for erosion and compaction, respectively.

Process of Change

Suppression of fire in the watershed has allowed for organic matter levels in the soil to increase in some areas, probably to levels higher than were present prior to fire suppression. However, in areas where scarification, tractor piling and burning, or prescribed burning have occurred, organic matter may have been reduced to levels at or below those present before fire suppression occurred. Reductions in organic matter from these activities would have to be assessed on a site-specific basis, due to the variability of site conditions prior to management and the management practices that have been implemented. The forest health problem in much of the watershed creates a concern that severe wildfire could occur, which would cause severe reductions in organic matter and surface cover.

Appendix S and pages 4-11 through 4-16 in the Klamath Falls Resource Area Proposed Resource Management Plan and Final Environmental Impact Statement and pages 4-91 through 4-94 in the Winema National Forest Land and Resource Management Plan and Final Environmental Impact Statement discuss the effects of compaction, displacement, and loss of soil cover on soil productivity and the soil resource in general. That information is summarized in this analysis. Based on a review of these documents, some generalizations can be made regarding the level of impact to soil productivity various timber harvest practices (including road construction) could have. These impacts could be mitigated and/or reduced if Best Management Practices are prescribed and implemented for these activities. The level of impact would also vary depending on the condition of the soil before and during activity implementation. A summary of these activities and the generalized impact level each has on soil productivity is given in Table 24. This is a list of the activities that have or are likely to occur in the watershed.

Of the changes to productivity that could result from the activities listed in Table 24, tractor yarding and road building have likely caused some losses in productivity throughout the watershed. The road density in portions of the watershed is high (see the Terrestrial and Aquatic sections). Roads

Table 24. Levels of Disturbance Resulting from Various Forest Management Activities (by disturbance type)

Activity	Loss of Surface Cover	Compaction	Displacement	Overall Disturbance
Hand Felling	L	L	L	L
Mechanical Felling	L-M	M-H	L-M	M
Cable Yarding	L	L	L	L
Tractor Yarding	M	M	L - Slopes <30% M - Slopes 30-65% H - Slopes >65%	M
Scarification	H	M	H	H
Hand Pile	L	L	L	L
Excavator Pile	L	L-M	L	L
Machine Pile	H	M	H	H
Broadcast Burn	M	L	L	L
Ripping (rock ripper)	L	L	M	L
Ripping (winged ripper)	L	L	L	L
Road Construction	H	H	H	H

L = Low M = Moderate H = High

cause direct on-site impacts to soil productivity by creating a compacted surface and disturbed areas where the cut and fill has occurred. Tractor yarding has occurred in a large portion of the watershed and, in instances, over the same area several times. Tractor yarding requires a network of skid trails that can cover a large portion of a harvest unit. Federal land administrators in the last 25 years or so have attempted to reduce the impact of tractor harvesting on soils through the prescriptions and implementation of Best Management Practices. However, it is likely that impacts to soil productivity have still occurred after the implementation of Best Management Practices due to the following factors: repeated entries into the same stand; the difficulty of restricting the extent of the skid trail network when selective harvest occurs or when a mechanical harvester is used; the difficulty in reducing existing compaction because of the high number of rocks in some of the soils; and the common use of rock rippers to reduce existing compaction instead of a winged subsoiler, which is more effective at breaking up compacted soil without churning it.

Growth losses of 4.8 percent have been factored into models of timber yields for BLM-administered lands. These models, used during preparation of the Klamath Falls Resource Management Plan and Final Environmental Impact Statement, are discussed in the document entitled *Managed Stand Yield Tables-Silvicultural Systems for the Retention of Biological Diversity, Klamath Sustained Yield Unit* (Pierle and Lewis 1991). The impacts from tractor yarding were deemed significant enough to quantify a reduction in yields (4.8 percent). This figure was based on the assumption that an area occupied by skid trails and landings is normally 12 percent or less when designated skid trails are used, and that a growth loss of 5 percent can be anticipated if 12 percent of the harvested area is compacted. The average of the land base subject to tractor logging is 95 percent; thus the reduction is 4.8 percent instead of a full 5 percent. The 4.8 percent reduction does not take into account additional productivity losses from site preparation methods or for when more than 12 percent of a harvest area is impacted by skid trails and landings.

It is not known whether growth losses from compaction are accounted for on USDA Forest Service and non-federal-administered lands. Also, it is not known what Best Management Practices or similar project design features are implemented to reduce productivity losses by non-federal landowners in the watershed during timber harvest activities.

Map 17 shows that the majority of the watershed is rated as having either a low or moderate susceptibility to productivity losses from surface erosion. Much of the area in the moderate risk category is federal land, a portion of which is located in the Mountain Lakes Wilderness Area. Both the BLM and USDA Forest Service implement Best Management Practices and project design features that conserve soil surface cover. Considering the gentle slopes and stable soil conditions in the watershed, there is a low probability that surface erosion from timber harvest activities has reduced soil productivity levels—with the exception of roads. Erosion from roads is addressed in the Aquatic section.

Map 18 shows that the majority of the watershed is rated as having a moderate susceptibility to productivity losses from compaction. However, there is a significant amount of acreage that is rated as having a high risk of productivity losses from compaction. These soils occur in the southern portion of the watershed, mostly on non-federal lands. Also, because these soils occur in the lower portion of the watershed, they are in an area that received the most and earliest impacts from human activity in the watershed (livestock grazing, road building, and timber harvest). Because of the repeated number of entries into many stands, the high road density in areas, and the common use of tractor yarding during timber harvest, it is likely that soils in the watershed have had reductions in productivity from compaction. It is also probable that the level of productivity losses is more on non-federal lands in the watershed because of the moderate risk rating for most soils on these lands and the common implementation of Best Management Activities and other project design features on federal lands. However, as discussed above, adverse impacts have not been entirely avoided and some reductions in productivity are likely in areas where more highly-impacting management practices have occurred.

Trends

Both the BLM and the USDA Forest Service have similar Best Management Practices and project design features that are intended to reduce, avoid, or limit adverse impacts to soils and soil productivity from the implementation of timber harvest activities. With the continued application of these tools, overall impacts to soils and soil productivity (direct, indirect, and cumulative impacts) should remain at current levels for the short term (1 to 5 years) and will be reduced through natural recovery processes or standard operational practices (such as ripping of existing skid trails if they are not needed for the next harvest activity) in the long term (5 years or more). Also, because of the generally reduced harvest activities prescribed in the newest land use plans for the federal lands, less land may be impacted by timber harvest activities, particularly within Riparian Reserves. However, this effect could be counteracted by more acres being treated for forest health objectives (for example, there are many areas in the watershed where the understory needs to be thinned or treated with prescribed fire).

The implementation of a prescribed fire program on federal lands in this watershed could cause short-term decreases in soil productivity due to exposure of mineral soil and decreases in organic matter content. However, fire was a natural disturbance agent and soils in the watershed evolved under the influence of fire to some extent. Best Management Practices will assist federal land administrators in maintaining soil productivity at current levels when implementing prescribed fire.

Highly impacting activities such as road building, scarification and tractor piling, and burning may occur on non-federal lands and to some extent on federal lands, and can cause decreased soil productivity in areas. On federal lands, the number of acres in the watershed expected to be subjected to these activities in the future is expected to be low, and impacts should be mitigated by Best Management Practices.

Impacts to soils and soil productivity on non-federal lands are expected to remain static or increase in the short term (1 to 5 years) as active forest health treatments and salvage programs are completed on these lands. In the long term (5 years or more), if harvest activity on non-federal land declines, then some recovery of soil productivity may occur through natural recovery processes.

Summary

It is likely that some losses in soil productivity have occurred in the watershed from recreational activities and timber harvest, including road building. The losses are mainly due to compaction and displacement. The lower portion of the watershed has likely seen the most reductions in productivity, due to the level and type of activity and the presence of soil types that are at a higher risk of productivity losses from compaction.

B. Late Successional Forest

Introduction

This discussion describes the landscape pattern in the Spencer Creek watershed with an emphasis on late-successional forests. It describes how the landscape patterns have changed within the watershed to reflect intensive forest management practices that have occurred in the last 40 to 60 years. Elements of fragmentation are discussed, including timber harvest and the density of roads within the watershed. Maps from Leiberg's 1899 inventory, Klamath County's 1945 inventory and the updated 1994 Pacific Meridian Resources data are used to describe the landscape patterns and changes.

Issue 5: Forest/range ecosystem health and resiliency has been altered in the watershed area.

Issue 9: The density of roads in the watershed is affecting wildlife.

Key Questions: How will late-successional stands be defined in the watershed? Have they been reduced below the 15 percent threshold level on federal land as stated in the Northwest Forest Plan?

Key Question: What is the density of roads in the watershed?

Assumptions/Analytical Process

Seral stages were mapped using size and structure obtained from 1988 Pacific Meridian Resource satellite imagery. This satellite imagery was updated to reflect changes due to harvest up through the fall of 1994. The definitions for each seral stage were based on the size/structure descriptions for the Pacific Meridian Resources data. Within these descriptions, references were made to the "old growth definitions" identified by Region 6, USDA Forest Service. A detailed description of the size structure categories used to map 1994 late-successional (old growth) forest and the other seral stages are included in Appendix 2. In addition, Appendix 2 gives a description on how the 1945 inventory data was categorized into different seral stages.

Blocks of habitat referred to as contiguous in the analysis actually contain elements of multiple seral stages. In most cases these variations comprise the minority of the forest block. When an area is dominated by a given seral stage, that block of forest is referred to as a contiguous block of forest in the dominant seral stage. Wildlife species may respond differently to a solid patch with virtually no inherent variation than to a patch with multiple seral stages. The response of wildlife to these differences is not analyzed.

Seral stages were divided into five categories and are defined as follows:

Nonforested - grass, snow, rock, agriculture.

Early-seral - Brush, clearcuts, plantations, and forest stands that have undergone shelterwood or seedtree harvests; seedling and sapling canopy layer is about even with or below the brush level. The brush still dominates the vegetative canopy layer.

Early-mid-seral - Forest stands dominated by pole (5 to 9 inches diameter at breast height) sized trees; trees have begun to dominate the vegetative canopy layer.

Mid-seral - Forest stands dominated by small (9 to 21 inches diameter at breast height) and some medium (21 to 32 inches diameter at breast height) sized trees.

Late-seral - Forest stands dominated by medium (21 to 32 inches diameter at breast height) and large (greater than 32 inches diameter at breast height) sized trees.

Queries were run in the Geographical Information System to determine present canopy closure for the entire watershed and also how the canopy closure was distributed by Forest Vegetation Zone.

Analysis Discussion

Historic Landscape Patterns

Leiberg 1899

Table 11 and Figure 2 summarize seral stage changes that have occurred in the watershed since approximately 1900. In 1899, Leiberg estimated that about 64 percent of the area surrounding and within the Spencer Creek watershed was forested with trees 4 inches in diameter or greater. The analysis team assumed that all forested stands over 4 inches in diameter were either mid or late successional stands at the time. Leiberg's 1899 estimate showed that about 24 percent of the land surrounding Spencer Creek was either burned or badly burned and 11.4 percent was nonforest. Leiberg's 1899 map (Map 11) and description indicates the largest area of early seral habitat surrounded Buck Lake and continued north of the Buck Lake area.

1945 Klamath County Inventory

The 1945 inventory of stands within the watershed show a slightly different landscape than Leiberg did (See Table 11). A significant amount of logging had taken place in the lower part of the watershed by 1945 (See Table 12). About 28 percent of watershed had been harvested by this time.

According to the 1945 inventory, mid and late seral stands still composed about 64 percent of the watershed. It was distributed primarily on federal land in the upper two-thirds of the watershed (Map 13). The upper portions of the watershed encompassed the mountain hemlock, shasta red fir, lodgepole pine, and mixed conifer zones. Patches of forest known to have late-seral characteristics were relatively scattered. Some of these were dominated by Douglas-fir trees. Stands dominated by white fir and ponderosa pine were also present. More late-seral stage forest was likely present in the area shown as mid-seral, but its distribution was difficult to determine from the 1945 inventory data.

Virtually all patches of late-seral forest within and surrounding the Spencer Creek watershed were connected to each other with large expanses of mid to late-seral stage forest. The one exception to this was in the southeast portion of the watershed (T.38S., R.6E., Section 30) where a brush patch separated two relatively large patches of late-seral stage forest which was bordered on one or more sides with early-mid seral stage forest.

For most of its length, the forest along Spencer Creek provided a connection to large blocks of unfragmented forest both within and outside of the watershed. Mid to late-seral stage forest was present along Spencer Creek from Buck Lake downstream to Township 39S. From this point to the southern boundary of the watershed the forest was early-mid seral stage forest along Spencer Creek. Other connections of mid to late seral forest stage forest was present between the headwater streams of the adjacent watersheds and the Spencer Creek watershed (Map 13).

The 1945 data had a separate code for deforested and nonstocked land as a result of fire. According to the 1945 data, about 3.5 percent of the watershed was either deforested or nonstocked because of fire. This data does not necessarily agree with Leiberg's 1899 estimate of 10 to 30 percent of the townships having burned or badly burned areas.

Process of Change

Forest Management Activities

Changes in the landscape are almost exclusively a result of forest management practices from 1920 through the present. Those management activities that have had the greatest impact include timber harvesting, road building, and fire suppresssion. Natural disturbances in the watershed include insect outbreaks, wind throw, and fire.

Changes in the Landscape as a Result of Fire Starts

Since the early 1920s, both natural and human-caused fires have had very little impact in shaping the existing landscape within the Spencer Creek watershed. Most of the fires within the watershed have been extinguished before they could grow to a size where they could impact the landscape. In contrast, prior to Euroamerican settlement, fire was the main disturbance agent of the landscape.

Table 14 and Figures 8 and 9 summarize existing fire records for the watershed. Note that the Oregon Department of Forestry data extends only from 1979 to 1994 with no data for 1991. In addition, Oregon Department of Forestry data covers both private lands and BLM-administered lands. Data extend from 1961 to 1992 and covers only USDA Forest Service-administered lands. A summary of fire statistics for the watershed is shown in Table 14.

Current Landscape Patterns - 1994

Late Successional Habitat

Currently, about 15 percent of the entire watershed (federal and private lands) is late-successional forest habitat. The remainder of the landscape is 20 percent mid-seral; 36 percent early-mid seral; 20 percent early-seral in trees, and five percent early-seral in shrubs; and four percent grass (Figure 10 and Table 11).

Twenty-five percent of the Federal land within the Spencer Creek watershed is late-successional forest and 29 percent is mid-seral stage forest. The percentages of all seral stages on Federal land are shown in Figure 11. One percent of private land within the watershed is late-successional forest and nine percent is mid-seral stage forest. The percentages of all seral stages on private land are shown in Figure 12.

Fifty-five percent of the late-seral stage forest within the watershed is in wilderness or Late Successional Reserves, two percent is in Riparian Reserves, and 41 percent is in the matrix (Figure 13). Within the matrix, late-seral forest is present in approximately equal amounts on National Forest lands and those administered by the Bureau of Land Management. Percentages of all seral stages by land ownership are presented in Figure 10.

Canopy Closure

Figure 14 indicates the current amount of the watershed at different canopy closure levels. Thirty percent of the entire watershed has a canopy closure between 11 and 25 percent. In addition, 22 percent of the entire watershed has a canopy closure between 26 and 40 percent. Only 22 percent of the watershed has a canopy closure above 56 percent (13 percent between 56 to 70 percent and 9 percent between 71 to 100 percent).

Map 19 and Figure 15 shows canopy closure distribution between the different forest zones. The highest canopy closures occur in the shasta red fir zone on federal lands. About half of the shasta red fir zone has a canopy closure above 55 percent. In the mixed conifer and ponderosa pine zones, the majority of the stands have a canopy closure between 11 and 40 percent. In the lodgepole pine and mountain hemlock zones, the majority of the stands have a canopy closure between 26 and 55 percent.

Connectivity of Contiguous Mid and Late Seral Blocks

The largest block of contiguous late-seral forest is in the Shasta Red Fir Zone in the northeast portion of the watershed (Maps 15 and 20). Existing vegetation is primarily shasta red fir and mixed conifer. This block is roughly 5,000 acres in size including the small patches of multi-seral stage forest scattered within it. All but a small portion of this 5,000 acre block is in the Mountain Lakes Wilderness and Late Successional Reserve on the adjoining National Forest lands to the south (Map 20 and 21). The upper reaches of Clover Creek are bordered by this forest within the wilderness. A portion of this block is outside of the wilderness and Late Successional Reserve in T. 38S, R. 6E, Sections 2 and 11. Mid-seral stage forest borders this large block in the vicinity of Aspen Butte, Little Aspen Butte, north within the wilderness area, and to the west outside of the watershed.

To the northwest of the 5,000 acre block is another large somewhat contiguous block of late-seral forest which is in the adjacent Rainbow Creek watershed. Within the two mile buffer analyzed, this block is at least

2,000 acres in size. It is also in a Late Successional Reserve. Mid-seral stage habitat and a large patch of brush separate these two late-seral stage forest blocks in T. 37S, R. 5E, Sections 25 and 26 and T. 38S, R. 6E, Section 30.

Other patches of late-seral forest ranging in size from roughly 125 acres to 490 acres and averaging 270 acres are present along the northern boundary of the Spencer Creek watershed west of the 5,000 acre block. These patches are also in the red fir zone. The vegetation is primarily mixed conifer (sugar pine, ponderosa pine, shasta red fir, white fir and Douglas-fir).

The western boundary of the watershed transects patches of late-seral stage forest patches on Surveyor Mountain and Burton Butte. These patches are primarily within the red fir zone. Currently the vegetation consists of shasta red fir, white fir and Douglas-fir, and a small amount of western white and ponderosa pine. The patch on Burton Butte is roughly 1,200 acres in size. The two patches on Surveyor Mountain total roughly 1,500 acres; however, only about a quarter of this acreage is within the Spencer Creek watershed. These patches provide some connection from within the watershed to the late-seral forest to the west; however, these patches are not connected to large blocks of late-seral forest within the Spencer Creek watershed.

All of the blocks of late-seral forest discussed above generally follow the perimeter of the Spencer Creek watershed from Little Aspen Butte on the east, to Surveyor Mountain on the west and occur within the red fir zone. These late-seral blocks are bridged primarily by mid-seral forest and smaller amounts of early-seral forest. This mixture of seral stages provides a moderately suitable connection between the largest blocks of late-seral forest in the north and northeast portion of the watershed and the late-seral forest associated with Burton Butte and Surveyor Mountain. Within the remainder of the watershed, no connections occur in an east-west or north-south direction, or via Spencer Creek or any of its tributaries.

Within the upper two-thirds of the watershed falling in the mixed conifer zone, only small scattered patches of late-seral forest are present. Fifteen patches greater than 10 acres in size were measured. These patches range in size from roughly 10 to 275 acres and average 95 acres in size. Many of these patches are contiguous with patches of mid-seral forest; however, these late/mid-seral patches are isolated and virtually surrounded by early to early-mid-seral stage forest (Maps 15 and 21). The existing vegetation of these patches is dominated by shasta red fir, white fir, and Douglas-fir with smaller quantities of lodgepole pine and ponderosa pine. In the vicinity of Buck Lake, lodgepole pine is more prevalent than ponderosa pine.

In the lower third of the watershed, both late and mid-seral forest is virtually nonexistent. The vegetation in this portion of the mixed conifer zone consists primarily of ponderosa pine, sugar pine, Douglas-fir, white fir, and incense cedar.

Current Wetlands

The largest wetlands within the watershed occur in the Buck Lake area, and along Spencer Creek upstream of Buck Lake in T. 38S, R. 6E, Section 11. Two relatively small patches (205 and 70 acres each) of late-seral habitat border these wetlands, in addition to a small amount of mid-seral habitat.

Current Road Densities

The Spencer Creek watershed has a high density of roads, particularly in the lower two-thirds of the watershed (Map 7). The density of roads within the Spencer Creek watershed is approximately four miles per square mile and ranges from 0.18 to 10.53 miles per square mile (weighted based on area within the watershed). The average density of roads is probably higher because a large number of roads present have not been mapped, and because about nine square miles without roads are considered in this average.

Outside the wilderness. nearly all patches of late-successional forest are fragmented by roads. The patches of late-successional forest that have very few miles of mapped road are near Burton Butte in T.38S., R.5E., Sections 8 and 9 and near the Mountain Lakes Wilderness in T.38S., R.6E., Section 3 and T.37S., R.5E., Section 36.

Trends

Over the long term, mid-seral habitat in the mapped Late Successional Reserve on the northern boundary of the watershed (T. 37S, R. 5E, Sections 17, 25, and 34-36 and T. 38S, R. 6E, Sections 4 and 5) will mature and fill in gaps to provide a fairly large contiguous block of late-successional habitat approximately eight miles in length and a mile and a half wide at the narrowest point. Other blocks of habitat (T. 38S, R. 6E, Sections 2 and 11 and T. 37S, R. 5E, Sections 28, 32 and 33, and T. 38S. R. 5E, Section 5) outside of the mapped Late-Successional Reserves could potentially contribute to the connectivity of late-successional wildlife habitats in the upper two-thirds of the watershed (see Map 9 for Late Successional Reserves and Map 15 for seral stages). Other areas with the potential for development into suitable connections between late-successional habitat patches are the mid-seral patches north and southeast of Buck Lake. There is a risk, however, that these areas could be harvested and the potential for a connection of late-seral stage forests through the Spencer Creek watershed would be lost.

Because of the existing fragmentation of the remaining patches of mid and late-seral habitat within the watershed, the land ownership pattern, and the potential for harvest, it is unlikely any system of connected late-seral patches would develop in the lower third of the watershed or along Spencer Creek.

Ponderosa pine forest is most abundant in the lower portion of the watershed on private land. Currently, very little late-successional forest is present on private land. Based on current harvest practices on private land and the current distribution of ponderosa pine forest, the only opportunity for retention and management for late-seral pine forests would be limited primarily to lands administered by the Bureau of Land Management.

Summary

Mid- to late-successional forests have been reduced in the watershed from the historic level of 60 to 70 percent to the current 30 to 40 percent. The largest contiguous blocks of late-successional forest are located in the wilderness area and upper portion of the watershed on federal land. On federal lands, 25 percent of the watershed is presently classified as late-successional, which is above the 15 percent threshold of the Northwest Forest Plan. Whereas historically late-successional forests were fragmented by lightning fire patterns, presently, late-successional forests are fragmented due to ownership patterns and different forest management treatments. This has resulted in disruptions of connectivity of late-successional forest.

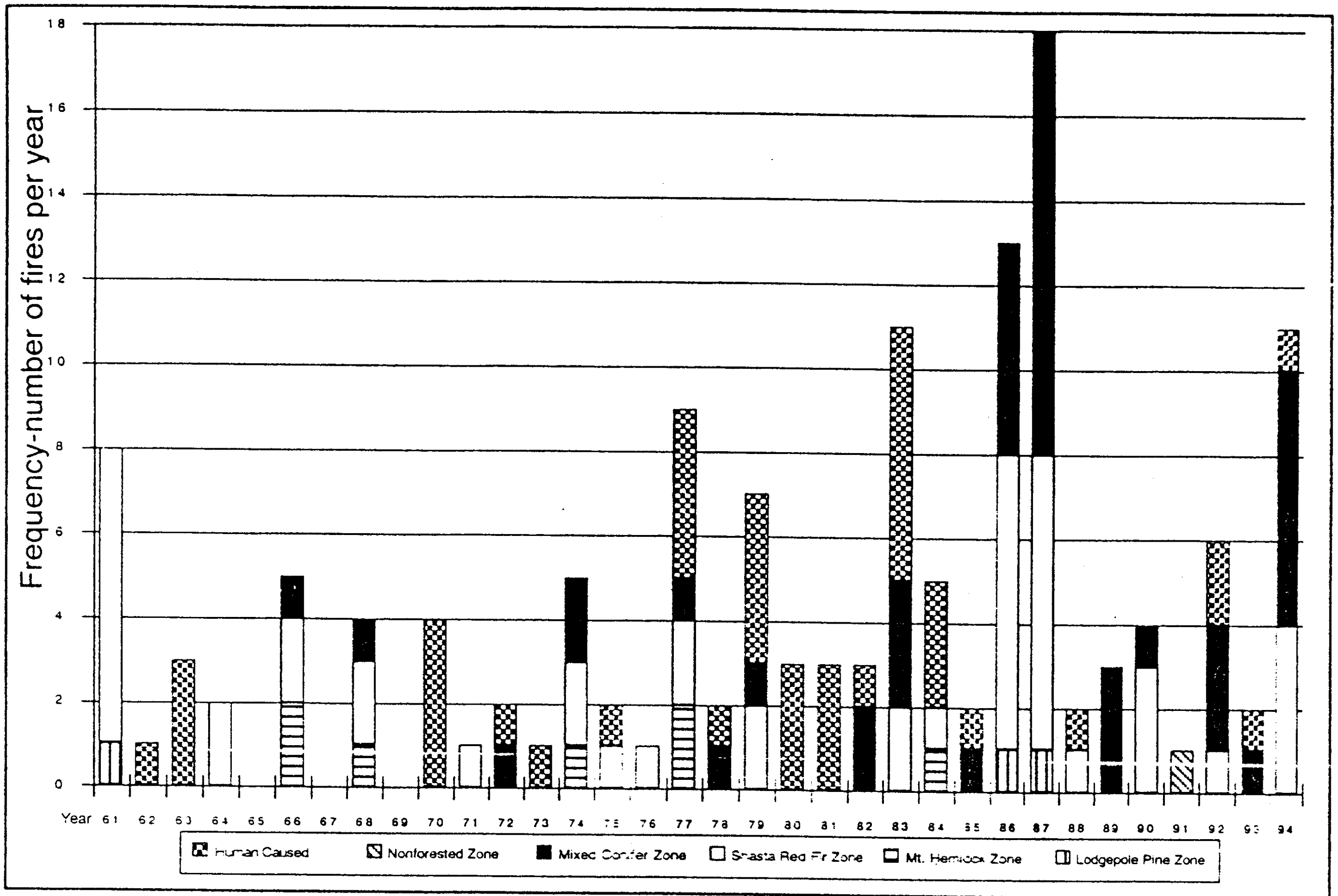


Figure 8. Spencer Creek - Lightning Fires By Zone and Human Caused Fires (for all lands)

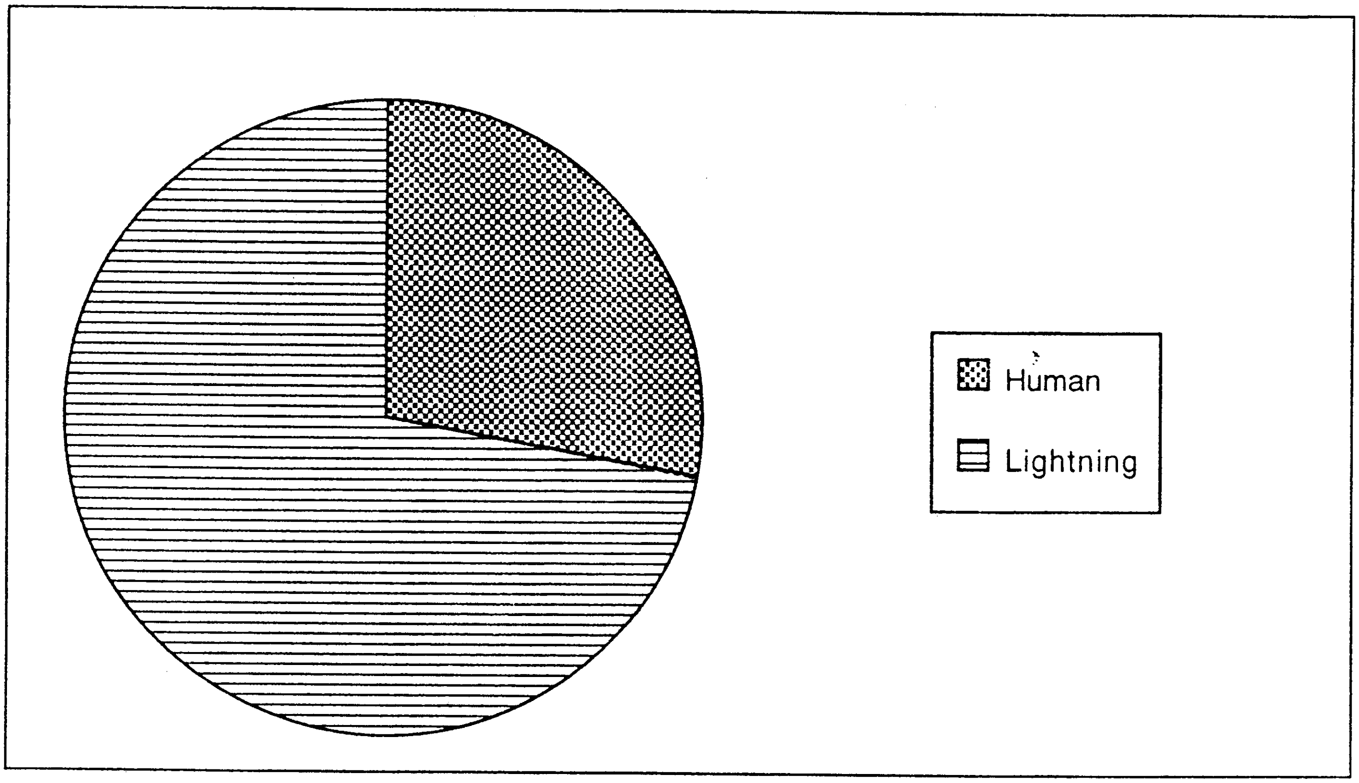


Figure 9. Spencer Creek - 1961-1994 Fires - Human Caused Versus Lightning Caused (percent of total fires)

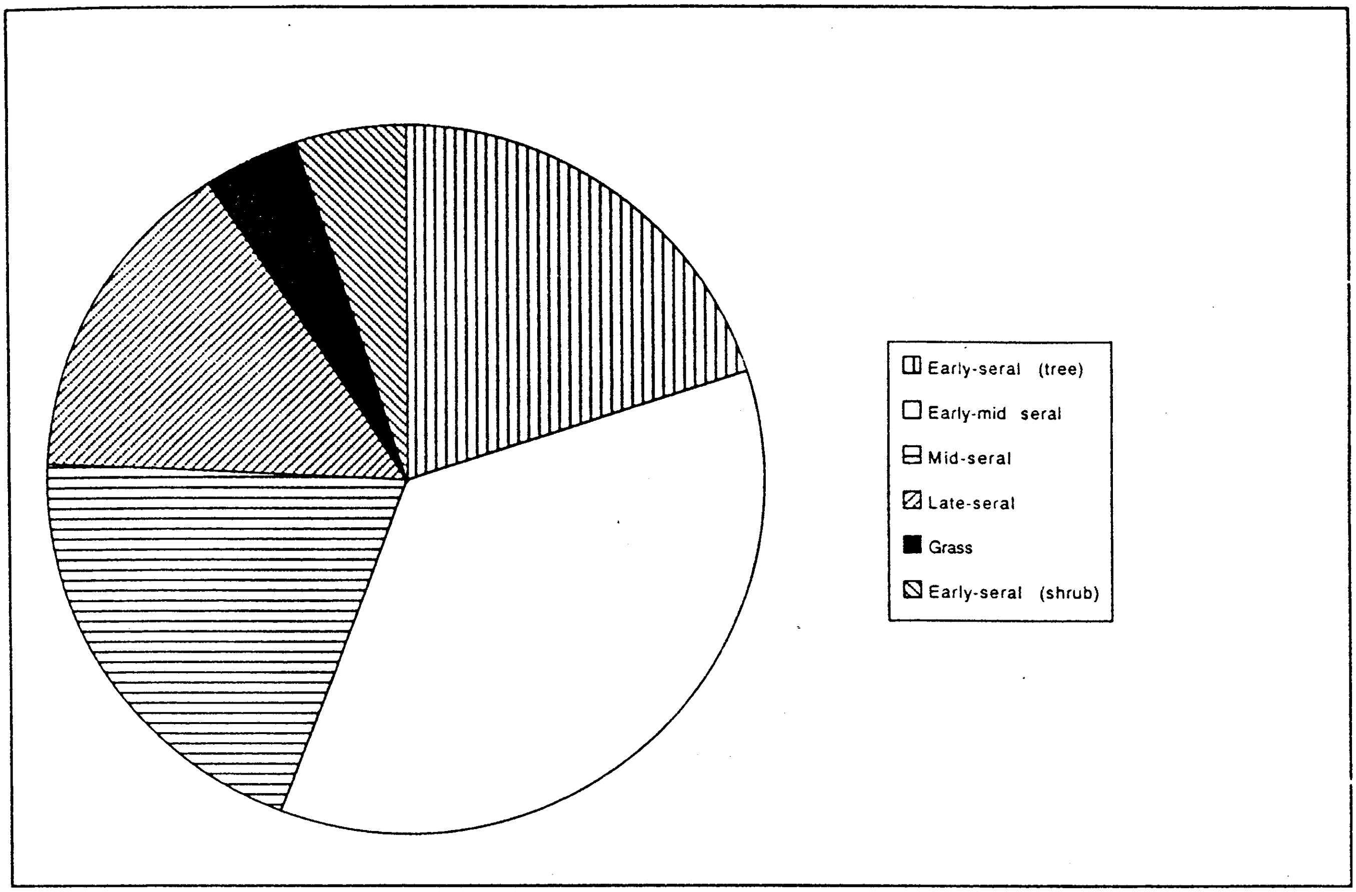


Figure 10. Percentage of land by each seral stage within the Spencer Creek Watershed (Federal and Private)

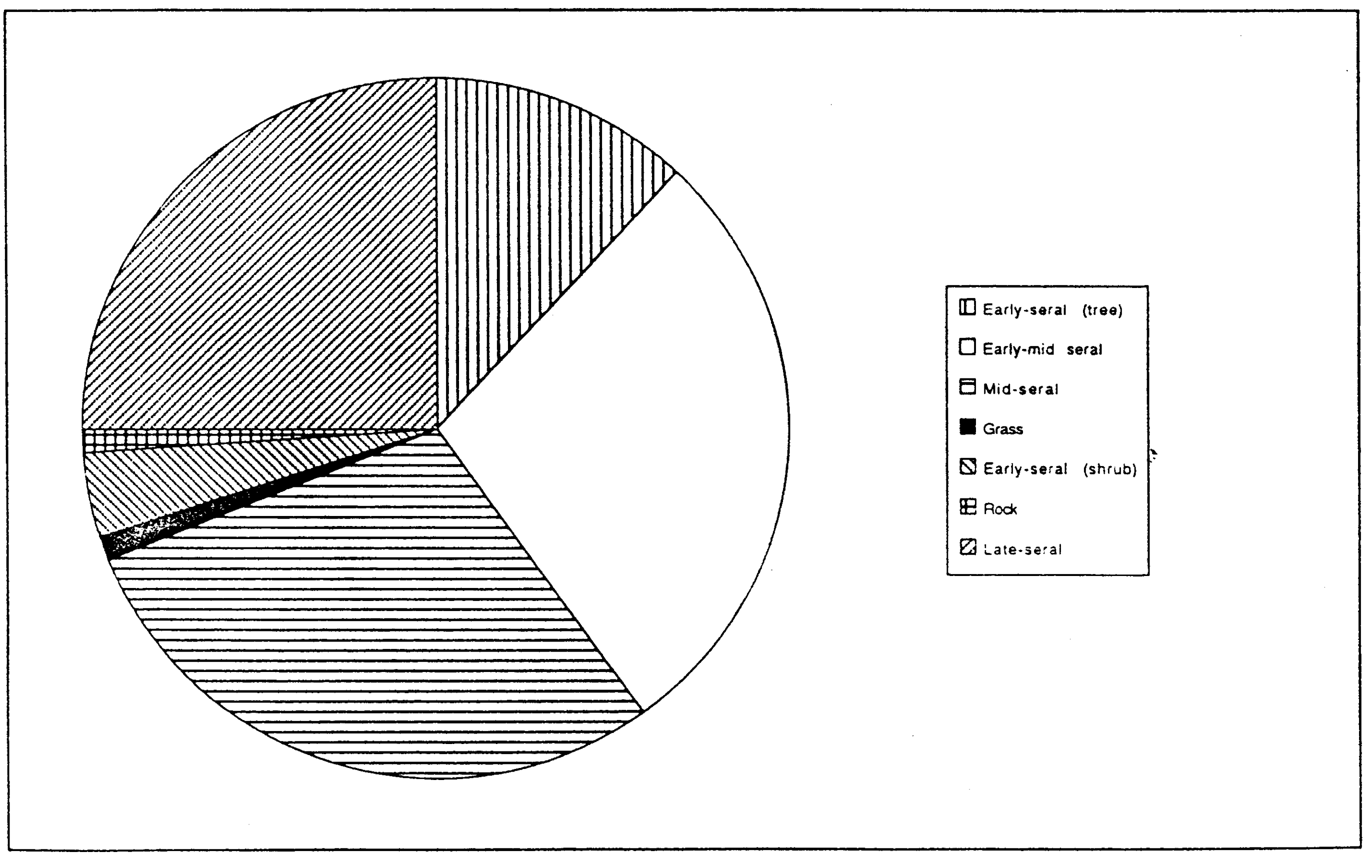


Figure 11. Percentage of Federal land by seral stage in the Spencer Creek Watershed.

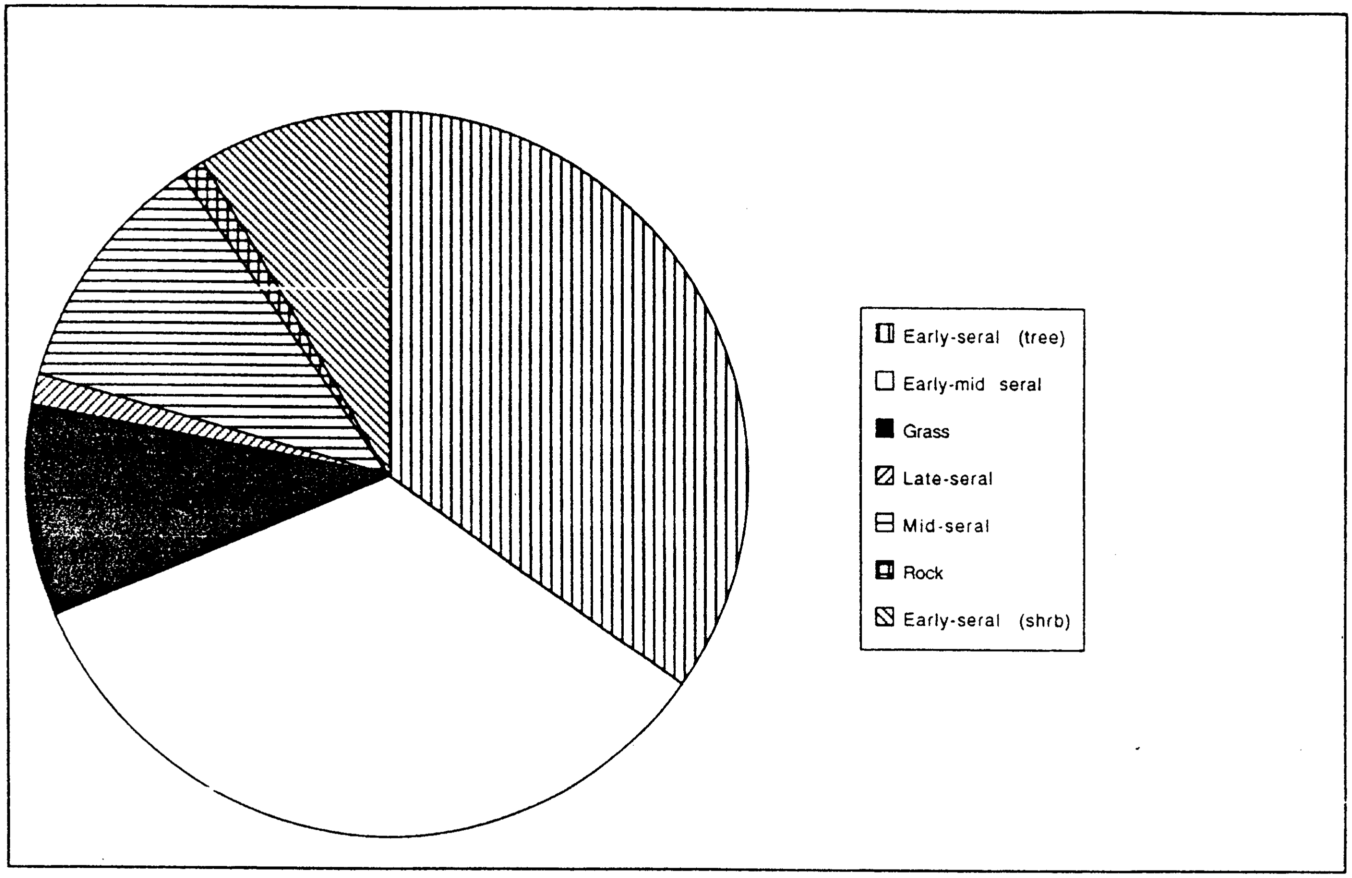


Figure 12. Percentage of private land by seral stage within the Spencer Creek Watershed..

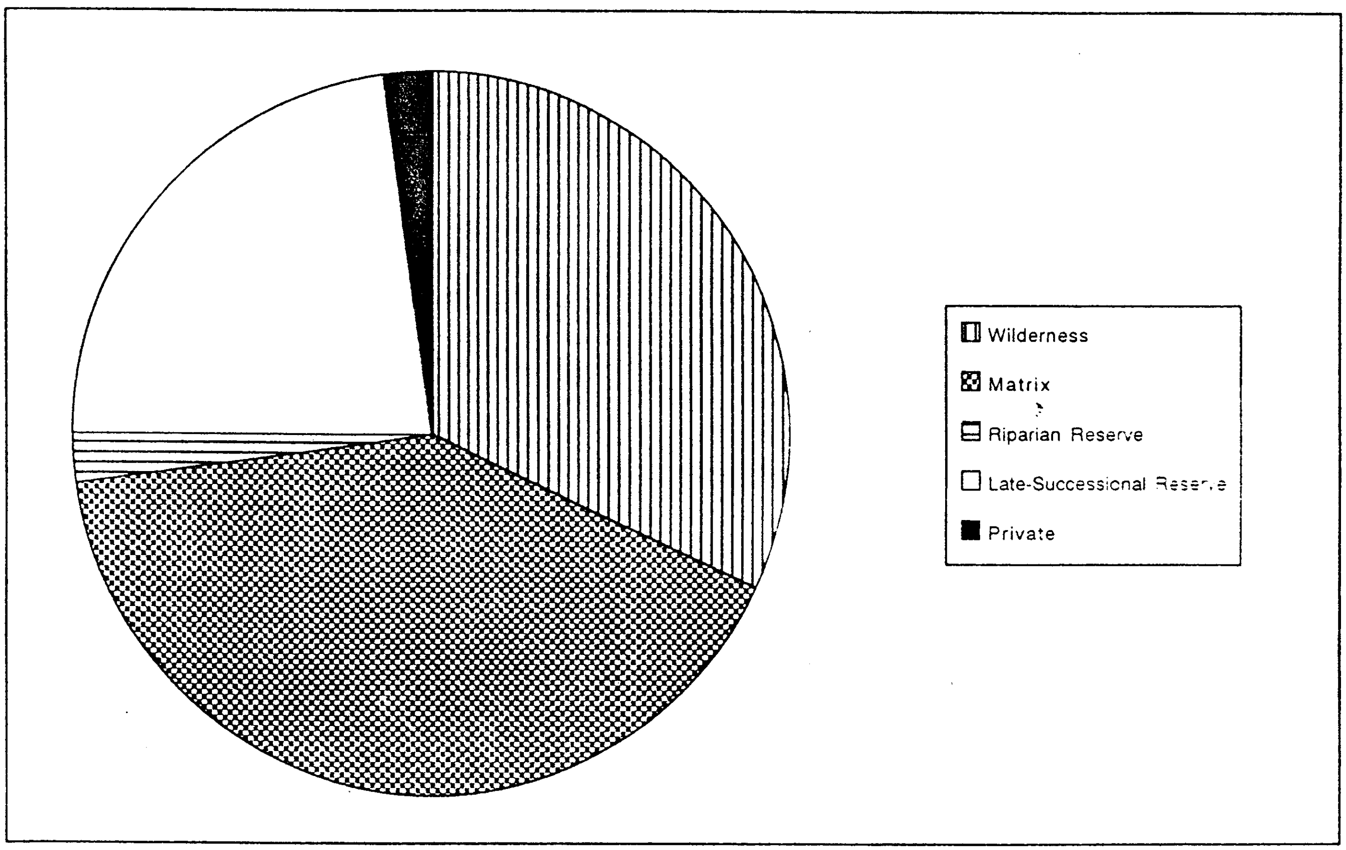


Figure 13. Percentage of Late-Successional Forest by Land Allocation (Late-Successional Reserve, Riparian Reserve, Matrix and Private Within the Spencer Creek Watershed

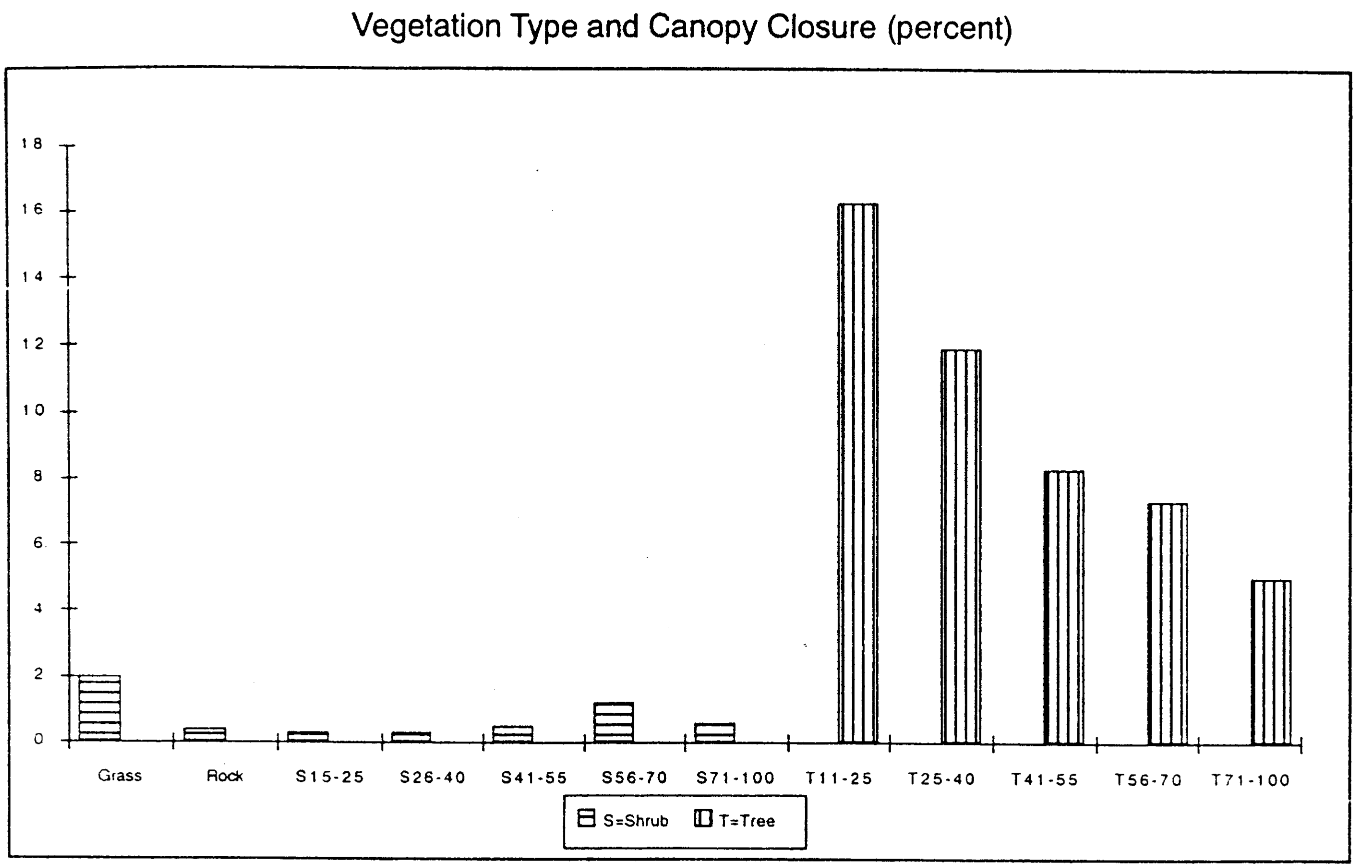


Figure 14. Spencer Creek Watershed - 1994 Canopy Closure for the Entire Watershed, All Vegetation Types

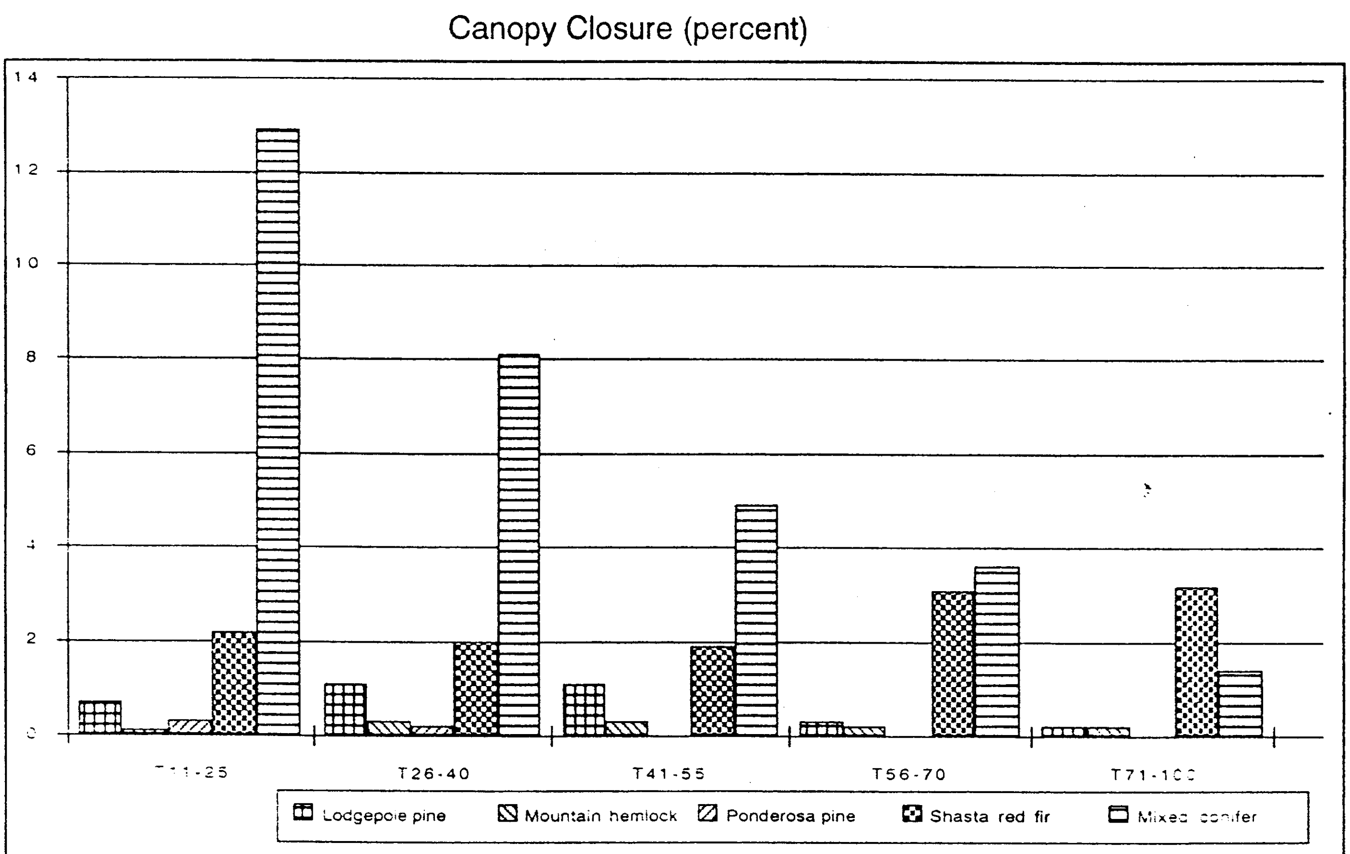


Figure 15. Spencer Creek Watershed - 1994 Canopy Closure, Trees Only

Wildlife Section

A. Late Succes - sional Forest Dependent Wildlife

Introduction

Although Late Successional Reserves are intended to provide for the needs of late-successional dependent wildlife species, habitat is needed between Late Successional Reserves to provide a connection between larger habitat blocks. Connections between Late Successional Reserves would improve travel and dispersal for many terrestrial animals and provide for greater connectivity of the watershed.

A two mile buffer surrounding the watershed was considered in this analysis to assess the connection of habitat between watersheds.

Analysis of the landscape pattern and its effect on late-successional dependent wildlife species is intended to provide an estimate of the relative suitability of the watershed's function in providing habitat for the dispersal of animals and population exchange between Late Successional Reserves, movement corridors, and winter cover. The intent of this section is to discuss the suitability of the landscape patterns, not necessarily to identify the suitability of all aspects of each patch of forest for wildlife.

This analysis is intended to give a broad view of how the landscape pattern meets the needs of late-successional dependent wildlife species as a group. Species with federal status or those determined to be high priority for analysis are discussed individually. The system for determining the priority of a species for analysis is presented in Appendix 5.

Issue 6: Existing and recruitment levels of large dead standing and downed woody material has been altered.

Issue 7: Habitat for Federally listed, proposed, or candidate species; State listed species; USDA Forest Service Region 6 Sensitive Species and BLM Special Status species of wildlife has been altered.

Issue 9: The density of roads in the watershed is affecting wildlife.

Issue 10: Late successional forest in the watershed has been fragmented and reduced in size through harvest.

Key Question: How are movement corridors, dispersal habitat, and winter cover being provided for late-successional dependent wildlife species?

Key Questions: Where does occupied and/or potential habitat occur? What is the condition of this habitat for species determined to be a high priority for analysis?

Key Questions: Are the current levels, distribution, and recruitment potential of snags and downed woody material providing the necessary habitat for late-successional dependent species? If not, where is the concern?

Key Question: What is the potential impact of the density and distribution of roads open to vehicular traffic, on wildlife species and their available habitat?

The answer to the above key questions are scattered throughout the wildlife section of this analysis.

Assumptions/Analytical Process

Seral stages were mapped using size and structure obtained from 1988 Pacific Meridian Resource satellite imagery. This satellite imagery was updated to reflect changes due to harvest up through the fall of 1994. The definitions for each seral stage were based on the size/structure descriptions for the Pacific Meridian Resources data. Within these descriptions, references were made to the "old growth definitions" identified by Region 6, USDA Forest Service. A detailed description of the size structure categories used to map late-successional (old growth) forest and the other seral stages are included in Appendix 2.

Seral stages for current vegetation were divided into five categories and are defined as described in part B, Late-Successional Forest, of the Landscape section.

Seral stage descriptions for landscape conditions present in 1945 are described in Appendix 2.

Not all of the species considered to be a high priority for analysis (see Appendix 5) have been given individual attention in this analysis. The fisher, marten, and great gray owl are covered in the most detail. Because the fisher and marten have large home range sizes, they are considered to be the most limited in movement by the adequacy of landscape patterns. Marten were specifically identified as an issue. The great gray owl was chosen because it is a "Protection Buffer" species which requires late-successional habitat in the vicinity of meadows. The spotted owl is considered separately later.

In the Management Recommendations chapter, connectivity corridors are discussed. The references used to come up with the criteria for the characteristics of the connectors were Freel (1991), Heinemeyer and Jones (1994), and Chapel et al. (1992).

Habitat is generally more useful for dispersal, daily movements, and migration if it closely resembles suitable habitat for the wildlife species of concern (Chapel 1992).

Many late-successional dependent wildlife species require interior forest habitat for such needs as cover and successful reproduction. These species may feed along edges between old and young forests or in a variety of forest seral stages; however, the limiting factor may, for instance, be the presence of interior late-successional forest for winter survival and protection from predators.

Species dependent upon interior late-successional forests distribute themselves positively and incrementally away from the edge between young and late-successional forests (Marcot 1994).

Species dependent upon interior late-successional forests are distributed most positively in portions of old forest that exceed 600 feet from an edge with young forest. The distribution of old forest species thus declines linearly with increasing proximity to edge with young forest (Marcot 1994).

Variation in the structural components of the forest including the number and sizes of snags and downed logs are not considered in assessing the suitability of individual mid and late-seral forest habitat patches. These data are not available for the specific patches discussed. Some data are available for inferring the quantity of snags and downed logs present on a general scale.

Due to data limitations, the variation and spatial arrangement of the overstory canopy closure, and understory woody and herbaceous vegetation are not considered in the landscape portion of this analysis.

Blocks of habitat referred to as contiguous in the analysis actually contain elements of multiple seral stages. In most cases, these variations comprise the minority of the forest block. When an area is dominated by a given seral stage, that block of forest is referred to as a contiguous block of forest in the dominant seral stage. Wildlife species may respond differently to a solid patch with virtually no inherent variation than to a patch with multiple seral stages. The response of wildlife to these differences is not analyzed.

Species are identified as being associated with late-successional habitat based on the findings by the Scientific Analysis Team (Thomas 1993).

It is assumed that the green tree retention requirements (under the Record of Decision for the Northwest Forest Plan) would provide some but not all of the habitat characteristics necessary for the movement and dispersal of some late-successional dependent species between Late Successional Reserves.

①→

Analysis Discussion

Historic Conditions

The Late-Successional Forest discussion talks about the abundance and distribution of habitat for late-successional associated species. Based on what is believed to have been present, in the past habitat was probably not limiting the populations of animals dependent upon shasta red fir and mixed conifer forests. Since the lower watershed was historically in late-successional ponderosa pine forest, species associated with more mesic (see Glossary) forest habitats were probably restricted to the upper portions of the watershed. Canopy closure levels in the mesic forest types appeared to be at least 55 percent which would have met the minimum canopy closure requirements for many of the late-successional dependent species.

Process of Change

The changes in the distribution of seral stages and forest types is discussed in detail in the Vegetation section. The change in the distribution of seral stages, corresponding losses in cover in the form of overstory trees and large snags and downed woody debris, and the increase in the size and frequency of large openings due to clearcuts and resultant changes in the microclimate of the forest, have all contributed to the alteration of habitat suitability for a variety of late-successional dependent wildlife species.

Current Conditions

Within the watershed, 55 species of wildlife, which have been documented or have the potential to occur, have a strong association with late-successional habitat for cover, breeding, and/or feeding. Fifty-four species, some of which are late-successional dependent, are associated with large woody debris. Fifty six are associated with snags, but not necessarily late-successional forest (see Appendix 5). The overall value of late-seral habitat to a particular species depends upon the habitat's distribution, patch size, canopy closure, and vicinity to riparian/wetland areas and contrasting habitat types.

① are missed Rip. Reserves were widened from half to full SAT to prove non-rip dep. wildlife species dispersal habitat

The role the landscape pattern plays for wildlife depends upon the wildlife species. Many late-successional dependent species are adversely affected by high interspersion or fragmentation of habitat patches (Harris and Silva-Lopez 1992; Morrison et al. 1992; both cited in Marcot et al. 1994). In general, the occurrence and persistence of species associated with old forest patches increases with increasing patch size and connectivity of such patches. Such species are primarily associated with interior habitat of one seral or structural stage.

Areas of mid-seral or late-seral forest over 600 feet from the edges of young forest represent the interior portions of habitat that experience the least variation in microclimate and least susceptibility to windthrow. In addition, habitat-interior species are more vulnerable to predation by edge-associated species with increasing proximity to edge (Harris and Silva-Gomez 1992, cited in Marcot 1994). Competition with edge species which colonize the early successional habitats may reduce the viability of interior species' populations (Lehmkuhl and Ruggiero 1991). Species such as the great horned owl benefit from high contrast edge (Marcot 1994). This species is a predator of and competitor with the great gray owl (Nero 1980; Duncan 1987; Voous 1988, cited in Hayward and Verner 1994) and other species including the northern spotted owl.

Patches 25 acres (10 hectares) in size are effectively all edge and have lost the essential attributes of the interior old growth condition. The isolation of forest fragments with distances up to 4.3 miles (7 kilometers) between the patches further limits the functioning of old-growth patches as wildlife habitat (Lehmkuhl and Ruggiero 1991).

A detailed discussion of the distribution and size of late-successional patches within the Spencer Creek watershed is presented under Late-Successional Forest Discussion. Within the watershed in the Shasta Red Fir Zone, the only block of late-seral habitat with a large amount of effective interior habitat is the 5,000 acre (rough acreage) block in the northeast portion of the watershed. Two of the four patches along the northern border of the watershed and the patch on Burton Butte also have some interior habitat. Although the patch on Surveyor Mountain is quite large, the amount of interior habitat is limited due to the linear shape of the patch. Within the mixed conifer zone, 7 of the 15 patches measured have no interior habitat as they are approximately 25 acres or less in size. Considering the size and shape of the remaining eight patches, four have small amounts of interior habitat. The greatest distance between patches of late-seral stage forest is about three miles.

The NWFP ROD looked at Regional Scale - assumed some loss in local areas, but high probability of overall spp. survival. We over range. We may affect locally! Is this stuff from EMAP?

Fifty-five late-successional dependent species have been documented or have the potential to occur within the watershed (see Appendix 5). Lehmkuhl and Ruggiero (1991) developed a system to rate the risk of local extirpation of wildlife due to decreasing patch sizes and greater isolation of forest patches. This rating system considers the cumulative risk of factors including animal body size, vagility (see glossary), migratory status, and abundance. Forty-two of the 55 species of concern in the Spencer Creek watershed were rated. Thirty-one of the 42 rated are considered to be at moderate to high risk. These species are listed in Appendix 5. The Pacific giant salamander, Northern flying squirrel, Douglas squirrel, and bald eagle were considered to be at the highest risk. All of the late successional dependent bat species were considered to be at moderate risk.

The home range size for many of the smaller birds including the red-breasted nuthatch, pygmy nuthatch, and golden-crowned kinglet are five acres or less (Chapel et al. 1992). Due to the general fragmentation of late-successional habitat, movement and dispersal between Late Successional Reserves is assumed to be more limiting for wildlife with larger home range sizes such as the fisher, marten, pileated woodpecker, and goshawk. Species that have been determined to be of highest priority for analysis are discussed below in terms of how the landscape pattern may impact their movement, dispersal, cover requirements, and distribution.

Fisher

The fisher is a Category 2 candidate species (see glossary) for federal listing as threatened or endangered by the U.S. Fish and Wildlife Service. The status of this species according to the State of Oregon, USDA Forest Service, and Natural Heritage Program is listed in Appendix 5.

In the western United States, fisher prefer late-successional forests (especially for denning and resting) and occur most frequently where these forests include the fewest large openings without overhead cover. Avoidance of open areas may restrict the movements of fisher between patches of habitat and reduce colonization of unoccupied but suitable habitat (Ruggiero et al. 1994). A compilation of many studies for management of fisher in California also indicates fisher prefer late-successional forest for denning, resting, and travel (Freel 1991).

The dendriform (see glossary) pattern of forested stream courses are used extensively by fishers as travel networks between watersheds (DeVos 1952; Buck 1982; Mullis 1985; Jones 1991; Heinimeyer 1993, cited in Heinemeyer and Jones 1994). These networks should have a similar function between Late Successional Reserves. Forested saddles, linking adjacent major drainages, may also serve as potential travel routes, and may be especially important for fisher movements (Heinemeyer and Jones 1994; Buck et al. 1983, cited in Ruggiero et al. 1994). It is uncertain whether saddles are used by dispersing young, as this has not been studied (Ruggiero et al. 1994).

Fisher are more selective of habitat for resting sites than of habitat for foraging. Resting and denning sites tend to occur in large trees, snags, and logs that are normally associated with late-successional conifer forest. The canopies of, or cavities within, live trees are the most commonly used resting sites reported in eastern and western studies (Arthur et al. 1989b; Buck et al. 1983; R.Golightly, pers. comm.; Jones 1991; Krohn et al. 1994; Reynolds and Self 1994, unpublished, cited in Ruggiero et al. 1994). In the published western studies, logs were of secondary importance, followed by snags (Buck et al. 1983; Jones 1991, cited in Ruggiero et al. 1994).

Historic Conditions

According to the Oregon Department of Fish and Wildlife, fisher were present within the Spencer Creek watershed historically.

In the Pacific States, fisher were originally most common in low to mid-elevation forests up to about 7,500 feet in elevation (Aubry and Houston 1992; Grinnell et al. 1937; and Schempf and White 1977, cited in Ruggiero et al. 1994). In the past 40 years, most sightings of fisher on the east slope of the Cascades where snow is less deep have ranged between 5,400 and 6,600 feet in elevation.

The range of elevation occupied by fisher may be related to snowfall. Areas of high snowfall are avoided by the fisher in winter unless the snow is intercepted by dense overhead cover such as that provided by late-successional forest (Ruggiero et al. 1994). Considering the quantity and distribution of late-successional forest historically, the range and movements of this specie was probably not limited.

Process of Change

Fisher populations declined in the early twentieth century, probably due to habitat loss from logging and settlement, overtrapping, and predator poisoning (Banci 1989, cited in Heinemeyer and Jones 1994). By the 1930s, only small remnant populations remained in the United States.

Current Conditions

Since that population decline in the first half of the century, populations of fisher have remained at low numbers or are absent throughout most of their historic range in the west, including Oregon. This indicates that fisher in general are having difficulty under current habitat conditions.

Minimum patch size for fisher is at least 120 to 125 acres according to Freel (1991) and Heinemeyer and Jones (1994), respectively. These minimum patch sizes specifically relate to "effective habitat island size" when considering fragmented habitats in forest ecosystems.

Considering the size and distribution of late-successional forest patches within the Spencer Creek watershed, currently there are no suitable connections along any of the drainages or over saddles between the headwaters of the drainages. A total of about 150 acres of late-successional forest and 370 acres of mid-seral forest are present within the Riparian Reserves within the Spencer Creek watershed. Riparian Reserves comprise 2.4 percent of the watershed. Unmapped Late Successional Reserves and Riparian Reserves combined comprise 3.5 percent of the watershed. The Bureau of Land Management's Protected buffer areas around unmapped Late Successional Reserves contribute an additional 2 percent to the reserve system. However, within the watershed, the above reserves combined are not believed to meet the needs of the fisher as connectivity corridors between Late Successional Reserves.

Mid-seral forest patches are present between the late-seral forest in the headwaters of Johnson Creek in the Jenny Creek watershed to the west, and the RO-227 Late Successional Reserve in the northern portion of the Spencer Creek watershed. In the future, this could provide a mid-elevation connection over a saddle at approximately 5,200 feet. Currently this mid-seral habitat is broken by many early-seral patches of forest and is interspersed by patches of late-seral habitat less than 100 acres in size.

Roads within suitable habitat, with the exception of the wilderness area, are numerous. Densities are now approaching four miles per square mile in the watershed area. Road densities should be no greater than 2 miles per square mile for moderate suitability for the fisher and zero to one-half mile per square mile for high suitability (Freel 1991). The distribution of roads in relation to late-successional habitat is discussed above in the Late-Successional Forest discussion.

Other critical habitat components that can be limiting factors for the survival of fisher are the levels of snags and downed logs. As referenced above, fisher prefer to utilize the cavities within live trees, or snags for resting/denning, and logs are of secondary importance.

At least one to two snags equal to or greater than 30 inches diameter at breast height per acre are desirable to provide moderately suitable habitat for resting and denning (Freel 1991). Snag data sampled on 3,253 acres of spotted owl habitat on National Forest land in 1990, 1991, and 1992 from the red fir, lodgepole, and upper elevation mixed conifer zones indicate there were about six large snags present per acre. There were, however, a small number of downed logs lumped into the data with the snags; however, it is likely the number of snags are sufficient in these areas.

According to the "Standards and Guidelines" in the Northwest Forest Plan for large woody debris, a minimum of 2 tons of logs per acre equal to or greater than 16 inches in diameter at breast height and 16 feet long need to be maintained in the matrix.

Information on the size and quantity of downed logs for the resting/denning requirements of the fisher in the Cascades/Sierras was not readily available in the literature. Freel (1991) did specify the needs of downed logs for hunting use. For moderately suitable habitat, a minimum of two to three logs 20 inches in diameter at breast height and 15 feet long are needed. At least four logs 30 inches or more in diameter are preferred (Freel 1991). These log needs would equate to approximately 1.2 to 4 tons per acre.

Downed logs were sampled in 1992 in the Mixed Conifer and Red Fir Zones at seven owl sites on lands administered by the Bureau of Land Management. Approximately 15 tons per acre of sound logs greater than 9 inches diameter at breast height were present. Based on the Northwest Forest Plan "Standards and Guidelines", the tonnage of logs present on sampled ground consisting of mid to late-seral stage forest is sufficient; however, because of the size class breakdown of logs sampled in the plots, it is unknown if the needs of this species are met based on the size specifications in the literature.

Most of the forest in the watershed that is early to early-mid seral stage has had virtually no snags or downed logs retained, particularly in the lower third of the watershed.

Marten

In most studies of habitat use, martens have been found to prefer late-successional stands of mesic (see Glossary) coniferous forest, especially those with complex physical structure near the ground. Complex structure near the ground is especially important in the winter. It provides access to the subnivian space where most prey are captured in winter, provides protective thermal microenvironments, and provides protection from predators (Buskirk and Powell 1994, cited in Ruggiero et al. 1994). Course woody debris, rock fields in the forest, and squirrel middens all provide ground structure (Buskirk et al. 1989; Finley 1969; both cited in Ruggiero et al. 1994).

Marten generally avoid habitats that lack overhead cover. Thompson and Harestad (1994) as cited in Ruggiero et al. (1994) reviewed the literature on the duration of the negative effects of clearcut logging on marten. They concluded that for the first 45 years after cutting, regenerating clearcuts supported 0 to 33 percent of the marten population levels found in nearby uncut forest. Those that did occupy these cut areas experienced high mortality rates from predation and trapping.

Historic Conditions

Considering the past continuity of the forest cover, the amount of mid and late-successional forest, and the undisturbed nature of the meadows, it is assumed that the mountain hemlock, red fir, and mesic portions of the Mixed Conifer Zone supported a healthy population of marten.

Process of Change

The reduction in abundance and distribution of marten in Washington, Oregon, and northwestern California has been attributed to the harvest of late-successional forest (Ruggiero et al. 1994). Trapping and fire have also contributed to the contraction of the historic range. The large home range size of the marten combined with low reproductive potentials and an affinity for habitats that have decreased dramatically over time, have resulted in limited ability for populations to recover from natural or human caused disturbances (Bennett and Samson 1984).

The mechanisms by which marten are impacted by timber cutting are the removal of overhead cover and large-diameter large woody debris. In addition, changes in prey communities can result from harvest prescriptions including clear-cutting, where mesic sites are converted to xeric sites (Campbell 1979, cited in Ruggiero et al. 1994).

The changes to the riparian habitat used by marten for foraging are discussed in the "Riparian Areas" discussion of the Riparian Ecosystem part.

Current Conditions

Marten have been documented within the watershed as recently as 1993. Sightings of the animals or tracks have occurred just south of the Mountain Lakes Wilderness and in the Surveyor Mountain area, mostly in areas associated with mid to late-successional forest.

The long dispersal distances of martens, in combination with the sensitivity of habitat providing overhead cover, is important to population dynamics and colonization of new areas by marten (Ruggiero et al. 1994). Although movements of marten beyond home range boundaries, including dispersal and migration, have hardly been studied, it can be assumed that unfragmented mid to late-successional habitat would provide the most desirable conditions. According to Freel (1991), marten need a minimum of a 600 foot wide area with at least 60 percent canopy closure to function as a high suitability travel corridor through fairly open forest. Moderate suitability corridors should have at least 50 to 60 percent canopy closure and be 300 to 600 feet wide.

Minimum patch size for marten is at least 120 acres according to Freel (1991). This minimum patch size specifically relates to effective habitat island size when considering fragmented habitats in forest ecosystems.

Considering the size and distribution of late-successional forest patches within the Spencer Creek watershed, currently there are no suitable connections along any of the drainages or over saddles between the headwaters of drainages. As mentioned above in the discussion on fisher, Riparian Reserves comprise 2.4 percent of the watershed. Unmapped Late Successional Reserves and Riparian Reserves combined comprise 3.5 percent of the watershed. The Bureau of Land Management's protected buffer areas around unmapped Late Successional Reserves contribute an additional 2 percent to the reserve system. These reserves, along with the late-successional forest currently present within the matrix, do not provide a suitable connection for marten through the watershed between Late Successional Reserves.

It is unknown if marten will cross ridges. Marten have been observed, however, in the Surveyor Mountain area in winter and generally occupy higher elevations than fisher. It is possible but unknown if marten disperse across the ridge of Surveyor Mountain where there is a narrow habitat connection to the Jenny Creek watershed.

Based on the habitat distribution within the watershed, marten movements are probably very limited or absent between the large block of late-successional forest in the northeast portion of the watershed and the patches associated with Surveyor Mountain.

The numerous roads now present within the watershed may have caused habitat disruption and/or animal mortality. Roads may decrease prey and food availability for marten (Allen 1987) due to prey population decreases resulting from behavioral barriers to movement and/or road kills. According to Freel (1991), road density should be no greater than one to two miles per square mile for moderate habitat suitability and should be less than one mile per square mile for high suitability habitat. Road densities are now approaching four miles per square mile in the watershed area. The distribution of roads in relation to late-successional habitat is discussed above in the Late-Successional forest discussion. Disturbance from snowmobiles is another concern especially since marten remain in high snow areas during the winter. The energy reserves of these animals can be low and continual disturbance from a source such as snowmobiles could be detrimental and could prevent the marten from using certain areas.

Winter cover for marten is generally correlated with the distribution of late-successional forest and the associated structural components of large woody debris (Buskirk et. al. 1989). Most of the forest in the watershed that is early to early-mid seral stage has had virtually no snags or downed logs retained, particularly in the lower third of the watershed. It can therefore be assumed that most winter cover is limited to the areas where mid to late-successional forest habitat is present.

At least 2 to 3 snags equal to or greater than 24 inches diameter at breast height and 10 to 19 logs equal to or greater than 15 inches by 15 feet long per acre are desirable to provide moderately suitable habitat for resting and denning (Freel 1991). Limited data from owl stands in mixed conifer and shasta red fir zones are available from plots measured in 1992 on lands administered by the Bureau of Land Management. For the areas sampled, these data indicate levels of downed woody debris are probably sufficient. Snag data sampled on 3,253 acres of spotted owl habitat on National Forest land in 1990, 1991, and 1992 from the red fir, lodgepole, and upper elevation mixed conifer zones indicate the number of large snags per acre are probably sufficient for the areas sampled.

The areas where snags and large downed woody debris could be the most limiting are in early to mid-seral stage habitats that are distributed between patches of mid- to late-successional habitat. These areas are in potential corridors discussed in the Late-Successional Forests discussion. They are generally north and south of Buck Lake, in the Burton Butte area, and the Surveyor Mountain area.

Great Gray Owl

Historic records on the great gray owl in south-central Oregon indicate they have a strong preference for forest habitat adjacent to meadows. Ninety-five percent of 63 nests studied by Bryan and Forsman (1987) were in forests less than 0.3 kilometers from meadows. The average distance between the nest site and meadows was 275 meters and the maximum distance was 750 meters (Bryan and Forsman 1987).

In south-central Oregon, Bryan and Forsman (1987) found all forests in which great gray owls were located in old growth (45 sites) or mature (18 sites) stands characterized by relatively large overstory trees. All locations where the birds were found contained some areas of fairly dense forest. Nest sites were located in lodgepole pine, lodgepole pine and ponderosa pine mix, or mixed conifer.

Foraging by great gray owls occurs mainly in deep-soiled meadows or open forest stands, including partially-logged stands with canopy closures of 11 to 59 percent and heavy ground cover (average 88 percent) dominated by grasses (Bryan and Forsman 1987; Bull and Henjum 1990). The size of meadows important to great gray owls in south-central Oregon ranged from 15 acres (6 hectacres) to over 247 acres (100 hectacres). All meadows where great gray owls were located were relatively wet during the early spring and many had grasses and herbaceous vegetation (Bryan and Forsman 1987). Optimum meadow habitat is created by narrow or undulating meadows with maximum forest edge relative to the meadow (Winter 1982).

According to studies by Winter (1982), the home range size of great gray owls varies from 372 acres (151 hectacres) to 753 acres (305 hectacres) and averages 593 acres (237 hectacres).

Historic Conditions

The historical distribution of meadow habitats is not totally known; however, 1945 Klamath County Inventory data show the existence of three large meadows in the Mountain Lakes Wilderness, long narrow meadows upstream of Buck Lake, and along Spencer Creek in the lower one-third of the watershed. Historically Buck Lake has been described as being marshy (Anderson, pers. comm. 1994) and therefore did not provide foraging habitat for the great gray owl. The meadows upstream of Buck Lake however, probably provided excellent habitat. In 1945, relatively large patches of late-successional forest were present within a suitable distance of two of the meadows in the wilderness area. A smaller amount of late-successional habitat was present in the vicinity of the meadow upstream of Buck Lake. The remainder of the forest in the vicinity of these meadows was in the mid to late-seral stage and could have provided suitable nesting habitat. Because the forest adjacent to the meadows in the lower watershed was probably dominated by more open ponderosa pine types, the canopy closure levels may not have been adequate for nesting by great gray owls.

Process of Change

The mechanisms of change to the foraging habitat for the great gray owl are discussed in the Riparian Ecosystem part. Forest habitat has been altered primarily due to logging but also fire suppression. Timber harvest has decreased the abundance of dense late-successional stands needed for nesting, but may have increased the foraging habitat where the stands are open enough to result in a dense cover of grass. However, without suitable nesting habitat within the maximum of 750 meters, this type of foraging habitat would not be beneficial. Availability of nest sites and suitable foraging habitat are considered the most important factors governing habitat use by breeding great gray owls (Lundberg 1979; Collins 1980; Nero 1980; and Mikkola 1983, cited in Hayward and Verner 1994).

Current Conditions

One of the only known sightings of a great gray owl in the watershed occured in the southwest portion near Surveyor Mountain in 1993. The great gray owl is considered rare or uncommon throughout its range in Oregon. This species is assumed to be declining because of loss of nesting sites (Goggans and Platt 1992).

Currently, potential foraging habitat is present in meadows upstream of Buck Lake. Buck Lake's pasture probably does not provide conditions suitable for the prey preferred by great gray owls. Based on the Pacific Meridian Resource data, meadows no longer appear to be present within the Mountain Lakes Wilderness. The suitability of the above areas for foraging by great gray owls are discussed in the Riparian Ecosystem part.

At the north end of Buck Lake, approximately 330 acres of mostly mid-seral forest is present within a suitable distance to potential foraging habitat. This mid-seral stage forest may not be mature enough to provide suitable nesting characteristics. Patches of late-successional forest that are about 200 acres each are present at the south and southeast end of Buck Lake. Considering the small patch size of these late-successional forest patches, and their distance to suitable foraging habitat, it is unlikely that nesting occurs.

Trend

Without specific management for some late-successional forest connectors within the matrix, species with large home-range size requirements that avoid openings, may not be able to take advantage of the wetland habitat in the vicinity of Buck Lake or utilize the watershed for travel between Late Successional Reserves.

Nesting habitat in the vicinity of Buck Lake could become available for the great gray owl as the stands of mid-seral forest north of Buck Lake mature. There is a possibility however, that these stands will be logged.

Summary

Fifty-five late-successional forest dependent species have been documented or have the potential to occur within the watershed (see Appendix 5). Some of the species documented in the watershed include nine species of bat, marten, and great gray owl.

About 2.4 percent of the Spencer Creek watershed is in Riparian Reserves. Unmapped Late Successional Reserves, the Bureau of Land Management's protected buffer areas around unmapped Late Successional Reserves, and Riparian Reserves combined, comprise 5.5 percent of the watershed. Within the Spencer Creek watershed, these reserves are not sufficient to provide connectivity corridors between Late Successional Reserves for some terrestrial species, such as the marten. It cannot be assumed the green tree retention requirements for harvest prescriptions within the matrix (under the Record of Decision for the Northwest Forest Plan) would always provide for the wildlife habitat characteristics needed within connectivity corridors. The result of harvest prescriptions would vary depending upon the characteristics of the stands prior to harvest and the site specific objectives of the prescription. In addition, the present distribution of late-successional forest within the matrix does not provide a connection between reserved areas of this habitat type. The fifteen percent late-successional habitat that would be retained under the requirement of the Record of Decision for the Northwest Forest Plan could contribute toward potential connectors if retained in certain locations.

Connectivity corridors would provide for movement and dispersal of some late-successional dependent wildlife species. Without specific management, late-successional dependent species that also use riparian/meadow habitat may not take advantage of this habitat. In addition, the watershed would unlikely be used for travel between Late Successional Reserves.

B. Spotted Owl

Introduction

This section specifically addresses the habitat condition of the northern spotted owl in the Spencer Creek watershed and how this population of owls relates to the regional population.

Issue 7: Habitat for Federally listed, proposed, or candidate species; State listed species; U.S.F.S. Region 6 Sensitive Species and BLM Special Status Species of wildlife has been altered.

Key Question: How has the spotted owl and/or its habitat been affected by past management activities?

Key Questions: Where does occupied and/or potential habitat occur? What is the condition of the habitat for the northern spotted owl?

Key Question: Is the intent of the Northwest Forest plan being met for the northern spotted owl?

Key Question: How does the population of northern spotted owls within the watershed contribute to the goals in the Northwest Forest plan for the regional population?

Key Question: Where are the 100-acre Late Successional Reserves associated with spotted owl sites located?

Assumptions/Analytical Process

Criteria were developed to query the Pacific Meridian Resource data to map both nesting/roosting/foraging habitat and dispersal habitat. The reference used to develop the criteria was Thomas et al. (1990). Specific criteria are included in Appendix 5. Once the query was run, a map of nesting/roosting/foraging and dispersal habitat was produced. This map was compared to suitable spotted owl habitat which had been mapped for the Klamath Ranger District of the Winema National Forest using aerial photographs. The nesting/roosting/foraging habitat from the two sources matched quite well; therefore, it was felt the reliability of the query and the Pacific Meridian Resource data was sufficient to map the spotted owl nesting/roosting/ foraging habitat for the watershed, including a two mile buffer. This allowed for a mapping process that would be consistent across all ownerships in the area.

It was determined an analysis of dispersal habitat for the northern spotted owl should be conducted during this watershed analysis based upon the following:

In a memorandum from the State Director of the Bureau of Land Management to the Field Supervisor of the U.S. Fish and Wildlife Service dated January 6, 1995, regarding Resource Management Plan (RMP) Compliance under Section 7 of the Endangered Species Act, it states that "During watershed analysis, province-planning efforts and the planning and design of individual projects, specific attention will be given to evaluating the likelihood of incidental take, impacts to dispersal habitat conditions for spotted owls and impacts to proposed and designated critical habitat of marbled murrelets and spotted owls, respectively. In a personal conversation between Patty Buettner and Joe Lint in July of 1995, Lint indicated that although the Northwest Forest Plan assumes that green tree retention, owl activity center protection, and Riparian Reserves provide dispersal habitat, it is the responsibility of the federal agencies to verify this assumption and to monitor future activities. The Northwest Forest Plan states on page B-13 that "watershed analysis should take into account all species that were intended to be benefited by prescribed Riparian Reserve widths", including northern spotted owls. "The specific issue for spotted owls is retention of adequate habitat conditions for dispersal". The Northwest Forest Plan also states on page 29 that "green tree retention, owl activity center protection, and the Riparian Reserves in particular mitigate timber harvest effects by providing for well distributed patches of late-successional forest that serve for dispersal of mobile species such as the northern spotted owl".

For these reasons, an analysis of dispersal conditions was conducted for the spotted owl. More discussion on the determination of dispersal habitat is given below.

The accuracy of dispersal habitat mapping using the Pacific Meridian Resource data is questionable. Calculations based on Pacific Meridian Resource data did not correspond to similar calculations previously developed by the BLM or USDA Forest Service. Bureau of Land Management and USDA Forest Service data were based upon stand exams and aerial photo interpretation. Analysis of dispersal condition was conducted in 1992 by BLM and in 1988 by the USDA Forest Service. On National Forest System-administered lands, some areas that were not initially counted as suitable dispersal habitat, were determined to be suitable based on later field visits. Areas which have been harvested subsequent to the original calculations were not considered.

The Pacific Meridian Resource data query used to identify dispersal habitat may not have accurately reflected the average dispersal condition. Because of the discrepancy between this data and the previous analyses mentioned above, it was decided that stand exam data and aerial photo interpretation results would more accurately reflect dispersal conditions.

Data on dispersal habitat conditions conducive to movement are limited, as are the methods of evaluating dispersal habitat. *In the absence of other peer-reviewed standards for adequate dispersal condition, 50-11-40 is used in this report for evaluating the current and potential future conditions for dispersal in the watershed.* The Interagency Scientific Committee defined 50-11-40 as forest conditions where 50 percent of the landscape contained forest that would provide shelter from weather and a prey source which would be likely to provide adequate survival and dispersal rates to supplement reserve populations (Thomas et al. 1990). Based on radiotelemetry information, forest stands with trees at least 11 inches average diameter at breast height and 40 percent canopy closure, would meet these minimal standards. To allow application on the ground, they defined the standard of 50 percent for federal lands only.

Where non-federal lands are interspersed with federal lands, maintaining 50-11-40 on federal lands within the quarter-township would still leave a landscape condition below 50-11-40. In such cases, dispersal opportunities might be limited.

Assumptions used include:

1. The model developed to query the 1988 Pacific Meridian Resource satellite imagery accurately reflects the nesting/roosting/foraging habitat used by the northern spotted owl.

2. The best method currently known to quantify the condition and adequacy of dispersal habitat for spotted owls is 50-11-40.

Analysis Discussion

Forest stands serve two, somewhat different, functions during the life of the spotted owl: as habitat for nesting, roosting, and foraging of resident (or territorial) birds; and as dispersal habitat for movements, primarily of young birds seeking territories. Both functions are critical to the population dynamics of the species. Habitat conditions suitable for nesting, roosting, and foraging will function for dispersal. However, not all habitat adequate to protect dispersing birds will provide nesting, roosting, or foraging opportunities for resident owls.

Historic Conditions

Within the Spencer Creek watershed, the forest types with the habitat attributes most suitable for the northern spotted owl are within the upper-elevation mixed conifer and Shasta Red Fir Zones. The tree species which would have been the most dominant within these zones include shasta red fir, Douglas fir, and white fir. Historical data from Leiberg (1899) indicate the percent of forest with these tree species were as follows by township and range:

T.37S, R.6E - 41%
T.37S, R.5E - 87%
T.38S, R.6E - 60%
T.38S, R.5E - 68%
T.39S, R.6E - 60%
T.39S, R.5E - 35%

It is important to note that only a portion of the watershed occurs within each township. The majority of the watershed is located within T. 38S, R. 5E and R. 6E (see Figure 2).

Within the Spencer Creek watershed it is estimated that the historical (1945) level of mid and late-seral stage forest within the red fir zone was 80 percent and the canopy closure probably exceeded 55 percent (see Table 19). The mid-seral stage habitat probably would have served primarily as foraging and dispersal habitat, but also as nesting and roosting where it was approaching the late-seral stage. Tree cavities were present due to the high percentage of Indian paint fungus presumed to be present historically. These cavities would have provided nest sites for the spotted owl.

Within the historic Mixed Conifer Zone (1945), approximately 55 percent of the forest, was in mid and late-seral stage forest and the canopy closure probably ranged from 20 to 60 percent, depending upon the elevation (see Table 15). These canopy closure levels would have limited the degree of use for nesting by the spotted owl, particularly where the mixed conifer forest was dominated by ponderosa pine with open park-like characteristics. The areas with 40 to 50 percent canopy closure could have been used for foraging and dispersal.

When fire occurred within the mixed conifer zone, spotted owl habitat may have been degraded for a decade or two, and, in limited areas, altered for longer periods (Agee 1993).

There are no records on the total acreage of spotted owl habitat or the number of spotted owl pairs or activity centers present within the historic Spencer Creek watershed. It is assumed that natural conditions provided dispersal habitat sufficient to allow for the dispersal of young and the maintenance of genetic diversity and interconnection of the population.

Process of Change

Within the red fir zone, there has been a reduction in the quantity of late-seral stands and an increase in early and early-mid-seral stands. This change is due to timber harvest, the majority of which has occurred within the last 40 years. The decrease in quantity of late-seral forest in the red fir zone has most likely decreased the availability of suitable nesting sites for the spotted owl in this zone. Agee (1993) states that most red fir forests have not experienced major alterations in forest species composition or structure due to the fire suppression policies of this century; therefore, habitat quality has probably not changed within the remaining stands.

Within the mixed conifer zone, it is speculated that in the East Cascades and Klamath Subregions, fire exclusion has helped create a broader landscape pattern of multiple-canopied stands with thick understories, thought to be suitable northern spotted owl habitat (Agee and Edmonds 1992, cited in Agee 1993) than occurred historically. Agee further states that although clear-cutting and fragmentation have reduced owl habitat in some areas, a policy of fire exclusion has helped to increase owl habitat in areas which were not owl habitat historically. It is unknown how the overall balance in the amount and quality of owl habitat has changed as a result of timber harvest and fire exclusion.

While historic owl numbers are unknown, within the last quarter-century four activity centers (2263, 0023, 0100, and 2390) known since the 1970s, and one as late as 1991, are no longer occupied. Two additional activity centers (1770 and 0024), which at one time had reproductive pairs, have either been unoccupied or have had only single birds over the last three years (see Table 25). The loss of occupancy by reproductive spotted owls in these activity centers is most likely due to habitat alteration and fragmentation as a result of timber harvest. Three of the four sites located since 1989 have produced young over the last three years. It is unknown when these sites were first occupied because extensive surveys were not initiated until around 1989. It is possible that one of the sites (3252) was not occupied until 1992.

Current Conditions

The Spencer Creek watershed contains 10,384 acres of spotted owl nesting/roosting/foraging habitat, which comprises 34 percent of the watershed in federal ownership. The distribution of this habitat is shown in Map 22.

Within the Spencer Creek watershed, nesting/roosting/foraging habitat is present within all land allocations. Acreages of nesting/roosting/foraging habitat are presented by land allocation in Table 26.

Within the Spencer Creek watershed, owls in six of the nine activity centers that have been active within the last three years, have produced young. Of the 13 activity centers known to be present since the 1970s, roughly half currently support reproductive pairs. The Master Site Number, name, location, reproductive history, and year the birds were first located are presented in Table 25.

Of the spotted owl activity centers occupied within the last three years, two are located within Late Successional Reserves, two within Critical Habitat Unit OR-37, one in the overlap area of Critical Habitat and Late Successional Reserve, one within the Mountain Lakes Wilderness, and three within the matrix (Table 27). One of the owls now located in a Late Successional Reserve originally nested in the wilderness area to the north.

The amount of habitat within the 1.2 mile home range radius for the 13 spotted owl activity centers within the watershed, is presented by site in Table 28. Where the quantity of suitable habitat within the home range radius is less than 40 percent of the median home range area (as estimated by a 1.2 mile radius circle), the pair is considered to be in habitat below levels sufficient for adequate survival and reproduction.

Eleven out of the thirteen owl pairs have habitat levels where survival and reproduction are expected to decrease. The two pairs that have sufficient habitat levels are in the wilderness or a Late Successional Reserve.

For those activity centers on lands administered by the Bureau of Land Management, 100-acre Late Successional Reserves have been mapped. Those spotted owl activity centers on National Forest System-administered lands which are outside of Late Successional Reserves R0-227 or R0-228 have not had the 100 acre Late Successional Reserves designated. These areas will be designated in the near future. The actual locations of these unmapped Late Successional Reserves cannot be revealed to the public.

One thousand, nine hundred and twenty-eight acres of suitable nesting/roosting/foraging habitat within the Spencer Creek watershed lie within designated Critical Habitat for the spotted owl, of which 940 acres are within the mapped Late Successional Reserves. Two currently active pair sites occur within that portion of the Critical Habitat outside of the Late Successional Reserve. Site 2265 is low on habitat, in both the 0.7 and 1.2 mile circles. It's long-term viability in the face of additional habitat removal is unknown. Site 1784 is slightly low in habitat within the 0.7 mile circle, but has a suitable quantity of habitat within the 1.2 miles. This site would likely persist in the absence of additional habitat loss. This Critical Habitat Unit was designed to provide a cluster of breeding spotted owls to form a source population. At least one of the two sites (1784) could function in this capacity.

Regional Population

The Spencer Creek watershed lies on the eastern edge of the range of the northern spotted owl. It contains parts of one large Late Successional Reserve (RO-227), one wilderness area, and is seven miles northeast of another large Late Successional Reserve (RO-247) (see Map 21). One additional small Late Successional Reserve (RO-228) lies within the boundaries of the watershed. A total of 5,845 acres of the watershed are within designated Late Successional Reserves and 5,920 acres are within the Mountain Lakes Wilderness.

Late Successional Reserve RO-227 lies partially within the watershed and extends to the northwest. This Late Successional Reserve encompasses approximately 52,400 acres of Federal land, of which 27,200 acres (52 percent) are currently considered spotted owl habitat (USDA, USDI 1994). Site RO-227 contains 37 known spotted owl sites (1987 to 1993), including 13 pairs that are known to have successfully reproduced. This Late Successional Reserve is generally well surveyed and this number may accurately represent the current population of owls within the Late Successional Reserve. Site RO-227 is immediately adjacent to the Mountain Lakes Wilderness and is connected to a large block of high elevation wilderness and Crater Lake National Park to the north (see Map 21). There is one known spotted owl site within the Mountain Lakes Wilderness. Owls associated with this site may freely interact with RO-227 and therefore supplement the population cluster.

The currently known population within Late Successional Reserve RO-227 and the adjacent wilderness is greater than 20 sites, though the habitat condition and viability of the individual sites is unknown. It is very likely that some of these sites are currently supported by habitat outside the Late Successional Reserve boundaries or may be below habitat levels that would continue to support breeding sites. The Interagency Scientific Committee (Thomas et al. 1990) concluded that individual populations of 20 interactive breeding pairs were likely to remain viable and extant for the short to intermediate term without high levels of input from outside populations, although they did assume some interaction or dispersal with neighboring population centers.

For the Spencer Creek watershed, information and time was insufficient to evaluate the habitat condition of each owl site within the Late Successional Reserve, or those immediately adjacent to the watershed.

The other large Late Successional Reserve (RO-247) lies approximately seven miles to the southwest of the watershed (see Map 21). This Late Successional Reserve encompasses approximately 32,600 acres of Federal land of which 9,800 (30 percent) is currently considered spotted owl habitat (USDA, USDI 1994). The Late Successional Reserve contains 19 known spotted owl pairs or resident singles (pers. comm. George Arnold, BLM Medford District). Site RO-247 is well surveyed and this number likely accurately represents the current population of owls within the Late Successional Reserve. This Late Successional Reserve is composed of checkerboard Federal lands, reducing its effectiveness as interior habitat and ensuring some continued fragmentation in the individual spotted owl home ranges.

Although the current spotted owl population within RO-247 is close to having 20 pairs, the viability of individual sites is unknown. Given the low percentage of habitat within the Late Successional Reserve, some individual sites are likely to have been severely impacted and may not be viable in the short term. Additional support from pairs on lands adjacent to RO-247 would reduce the chance of local extirpation of the species in this Late Successional Reserve. However, to supplement the population the additional owls would need to freely interact with the owls within the Late Successional Reserve. Spotted owls within the Spencer Creek watershed lie some distance from RO-247. The most direct route between Spencer Creek and RO-247 contains a large block of non-federal land that may affect movements. Birds could move westerly, then south through checkerboard Federal lands to the Late Successional Reserve. Birds could disperse between the Spencer Creek watershed and RO-247; however, it is unknown if pairs from Spencer Creek would contribute to a functional population cluster in RO-247.

A small Late Successional Reserve (RO-228) lies within the boundaries of the watershed, immediately south of the Mountain Lakes wilderness. This area contains approximately 2,800 acres of federal land in a checkerboard pattern interspersed with private ownership, of which 1,500 acres (54 percent) is currently considered suitable spotted owl habitat (USDA, USDI 1994). This Late Successional Reserve currently contains two known spotted owl sites. Within the past three years one site was occupied by a single bird and the other site was occupied by a pair for which reproduction has not been documented.

Late Successional Reserve RO-228 is extremely small and fragmented by checkerboard ownership, and is therefore unlikely to retain a viable population of spotted owls by itself. Habitat within this area may support more than one reproductive pair over time, as habitat conditions improve. It may also lend habitat support to sites within the immediately adjacent portions of the Mountain Lakes Wilderness.

Dispersal Habitat in the Spencer Creek Watershed

Young spotted owls leaving their natal areas each fall are the primary source of dispersing individuals, contributing to the interchange of genetic material and supporting existing local populations. Dispersing young provide the best source to replace territorial adults that have died. For populations to survive and remain viable, particularly in isolated reserves such as the Late Successional Reserve system, dispersing individuals must be able to survive and move among the reserves at levels at least sufficient to replace lost adults. This includes movements out of, and back into, the same reserve.

According to research on the dispersal of spotted owls, approximately two-thirds of young spotted owls radio-tracked from their natal area ended up within 12 miles of their starting place. The Interagency Scientific Committee designed their reserve areas to occur within 12 miles to encourage dispersal (Thomas et al. 1990). This concept was translated into the Late Successional Reserve system of the Northwest Forest Plan. While birds may move more than 12 miles of each other, it is likely that dispersal habitat within this distance of a reserve is of greater value in allowing movements between Late Successional Reserves than areas further away. Therefore, maintaining or developing habitat within 6 miles of any individual Late-successional Reserve is the most critical to promoting dispersal. Even where habitat does not lie directly between Late Successional Reserves, it functions to provide for the survival of young that move out of, then back into, the Late Successional Reserve.

The percentage of dispersal habitat present within each quarter township within the watershed is presented in Map 23. Based on stand exam data and aerial photo interpretation conducted in 1988 and 1992, dispersal condition was determined for quarter-townships in the watershed.

For those quarter-townships that cover all or a portion of the Spencer Creek watershed, all but two have adequate dispersal conditions on federal land (see Map 23). One of the quarter-townships deficient in dispersal habitat on federal lands is T.38S., R.6E, northwest quarter, which is just south of the Mountain Lakes Wilderness on Forest Service-administered lands. This quarter-township has 43 percent of the federal land base in dispersal habitat. The other quarter-township is deficient on Forest Service-administered lands only. However, it is in the southeastern portion of the watershed, relatively distant from the Late Successional Reserves and therefore less likely to affect dispersal among the Late Successional Reserves.

The Pacific Meridian Resource data query indicated that dispersal condition is inadequate in the majority of the quarter townships.

Regional Dispersal

The large Late Successional Reserves RO-227 and RO-247 lie within four miles of each other at their closest point, though this point is west of the Spencer Creek watershed (see Map 21). In this southern portion of the Cascade Mountains in Oregon, the Late Successional Reserve network is restricted to a single chain of reserves, increasing the importance of maintaining populations within each reserve and potential for significant movement between reserves.

Immediately southwest of the watershed is a large block of relatively-contiguous private land that lies immediately between much of the Spencer Creek watershed and the Late Successional Reserve RO-247. This private land potentially restricts movements through the southwestern portions of the Spencer Creek watershed between RO-247 and RO-227. Movements would still be possible through the northwestern portion of the Spencer Creek watershed and presumedly south through the Jenny Creek Watershed. In fact, spotted owls banded as juveniles within the Spencer Creek watershed have been relocated on the Klamath National Forest to the south in California, which indicates these birds are currently able to successfully disperse to the south.

Dispersal is very important to maintaining the connection of populations within and between physiographic provinces to improve population stability and viability. Given the low levels of nesting/roosting/foraging habitat in Late Successional Reserve RO-247, it is particularly important to support the population with significant dispersal of spotted owls from the neighboring Late Successional Reserves, such as RO-227. Maintaining adequate dispersal habitat within the Spencer Creek watershed is important to retaining connection between the populations.

Trend

The risk of losing spotted owl habitat to fire and insects has probably increased in some overstocked stands within the mixed conifer zone. Currently, higher fuel loads, more uniform multilayered canopies, and altered densities and species composition in such areas could result in an increased risk of a stand replacement fire and/or increased insect infestations. According to Agee (1993), a stand replacement fire would destroy owl habitat for at least 80 years. Within the red fir zone, stand conditions probably remain closer to the historical situation. The risk of owl habitat loss to stand replacing fires and/or insect infestation is much lower in the Shasta Red Fir Zone.

Historic information is lacking to measure the trend in dispersal habitat for spotted owls within the Spencer Creek watershed. However, the conversion of mid- and late-seral forest to early-seral and plantation stands has likely reduced the dispersal condition of the landscape. This is particularly acute in the areas with significant private lands as these areas have the greatest conversion rate to early-seral forest and are likely to remain in early- to mid-seral condition with continued management for wood fiber.

Based on the Northwest Forest Plan allocations and requirements, approximately 13,680 acres (25 percent) of the entire watershed would be in a reserve status (mapped and unmapped Late Successional

Reserves, Riparian Reserves and Wilderness). Most of this is concentrated in the north and northwest portion of the watershed. Within the matrix, 5.5 percent of the federal lands are within Riparian Reserves, unmapped Late Successional Reserves, or the Bureau of Land Management's protected buffer areas around unmapped Late Successional Reserves. This area, by itself, is inadequate to provide adequate dispersal condition for spotted owls. The requirement for 15 percent of federal lands within the watershed to be maintained in late-successional forest, would only ensure 15 percent dispersal habitat.

Given the partial harvest methods commonly used in this area, it may be possible to maintain adequate dispersal conditions within the harvest constraints of the Northwest Forest Plan for matrix lands.

The two spotted owl activity centers (1785 and 2758) which currently have sufficient habitat within the 1.2 mile home range radius, are likely to remain viable because they are located in wilderness or Late Successional Reserve and are in the red fir zone. Habitat conditions for two additional owl sites (0039 and 0024) are likely to improve because of their location in Late Successional Reserve RO-227 and RO-228. The remaining spotted owl activity centers within the watershed are located in the matrix and are currently below the take level. It is unlikely these owl sites will remain viable over time.

Summary

Historically, nesting habitat for the spotted owl was likely present in the red fir zone and upper elevations of the mixed conifer zone. The lower elevation area of the Mixed Conifer Zone probably provided foraging habitat. The decrease in quantity of late-successional forest in the red fir zone has most likely decreased the availability of suitable nesting sites. In the mixed conifer zone, fire exclusion has helped create a broader landscape pattern of multiple-canopied stands with thick understories, thought to be suitable spotted owl habitat (Agee and Edmonds 1992, cited in Agee 1993). However, a large amount of the mixed conifer zone has been logged.

Of the thirteen spotted owl activity centers known to be occupied since the 1970s, nine have been active within the last three years. Six of these nine sites have had successful reproduction within the last three years. The loss of occupancy by reproductive spotted owls is most likely due to habitat alteration and fragmentation as a result of harvest.

The majority of spotted owl habitat available occurs in the wilderness or Late Successional Reserve. Of the nine spotted owl activity centers occupied within the last three years, four are located in wilderness or Late Successional Reserve and five in the matrix, two of which are in Critical Habitat Unit OR-37.

Dispersal habitat within the Spencer Creek watershed is adequate except within one quarter-township close to the Late Successional Reserves. This quarter-township has 43 percent dispersal habitat on federal lands. Although a new dispersal habitat query should be run on the Pacific Meridian Resources data and any discrepancies with the stand data examined, for now dispersal condition appears adequate in the matrix to provide exchange of spotted owls between these two Late Successional Reserves.

There are two late successional reserves within the Spencer Creek watershed. Late Successional Reserve RO-227 has greater than 20 interactive breeding pairs of spotted owls; therefore, the population is likely to remain viable and extant for the short to intermediate term. Late Successional Reserve RO-228 is unlikely to retain a population of spotted owls alone, due to its small size and interspersion with private ownership; however, provided habitat conditions remain suitable in the Mountain Lakes Wilderness, this area would provide for exchange and interaction with the population of owls in Late Successional Reserve RO-227.

A large Late Successional Reserve (RO-247) approximately seven miles to the southwest of the Spencer Creek watershed nearly has the recommended number of owl pairs; however, many of these pairs have less than the amount of habitat needed to remain viable. In order for this population of owls to remain viable, it needs to be supplemented with owls from adjacent lands. One source of spotted owls would be from Late Successional Reserve RO-227. Over the long term it is less likely the matrix of the Spencer Creek watershed would provide a source of spotted owls to RO-247 because of the expected long-term viability of the owl sites in the matrix of the Spencer Creek watershed.

Table 25. Reproductive history for the northern spotted owl activity centers within the Spencer Creek Watershed

Owl Site No.	Site Name	Location	Reproductive History 1994	1993	1992	Year First Located
2758	Upper Clover Creek	T38S, R6E, S3	P	P	P/Fn	1991
1785	High Knob I	T37S,R6E,S32	R2Y	P	R2Y	1990
1770	Little Aspen Butte	T38S,R6E,S2	S	S	U	1977
0039	High Knob	T37S,R5E,S36	P/FN	P	R1Y	1972
1784	Ichabod Quarry S,	T37S,R5E,S33	S	R1Y	P	1982
2263	Crystalline Spring	T37S,R5E,S35	U	U	U	1977
2265	Burton Butte	T38S,R5E,S9	R2Y	P	P	1977
0023	Buck Lake	T38S,R6E,S7	U	U	U	1972
0024	Buck Peak	T38S,R6E,S9	U	U	S	1977
0100	Buck Lake (BLM)	T38S,R5E,S23	U	U	U	1974
2390	Spencer Creek	T38S,R6E,S19	U	U	U	1991
3252	E. Miners Creek	T38S,R6E,S33	P/FN	R1Y	P	1992
2065	Miner's Creek	T39S,R6E,S5	2A	R1Y	R2Y	1989

P = Pair
FN = Failed Nest
R1Y & R2Y = Reproductive with 1 of 2 young
S = Single Bird
2A = 2 Adults
U = Unoccupied.

Table 26. Acres of total nesting/roosting/foraging habitat within the Spencer Creek Watershed by land allocation

LSR	2,014
RR	288
UMLSR	184
WLD	3,080
MATRIX	4,818

LSR = Late Successional Reserve
RR = Riparian Reserve (Option 9)
UMLSR = Unmapped Late Successional Reserve
WILD = Wilderness

Table 27. Spotted Owl Activity Center Status in 1994, by Land Allocation[1]

OWL SITE #	CUR. ACT.	CHU	LSR	CHU/LSR	RR	CHU/RR	WLD	MATRIX
2758	Y	-	X	-	-	-	-	-
1785	Y	-	-	-	-	-	X	-
1770	Y	-	-	-	-	-	-	X
0039	Y	-	-	X	-	-	-	-
1784	Y	X	-	-	-	-	-	-
2263	N	-	-	X	-	-	-	-
2265	Y	X	-	-	-	-	-	-
0023	N	-	-	-	-	-	-	X
0024	Y	-	X	-	-	-	-	-
0100	N	-	-	-	-	-	-	X
2390	N	-	-	-	-	-	-	X
3252	Y	-	-	-	-	-	-	X
2065	Y	-	-	-	-	-	-	X

[1]Sites active within the last three years
Abreviations used in the Table:
Cur. Act. = Current Activity
CHU = Critical Habitat Unit
LSR = Late-Successional Reserve
RR = Riparian Reserve
WLD = Wilderness

Table 28. Spotted Owl Nesting/Roosting Habitat

Owl Site	Acres of Habitat Within 0.25 Miles	Acres of Habitat Within 0.7 Miles	Acres of Habitat Within 1.2 Miles	Percent Of HRR >500 acres/>1182 acres 0.7 mi/1.2 mi	Below Take Level Y/N
2758	113	678	1839	Y/Y	N
1785	118	730	1893	Y/Y	N
1770	76	474	972	N/N	Y
0039	86	420	1267	N/Y	Y
1784	60	378	1185	N/Y	Y
2263	62	462	1445	N/Y	Y
2265	94	454	920	N/N	Y
0023	54	224	572	N/N	Y
0024	66	366	722	N/N	Y
0100	86	312	510	N/N	Y
2390	80	422	818	N/N	Y
3252	42	286	628	N/N	Y
2065	74	302	566	N/N	Y

Without field verification, it is unknown how much if any could be suitable habitat. Because of this, only preferred habitat was quantified and discussed. Although secondary habitat could not be reliably quantified, maps of it are available and could be used for field verification of forest types considered to be of secondary importance.

Snag data were not available for stands believed to be representative of the habitat types preferred by the wildlife species analyzed here; therefore, an analysis of the adequacy of snags was not conducted.

The Pacific Meridian Resource wildlife species queries reflect a fairly accurate picture of the preferred habitat available for a given species. The quantity of habitat is a rough estimate.

Analysis Discussion

Historic Conditions

Historically (1945), approximately 55 percent of the ponderosa pine and mixed conifer forest within the Spencer Creek watershed was in mid and late-seral stages, 41 percent was in early-mid, and three percent was in early.

Historical data from Leiberg (1899) indicates the percent of ponderosa pine forest within the vicinity of the watershed by township and range was as follows:

T.37S, R.6E - 10%
T.37S, R.5E - 1%
T.38S, R.7E - 60%
T.38S, R.6E - 30%
T.38S, R.5E - 25%
T.39S, R.7E - 73%
T.39S, R.6E - 31%
T.39S, R.5E - 60%

It is important to note that only a portion of the watershed occurs within each township. The majority of the watershed is within T. 38S, R. 5E and 6E where the percent composition of ponderosa pine forest ranged from 25 to 30 percent. The greatest concentration of ponderosa pine forest appeared to be within the southeast corner of the watershed in T.39S, R.7E. Figure 1 shows the location of the townships and the percent forest composition within these townships.

According to the 1945 Klamath County Inventory, ponderosa pine was the dominant component on approximately 25,000 acres (46 percent of the watershed).

According to Merle Anderson (pers. comm., 1994), there was mainly ponderosa pine in the area with some sugar pine, white fir, and red fir. The area he was referring to is assumed to be the general area of the Spencer Creek watershed. The characteristics of late-seral ponderosa pine have been described by various sources. According to Agee (1993), the lower elevation mixed conifer forests with a large component of ponderosa pine were open and parklike in the mid-nineteenth century. Covington and Moore (1994a) describe the large size of pine trees, the forest's open structure (less than or equal to 25 to 30 percent canopy closure), the low abundance of underbrush or small trees, and the excellent grass cover.

At the turn of the century 10 to 15 percent of the trees in the ponderosa pine forests had trees with dead tops. Insects killed about one tree per acre. Root pathogens also contributed to the snags in the stand (Munger 1917, cited by Hopkins et al. 1993).

Process of Change

The ponderosa pine forests within the watershed have changed considerably from historic conditions due to timber harvest and fire exclusion. The greatest change has been the loss of large pine through harvest. including the conversion to plantations. Fire exclusion has contributed to the increase in composition of shade-tolerant species including white fir and a dramatic decrease in shade-intolerant species including ponderosa pine, sugar pine. and to some degree Douglas fir.

In the lower part of the watershed, the large old growth pine were some of the first trees to be removed on both private and federal land. The condition of the stands on both National Forest System Lands and those administered by the Bureau of Land Management indicate that the dominant harvest prescription was until recently overstory removal of large overstory trees (ponderosa pine, Douglas fir, and sugar pine). Weyerhaeuser Company has entered a typical

C. Ponderosa Pine Associated Species

Introduction

Under this subsection, the analysis of the function of the physical habitat for wildlife is focused on species that are strongly associated with ponderosa pine forest. The historic condition of the ponderosa pine forest, how this forest has changed, and how these changes may have affected the wildlife species dependent upon it, will be discussed. More detailed analysis is made for those species determined to be the highest priority for analysis. These include the federally listed bald eagle and species requiring protection buffers in the "Standards and Guidelines" of the Northwest Forest Plan (white-headed woodpecker, black-backed woodpecker, pygmy nuthatch, and flammulated owl).

Species' life history information is included to answer portions of the key questions and to clarify the discussion on historic habitat conditions, changes, and current conditions.

Information on the ponderosa pine forest is discussed in detail under the Vegetation section (Mixed Conifer Zone and Ponderosa Pine Zone). Some of that information is summarized below where it is pertinent to the discussion of wildlife.

Issue 7: Habitat for Federally listed, proposed, or candidate species; State listed species; USDA Forest Service Region 6 Sensitive Species; and BLM Special Status Species of wildlife has been altered.

Key Questions: Where does occupied and/or potential habitat occur? What is the condition of this habitat for species determined to be the highest priority for analysis?

Key Question: How have these species and/or their habitat been affected by past management activities?

Key Question: Where does occupied and/or potential habitat occur for those species which require protection buffers as stated in the Record of Decision for the Northwest Forest Plan?

Assumptions/Analytical Process

Pacific Meridian Resource data was used to map preferred habitat for the bald eagle, white-headed woodpecker, black-backed woodpecker, pygmy nuthatch, and flammulated owl. Queries were developed based on literature review of the habitat requirements for these species. Pacific Meridian Resource classification categories did not always perfectly match habitat criteria, therefore there may be errors for some species.

The literature reviewed to develop each query by species is as follows:

- Bald Eagle: U.S. Fish and Wildlife Service 1986; Anthony and Isaacs 1989.
- White-headed woodpecker: Blair 1993; Frederick and Moore 1991; Marshall 1992.
- Black-backed woodpecker: Marshall 1992a; Marshall 1992b; Goggans, Dixon, and Seminara 1988.
- Pygmy nuthatch: Chapel et al. 1992; Marshall 1992a.
- Flammulated owl: Hayward and Verner 1994; Marshall 1992a.

Suitable habitat may be underestimated for some wildlife species due to the Pacific Meridian Resource classification system for tree species. Preferred habitat is mapped when the preferred tree species are specified to be dominant or codominant within a stand. In this case there is a high level of confidence the suitable habitat is present. However, where there is less than 25 percent of any one given tree species in a stand, the composition is unknown and it is referred to as a mix. Some moderately suitable, or secondary habitat may be present in the stands categorized as mixed.

stand on the average of five times and has recently thinned their stands leaving residual ponderosa pine at very low densities (Sokol 1994).

The change in structure of the ponderosa pine forest within the watershed has been the reduction of large, old growth pine and the ability to recruit old growth pine into future stands (see the Terrestrial section, Part I. Vegetation for more detail).

Current Conditions

Under current conditions within the watershed, 7 percent of the mixed conifer/ponderosa pine forest is in late-seral, 18 percent is in mid-seral, 44 percent is in early-mid, and 31 percent is in early-seral stage forest. The lower portion of the watershed is comprised of second growth ponderosa pine, Douglas fir, and white fir ranging in size from 6 to 18 inches in diameter at breast height. The largest concentrations of late-successional stands occur on federal lands in the upper two-thirds of the watershed.

Currently, about 8,500 acres (8 percent) of the watershed is in ponderosa pine.

Wildlife

There are at least 16 known species of wildlife that are associated with ponderosa pine forests or forests with some component of this tree species. Twelve of these wildlife species are known to occur within the Spencer Creek watershed and two may potentially occur (see Appendix 5). A detailed analysis of five of these species is covered below.

Bald Eagle

The bald eagle is listed as threatened in Oregon by the U.S. Fish and Wildlife Service. The Spencer Creek watershed is within the Klamath Basin Recovery Zone under the Pacific Bald Eagle Recovery Plan. Spencer Creek does not fall within a "Key Area" for which target recovery territory goals have been set. The nearest "Key Area" is the Klamath River. Although Spencer Creek is not within a "Key Area", the Recovery Plan states that eagle requirements should be met in potential and occupied nesting areas (USFWS 1986).

Bald eagles within the inland pacific northwest are found in close association with lakes, reservoirs, rivers, or large streams that provide abundant prey and suitable nesting habitat (Anthony et al. 1982; Lehman 1979). In the Klamath Basin, the majority of nests are located within 0.7 mile of water. Bald eagle nests are usually located in uneven-aged (multistoried) stands with old growth components (Anthony et al. 1982). Trees selected for nesting are characteristically the largest in the stand or at least codominant with the overstory. Trees typically used for perching and nesting east of the Cascades on land surrounding Upper Klamath Lake are ponderosa pine, Douglas fir. and sugar pine. This is consistent with the findings of a study of nest trees in Oregon by Anthony and Isaacs (1989). They found ponderosa pine and Douglas fir were the most frequently used species for nest construction.

Historic Conditions

Based upon the discussion of the historic ponderosa pine habitat present within the Spencer Creek watershed, nesting and perching habitat is presumed to have been fairly widespread in the lower portion of the watershed in the vicinity of Buck Lake, along Spencer Creek, and along the Klamath River.

The species of prey present historically has not been verified; however, oral histories indicate there is a good possibility that runs of Chinook salmon occurred in Spencer Creek and a chance that steelhead also spawned in the creek. Verified runs of anadromous fish were present in the Klamath River in the vicinity of Spencer Creek and migratory rainbow trout and resident trout were present within Spencer Creek. In addition to these fish species suckers could have provided a prey base for the bald eagle. A detailed analysis of the presence and distribution of fish species within the watershed is covered in the "Aquatic Resource" section.

Prey in the form of waterfowl were probably available at Buck Lake which was "swampy" according to oral history from Merle Anderson who lived near the confluence of Spencer Creek with the Klamath River during the period before Buck Lake was altered in the 1940s.

It is unknown how many eagle pairs may have nested in the area historically but it is likely there were reproductive pairs due to the abundance of prey species and nesting habitat.

Process of Change

Ponderosa pine provides one of the key habitat components for the bald eagle. The changes to the ponderosa pine forest are discussed above and in more detail in the "Vegetation" section.

The biggest change in the prey base has been the loss of anadromous fish runs in the portion of the Klamath River near the confluence of Spencer Creek. Salmon and steelhead are now absent from this portion of the river due to the construction of Copco Dam in 1917. This dam is approximately 25 miles downstream from the mouth of Spencer Creek on the Klamath River. Resident trout and spawning runs of migratory trout still occur within Spencer Creek. Eastern brook trout are now present in Tunnel Creek due to introduction which probably occurred in the 1930s (J. Fortune, pers. comm. 1994).

Since Buck Lake was drained in 1944, the number of waterfowl using the area has probably decreased substantially. Another source of prey has become available since the draining of Buck Lake. According to Hugh Charley (pers. comm. 1994b) who currently lives at Buck Lake, hundreds of ground squirrels are now present in the old lake bed.

Current Conditions

One nesting pair of bald eagles has been observed periodically along Spencer Creek since 1991. The bald eagles observed occupied a territory site along the creek in 1991 and 1992; however, no eggs or young were observed. The site was unoccupied in 1993. In 1994 the location of the site was unclear (Isaacs and Anthony 1994); however, approximately one mile west of the nest site, Waterbury observed a pair on June 1, 1994 flying from west to east (ODFW 1994).

Hugh Charley has observed an average of four to five bald eagles a year in the Buck Lake area. He has seen them during all seasons, but particularly during the early summer. He has observed the eagles take ducks (pers. comm. 1994b).

Currently, suitable nesting habitat in the watershed within 0.75 mile of Spencer Creek, Buck Lake, and the Klamath River is extremely scarce. Suitable nesting habitat is presented in Map 24. Habitat within 0.75 mile of these water sources is the most likely to be used for nesting, based upon data for nest sites in the Klamath Basin (Anthony et al. 1982).

Trends

Considering the very limited quantity of suitable nesting habitat in the watershed and the limited foraging capacity of Buck Lake, it is unlikely more than one or two pairs of bald eagles would nest in the watershed in the short term. However, considering the distribution of nesting and foraging habitat and the home range size of bald eagles, the Buck Lake area would be the most likely site for a second pair of nesting birds. In the long term (100 years), more nesting habitat may become available on federal land with proper management of ponderosa pine and Douglas fir habitats; however, foraging opportunities are limited within 0.75 miles of suitable nesting sites on federal land. On private land, which happens to be the closest to more suitable foraging habitat, it is unlikely pine greater than 20 inches diameter at breast height will occur for many decades, if ever.

White-headed Woodpecker

White-headed woodpeckers prefer open-canopied stands of mature and older ponderosa pine and, to a lesser degree, mixed ponderosa pine and Douglas fir (Weber and Cannings 1976; Cooper 1969; Burleigh 1972; Ligon 1973, cited in Blair

1993; Frederick and Moore 1991). Sugar pine, and red and white fir forests have been reported to provide secondary habitat (Scott et al. 1977, cited in Blair 1993). Home range sizes for white-headed woodpeckers vary depending upon the quality and fragmentation of the preferred habitat. Recent estimates range from an average of 261 acres in good habitat to 1,100 acres in fragmented habitat (Rita Dixon, pers. comm., cited in Blair 1993).

White-headed woodpeckers prefer to nest in snags. Snag diameters of nest trees in Oregon averaged 26 inches diameter at breast height according to R. Dixon (pers. comm. cited in Blair 1993). Milne and Hejl (1989) as cited in Blair (1993) reported local breeding territories in the Sierra Nevada to be about 24 acres in size.

White-headed woodpeckers forage mainly on large (greater than 24 inches diameter at breast height) live ponderosa pine trees. Dependence on ponderosa pine may be partly explained by the fact that the large seeds of this species comprise up to 60 percent of the annual diet and provide a crucial winter food supply for these birds. Ponderosa pine do not produce heavy seed crops until 60 to 100 years of age.

Historic Conditions

Based upon the characteristics and distribution of the historic ponderosa pine habitat present within the Spencer Creek watershed, breeding and feeding habitat is presumed to have been fairly widespread in the lower elevations of the watershed. It is assumed that the white-headed woodpecker was fairly common because of the historic distribution of ponderosa pine.

Process of Change

Habitat reduction and the resulting increased interspecific competition with other cavity-nesting species is the most likely cause for the decline of the white-headed woodpecker throughout its range. Past forest management practices applied in ponderosa pine and Douglas fir habitat types are assumed to have contributed to the loss of large trees and snags important to the white-headed woodpecker. Studies of snag use by a variety of cavity-nesting birds of the Sierra Nevada (Raphael and White 1984) suggest that the foraging niche of the white-headed woodpecker strongly overlaps with a wide range of other cavity-nesting bird species. The inability of white-headed woodpeckers to successfully compete with these other cavity-nesting birds may be limiting this species abundance (Milne and Hejl 1989, cited in Blair 1993).

Current Conditions

Surveys have not been conducted in the Spencer Creek watershed for the white-headed woodpecker, therefore its frequency is unknown.

Currently less than 1,500 acres of preferred habitat occurs within the Spencer Creek watershed for the white-headed woodpecker. This habitat is scattered across the landscape (see Map 25).

Patch size of the preferred habitat was not determined; however, considering the fragmentation of the preferred habitat and the relatively large home range size required in fragmented habitats, the white-headed woodpecker is probably relatively scarce in the watershed.

Trends

Considering the quantity, distribution, and declining health of the preferred forest habitat types in the watershed, suitable habitat conditions will remain scarce in the short term. With proper management in appropriate forest types, including controlled burns and control of tree species composition and density through thinning, habitat may become more available on federal lands within 60 to 100 years. With management of protection buffer requirements for this species, conditions could improve in forest stands which currently meet the minimal requirements for this bird. Unless management practices change, it is unlikely habitat will develop on private lands.

Pygmy Nuthatch

The pygmy nuthatch prefers uneven-aged ponderosa pine forests with medium to large sized trees, although they will forage in younger trees (Marshall 1992). Very limited information was available on preferred canopy closure levels. In a study of preferred habitats in Arizona, canopy closure was usually less than 50 percent (Cunningham et al. 1980, cited in Chapel et al. 1992).

The pygmy nuthatch is heavily dependent on snags which are used for nesting and feeding. Nuthatches prefer large broken-topped snags with a minimum of 60 percent bark which are at least 24 inches diameter at breast height (Marshall 1992).

The breeding territory size of pygmy nuthatches is about 5 acres (Marshall 1992).

Historic Conditions

Ponderosa pine provides the preferred habitat for the pygmy nuthatch. The condition of the historic ponderosa pine forests are discussed above and in more detail in the Vegetation section.

Based on the habitat needs of the pygmy nuthatch, the characteristics of the historic ponderosa pine forests appear as though they would have met the needs of this species.

Process of Change

Changes to the ponderosa pine forest are discussed above and in more detail in the Vegetation section.

Current Conditions

Currently less than 1,500 acres of habitat preferred by the pygmy nuthatch is present within the Spencer Creek watershed. This habitat is scattered across the landscape.

Considering the small home range size of this species, it is probably more abundant than species with large home range sizes such as the white-headed woodpecker. Because the number and sizes of snags present is unknown, the capability of the habitat to support this species is unknown.

Trends

Considering the quantity, distribution, and declining health of the preferred forest habitat types in the watershed, suitable habitat conditions (such as large pines) will remain scarce in the short term. With proper management including controlled burns and control of tree species composition and density through thinning, habitat may become more available on federal lands within 60 to 100 years. With management of protection buffer requirements for this species, conditions could improve in forest stands that currently meet the minimal requirements for this bird.

Black-backed Woodpecker

In Oregon the black-backed woodpecker is associated with lodgepole pine, ponderosa pine, or mixed forests containing the above pine types mixed with true fir (Marshall 1992a). In response to local temporary abundance of food, black-backed woodpeckers are frequently found in areas having fire, wind, or insect-killed trees that are infested with bark-beetles. The black-backed woodpecker tends to be more common in lower elevation forests ranging from 3,000 to 5,400 feet (Marshall 1992b).

For foraging, the results of two studies east of the Cascade Range showed these birds tend to select mature and over-mature lodgepole and ponderosa pine, both live and dead (Marshall 1992b). Bull et al. (1986) cited in Marshall (1992b), found the average diameter of forage trees to be 13 inches diameter at breast height and 62 feet tall.

Results of studies in Oregon indicate a preference for nesting in both live and dead lodgepole and ponderosa pine, especially those with heart rot. Black-backed woodpeckers select for relatively small diameter trees for nesting. Nest tree diameters averaged between 11 and 20 inches diameter at breast height depending upon the study (Marshall 1992a). Bull et al. (1986), cited in Marshall (1992b), believes this is related to the fact that the sapwood layer is thicker in ponderosa pines. The sapwood decays more quickly than the heartwood, therefore making nest excavation easier.

A pair of black-backed woodpeckers is believed to need a minimum of 956 acres of lodgepole pine dominated habitat in mature or over-mature condition according to Goggins et al. (1987), cited in Marshall (1992b).

Historic Conditions

Historic conditions for ponderosa pine are summarized above and discussed in more detail in the Vegetation section.

Klamath County Inventory data indicates that about 98 percent of the lodgepole pine forest was in the mid to late-seral stage in 1945. Prior to this, Leiberg (1899) indicates there was a large burned area poorly stocked with lodgepole pine which extended from about 0.5 mile south of Buck Lake and north out of the watershed.

Aerial photographs from 1940 to 1950 indicate the presence of bands of lodgepole along Spencer Creek, in the area surrounding and upstream of Buck Lake, in the Desolation Swamp area, and along a tributary to Spencer Creek which enters just downstream of Buck Lake. At that time, there were approximately 4,930 acres of forest dominated by lodgepole pine.

Process of Change

The changes in the ponderosa pine stands are summarized above and discussed in more detail in the Terrestrial part of the Vegetation section.

The bulk of the stands that historically contained mature and dying ponderosa pine have been converted to actively growing even-aged stands of young trees which will likely be harvested before they can meet the needs of the black-backed woodpecker.

Some harvest of lodgepole pine stands has occurred in the Spencer Creek watershed. The seedtree or clearcut harvest prescriptions have been in small patches on federal land. In addition, unauthorized cutting of lodgepole pine for firewood is a problem in the Spencer Creek watershed. Both the timber harvest and firewood cutting has resulted in a decrease in the number of lodgepole pine snags and downed wood.

The composition of lodgepole pine stands has changed due to fire exclusion with a slow increase in shade tolerant species, including white fir.

The 1940s aerial photos indicate a greater amount of lodgepole pine in the vicinity of Buck Lake, particularly along the western and southern boundary, compared to present. It is possible the decreased quantity of lodgepole pine is a result of the draining of Buck Lake which occurred in the mid-1940s. Historically, this lake was reported to be swampy and held up to four to five feet of water in the spring after snowmelt.

Current Condition

The current condition of ponderosa pine forests is summarized above and discussed in more detail under the Terrestrial part of the Vegetation section.

The amount of lodgepole pine present in the watershed has decreased from levels in the 1940s. Presently, about 2,866 acres of forest dominated by lodgepole pine is present. This is a decrease of about 42 percent from 1945.

The amount of currently available preferred habitat for the black-backed woodpecker is less than 2,000 acres.

The decrease in quantity and increase in fragmentation of ponderosa and lodgepole pine forests, in addition to the altered fire regimes and woodcutting, have almost certainly had a negative impact on the abundance of black-backed woodpeckers. Because the black-backed woodpecker requires a large home range size, populations numbers are probably very low in the watershed.

Trends

The ponderosa pine forest is unlikely to provide sufficient quantities of suitable habitat within the short term. With proper management including controlled burns and control of tree species composition and density through thinning, habitat may become more available on federal lands within 60 to 100 years.

Where dense patches of mature lodgepole pine occur, future outbreaks of mountain pine beetle will most likely occur, particularly if drought conditions continue. This would provide additional foraging as well as nesting habitat for the black-backed woodpecker.

The forest is currently vulnerable to stand replacing fires in the areas where the stands are overstocked. Such an event would provide a localized temporary abundance of food for the black-backed woodpecker.

If unauthorized firewood cutting continues unabated, the number of lodgepole pine snags that provide habitat for this woodpecker species will continue to decrease.

Lodgepole pine forest within the watershed offers the best opportunity to provide enough available habitat to support reproductive pairs of the black-backed woodpecker within the near future. Thirty-seven percent of the lodgepole pine forest present is currently in mid-seral stage and should provide suitable habitat within 10 to 20 years.

With management of protection buffer requirements for this species, conditions could improve in forest stands that currently meet the minimal requirements for this species.

Flammulated Owl

Although no systematic surveys have been conducted for the flammulated owl within the Spencer Creek watershed, this species has been documented in the northern portion of the watershed.

The flammulated owl occurs mostly in mid-level conifer forests that have a significant component of yellow pine (ponderosa and jeffrey pine). The flammulated owl will also utilize very dry submontane interior Douglas fir stands that are more open due to selective logging (Hayward and Verner 1994). The flammulated owl's preference for ponderosa pine and/or Douglas fir has been linked to prey availability of lepidopteran species associated with these forests (Reynolds and Linkhart 1992, cited in Hayward and Verner 1994).

A significant selection for mostly open patches of old ponderosa pine/Douglas fir and avoidance of patches of both young conifer and mature aspen vegetation was shown by Linkhart 1984; Reynolds and Linkhart 1992, cited in Hayward and Verner 1994.

In northeast Oregon, a study of habitat structure and nest-tree characteristics indicated habitat on ridges, upper slopes, south and east slopes was generally selected (Bull et al. 1990, cited in Hayward and Verner 1994). Two studies in Oregon indicated an average minimum nest tree diameter of 22 and 28 inches (Goggans 1986 and Bull et al. 1990, cited in Hayward and Verner 1994). Flammulated owls are secondary cavity nesters. The preferred cavities for nesting in Oregon are those excavated by the pileated woodpecker (Bull et al. 1990, cited in Hayward and Verner 1994).

In contrast to foraging and nesting habitat, preferred roosting habitat appears to be dense vegetation. In one Oregon study, these owls roosted disproportionately in multilayered, mixed-conifer forest with a ponderosa pine component (Goggans 1986, cited in Hayward and Verner 1994). Pure ponderosa pine stands were avoided, although they strongly selected ponderosa pines for roost trees within mixed conifer stands. In Oregon, mean distances from roosts to nests ranged from 27 yards to less than 109 yards depending upon the stage of the nestlings.

Average home range size during the breeding season ranges from 39 acres during incubation to 9 acres during the fledgling period (Goggans 1986, cited in Hayward and Verner 1994).

Historic Conditions

Based upon the characteristics of the historic ponderosa pine forest present within the Spencer Creek watershed, breeding/feeding habitat for the flammulated owl is presumed to have been fairly widespread. Data on the distribution of forest types from 1945 photographs indicate there were a few patches of late-seral stage Douglas fir forest totaling 1,335 acres. It is unlikely these stands were open enough to provide suitable habitat for the flammulated owl.

Process of Change

Habitat reduction resulting from forest and fire management practices are the major factors affecting the abundance and distribution of the flammulated owl. Some remnant trees remaining after past logging may have been sufficient in number and size to provide some nesting cavities, but they were not sufficiently dense to allow for safe roosting. As fire suppression led to the establishment of denser forest, more roosting habitat may have become available; however, the resulting poor foraging quality would remain the major determinant of population persistence (Hayward and Verner 1994).

Current Conditions

The quantity of preferred nesting/breeding habitat in which the stands are open and dominated or co-dominated by mature ponderosa pine and Douglas fir, comprise less than 900 acres. Disregarding canopy closure, less than 1,500 acres have the characteristics of suitable tree species and size structure but may be either too dense or open to provide optimal foraging or nesting habitat. Suitable roosting habitat within relatively close proximity to suitable nesting/foraging habitat totals less than 2,500 acres.

Trends

Considering the quantity, distribution, and declining health of the preferred forest habitat types in the watershed, suitable habitat conditions will remain scarce in the short term. With proper management including controlled burns and control of tree species composition and density through thinning, habitat may become more available on federal lands within 60 to 100 years. With management of protection buffer requirements for this species, conditions could improve in forest stands that currently meet the minimal requirements for this bird.

Summary

The ponderosa pine forests within the watershed have changed considerably from historic conditions due to timber harvest and fire exclusion. The greatest change has been the loss of large pine through harvest, including the conversion to plantations. The presence of shade tolerant species such as white fir, is preventing the recruitment of ponderosa pine into the forest. It is estimated that the extent of forest dominated by ponderosa pine has been reduced from approximately 25,000 acres in 1945 to 8,500 acres currently. Very little of this is late-seral ponderosa pine.

There are at least 16 known wildlife species associated with ponderosa pine. The white-headed woodpecker, pygmy nuthatch, and flammulated owl are all dependent upon large ponderosa pine for breeding and/or feeding. These species are protection buffer species as defined in the "Standards and Guidelines" of the Northwest Forest Plan. The bald eagle is also dependent upon large ponderosa pine for nesting habitat.

Without active management for the maintenance of large ponderosa pine and restoration of the recruitment potential for young pine, the wildlife species dependent upon this tree species will not be provided for within the watershed.

D. Deer and Elk

Introduction

Habitat mapping for deer is used to represent the general distribution patterns of escape cover for both deer and elk. Although thermal cover is a factor to be considered in the summer range for deer and elk, escape cover was determined to be the primary issue of concern on the summer range. The density of roads is also discussed because it is a determining factor in the quality and suitability of cover for deer and elk.

Issue 11: The size and distribution of big game cover patches and foraging habitat has been altered.

Issue 9: The density of roads in the watershed is negatively affecting wildlife.

Key Questions: How is the cover for deer and elk distributed within the watershed? Are there cover patches that are inadequate in terms of size and distribution? How does the quantity and distribution differ from assumed historic conditions, and what is the expected long term condition of the cover habitat?

Key Question: What is the potential impact of the density and distribution of roads open to vehicular traffic on wildlife and on their available habitat?

Assumptions/Analytical Process

This discussion is based on modeling of escape cover for deer using the Pacific Meridian Resource Satellite Imagery data. Hiding cover was considered to include all forest types consisting of trees at least pole size or larger and plantations with trees at least 5 feet tall. Canopy closure in these types had to be 41 to 100 percent to qualify as escape cover. Small trees up to about six feet tall are a very important component of hiding cover. Decadent brush was also included where canopy closure levels were between 56 and 85 percent. References used to determine habitat criteria for hiding cover were obtained from Shimamoto and Airola (1981) and Thomas (1979).

The satellite imagery data are limited in terms of the ability to map understory trees where there is a dense overstory. Because of this, escape cover mapped most likely varies in quality depending upon how much understory vegetation is present. In addition, the map may not represent all of the cover present in the watershed. To do a truly representative cover analysis, field work would be necessary, but was not conducted for this analysis due to time limitations. In addition, a detailed analysis of the size and distribution of cover patches and their relation to the size of openings was not conducted.

The best application for the Pacific Meridian Resource data is for deer habitat mapping is to determine where cover habitat is the most limiting in relation to foraging habitat and road density.

Assumptions

The Pacific Meridian Resource data accurately maps the categories for hiding cover.

The decadent brush is greater than five feet in height.

Areas that have been clearcut provide foraging opportunities for deer and elk until the canopy cover shades out the early-seral species.

Forage is more abundant along unconfined to moderately confined reaches of streams than along confined reaches (see the Aquatic discussion).

Analysis Discussion

Historic Conditions

It is unknown what the historic population of deer would have been in the Spencer Creek watershed. Forage was probably less abundant, but may have been in better the absence of cattle grazing. Cover was most likely more abundant in the upper watershed where fir forest was dominant. In the lower watershed the forest was probably more open and provided forage opportunities as well as some cover.

Elk were first spotted in the South Keno Management Unit east of the Cascades about 20 years ago. These elk were probably a cross between the Rocky Mountain elk introduced into Crater Lake National Park in the 1920s and Roosevelt elk from the Rogue Valley.

Process of Change

The changes in the distribution of forage and effective cover for big game is the result of timber harvest, fire exclusion, high road density, and forage competition with livestock.

Elk, which currently occur in the watershed in summer, have probably moved into the area partially in response to favorable forage to cover ratios resulting from clearcut timber harvest prescriptions (Waterbury, pers. comm., 1994).

Current Conditions

The Spencer Creek watershed is strictly summer range for the black-tailed deer population and is within the "Keno Management Unit". Some of the deer found within the watershed have been documented to winter in the Agate Flat area in Jackson County. Although the deer are mostly black-tailed, some hybridization with mule deer has occurred (Waterbury, pers. comm. 1994).

A resident herd of about 300 elk has become established on the east side of the Cascades north of the Klamath River. The herd is referred to as the South Cascades Herd. The Mountain Lakes Wilderness, Spencer Creek, and Aspen Lake country are believed to be part of the summer range for this herd. They winter in the Johnson Creek and Long Prairie Creek drainages at elevations between 3,500 and 4,500 feet.

According to the Pacific Meridian Resource Satellite Imagery data query for deer cover, cover habitat is scarce in the lower watershed (see Map 26). This data query may not represent some of the older plantations which could be providing cover (see Assumptions/Analytical Process for more details). In addition, the value and use of the cover available is believed to differ between deer and elk. This will be discussed below. The data query indicates the cover present occurs as very small isolated patches. In the Mountain Lakes Wilderness, Surveyor Mountain area, and other areas in the northwest portion of the watershed, fairly large patches of cover habitat are present. The distribution patterns of forage and cover are not advantageous to deer. Forage is present in clearcut areas, primarily in the lower watershed, and in association with Buck Lake, Spencer Creek, and portions of Clover Creek. Cover, however, is inadequate along many of the unconfined reaches of Spencer Creek and along Clover Creek. Where forage is present, clearcuts are generally too large in relation to the amount of cover present to allow full utilization. For maximum use by deer, forage areas should have no point farther than 600 feet from the edge of cover; use becomes insignificant beyond that point (Thomas 1979). Cover appears to be adequate in the higher elevation areas; however, according to Beth Waterbury (pers. comm. 1994) these areas are extremely forage poor due to the late successional condition and fire exclusion.

Important fawning habitat for deer probably occurs in the riparian corridor along Spencer and Clover Creeks, Buck Lake, and in association with springs and seeps throughout the watershed. Many doe and fawn tracks have been observed in these areas (Waterbury, pers. comm. 1994).

The high density of roads in the watershed is believed to be tied to deer losses resulting from poaching. Mountain lions, coyotes, and bobcat are also believed to be having an impact on the deer herd. Because these predators are more effective where cover is limiting, deer may be avoiding some good foraging areas due to the threat of predation (Waterbury, pers. comm. 1994).

The elk seem to be more adaptable than the deer, to the distribution of forage and cover in the watershed. Even though there appears to be a lack of cover in the clearcuts, elk appear to be utilizing this source of forage. Other very important forage sources are the wet meadows and vegetation associated with springs and seeps, especially in the spring and summer. Elk have successfully taken advantage of the existing cover patches in heavily roaded areas as evidenced by low to moderate hunting success (Waterbury, pers. comm., 1994). It is not believed that poaching of elk isa signficant cause of mortality.

Elk probably utilize Spencer and Clover Creeks as well as spring sites for calving. They also most likely utilize the mesic areas in the upper reaches of Clover Creek and the Mountain Lakes Wilderness. These upper elevation areas are probably favored by elk as long as water and forage are available.

The density of roads in the watershed averages 4 miles per square mile. The Coordinated Resource Management Plan recommends a maximum of 1.5 miles per square mile to allow for more effective use of existing cover by big game. The areas that have cover present relatively close to forage occur near Buck Lake and the unconfined and moderately confined reaches of Spencer Creek.

Trends

The distribution of cover and forage in the lower watershed will probably not change significantly. Plantations will become denser and provide better cover and less forage, whereas areas currently in cover condition may be harvested and provide better forage.

If the Transportation Plan discussed in the Coordinated Resource Management Plan for Spencer Creek is implemented along with the recommendations for road closures/ obliterations of this watershed analysis, the quality of cover habitat for deer and elk should improve.

The numbers of elk are continuing to expand and are expected to reach the Oregon Department of Fish and Wildlife's Management Objective of 700 animals by the year 2000. Once the herd reaches the management objective, intensive management is proposed by the Oregon Department of Fish and Wildlife. Provided the number of elk does not exceed 700, it is believed there would be no direct conflicts between deer and elk for forage or cover. There is potential for competition between deer and elk for fawning and calving habitat due to the limited number of mesic sites next to good cover. Elk are more adaptable and would probably out-compete the deer (Waterbury, pers. comm. 1994).

Summary

The Spencer Creek watershed provides summer range for black-tailed deer and both winter and summer range for the Cascade Herd of elk. Currently, the distribution of cover and forage are not advantageous for deer and elk, although the elk seem to be less affected by the pattern of distribution than do the deer. Cover is most deficient in the lower portion of the watershed. Although forage is present in clearcuts, cover patches in the vicinity of these areas are small and isolated. The presence of cover in the close vicinity of riparian areas potentially used for foraging, fawning, and calving, is especially limited along the lower reaches of Spencer and Clover Creeks. In addition, the density of roads in the watershed is high and has been continued to the poaching of deer in the area (Waterbury, pers. comm. 1994).

Desired Future Conditions for the Terrestrial Section

On going mortality and future risk to existing stands from fire, insects, and disease is reduced.

Residual pine and Douglas fir component in the watershed, particularly the large tree component, is maintained and enhanced.

Prescribed burning is introduced into many areas of the watershed on a cyclic basis.

Fuel loads and biomass levels are reduced to levels where prescribed burning is feasible on a cyclic basis.

Root pathogens and diseases are arrested or the spread is at least slowed.

Blister rust resistant western white pine and sugar pine are made available and planted.

A sustainable supply of forest commodities is provided for utilization, community stability and economic opportunity.

Unauthorized firewood cutting is reduced, particularly in sensitive areas.

No new plant species are added to federal special status listings as a result of management activities. Existing special status plant species on the federal lists are adequately protected. In addition, plant communities of interest are adequately protected through project design features. Sufficient data are gathered on Northwest Forest Plan's Survey and Manage species to adequately address the needs of these species.

Grazing in riparian areas results in minimal to no impacts.

The spread of noxious weeds within the watershed has been arrested through the implementation of an integrated weed management program. Population levels of noxious weeds have been reduced in the watershed. No additional exotic vegetation is introduced into the watershed.

Soil productivity has been maintained or improved through the design, prescription, and implementation of Best Management Practices and other project design features during land management activities. Productivity in areas of high impact has been improved through restoration activities.

Viable late-successional habitat within the watershed has been increased by complying with the "Standards and Guides" of the Northwest Forest Plan.

An opportunity for at least one connectivity corridor within the Spencer Creek watershed that connects blocks of existing late-successional forest with riparian areas and meadows has been provided for late-successional dependent wildlife species.

The density of roads in the watershed, particularly in areas to be retained as late-successional forest or as connectivity corridors, has been reduced.

Adequate dispersal conditions for the spotted owl in the watershed within six miles of Late Successional Reserve RO-227 has been maintained.

The viability of spotted owl sites in Late Successional Reserves RO-227 and RO-228 that lie within 1.2 miles of the reserve boundaries has been maintained and improved.

The amount of late-seral ponderosa pine within the watershed has increased.

Habitat for a stable nesting population of bald eagles in the watershed has been provided through the maintenance and restoration of suitable nesting and foraging habitat using the guidelines in the Pacific Bald Eagle Recovery Plan.

The population levels of Protection Buffer species (black-backed and white headed woodpeckers) is met as stated in the "Standards and Guidelines" of the Northwest Forest Plan.

The density of roads in the watershed, particularly in areas suspected to be fawning habitat and in areas used for cover, has been reduced.

Part III. Riparian Ecosystem

A. Riparian Areas

Introduction

This section describes the past and current condition of the riparian zone resources and the changes that have altered ecological processes. It starts by describing the historic condition and processes of the riparian ecosystem. Then it describes how management has altered condition and function. Information about riparian dependent species and ecology is then described to link physical processes to effects in the biologic community.

Two key questions were develop to address the riparian ecosystem in Spencer Creek. The first describes the changes in physical structure and condition. The second focuses on how these changes have influenced the riparian dependent species. Special wet habitats throughout the watershed will also be discussed in the second key question.

(Note: See also the Terrestrial Ecosystem section, Rangelands, for a discussion of riparian conditions and attributes as related to livestock grazing.)

Issue 12: Wetlands, riparian, and meadow ecosystems in the Spencer Creek watershed have been altered.

Key Questions: What are the assumed historic conditions and functions of riparian areas in Spencer Creek watershed? Have management activities altered riparian function?

Assumptions/Analysis Procedure

A riparian zone consists of the stream channel, the floodplain, and upland areas that influence the stream environment.

Two components of the riparian zone will be addressed -- the vegetative and physical structure. Physical structure includes form and distribution. The physical and vegetative structures combine to determine the following functions:

- Large wood recruitment;
- stream shading;
- delivery and transportation of water, sediments, and organics; and
- biodiversity

Queries specifically related to riparian vegetation were made in the Geological Information System to classify all vegetation by seral stage within 100 and 300 feet of both perennial and intermittent streams. An additional query was run to determine canopy closure within 100 and 300 feet of both perennial and intermittent streams. The queries resulted in a comparison of riparian vegetation in 1945 to 1994 riparian vegetation.

Table 29 and Figure 16 summarize the queries for riparian vegetation within 300 feet of perennial and intermittent streams. Early seral stage vegetation included: early shrubs, early tree, grass, and non-forest categories. These categories were all grouped under "early" because they function similarly in regards to shading, large woody recruitment, and thermal or connectivity habitat for wildlife. Early-mid seral vegetation included pole size trees 5.0 to 8.9 inches diameter at breast height as described in the vegetation analysis. Mid and late seral vegetation is combined because the 1945 stand inventory descriptions were so limited that the data are more reliable combined than separate. For comparison purposes, 1994 mid and late seral stage vegetation is combined as well.

In addition, botanical surveys within the watershed have identified a number of plant communities that are associated with riparian habitat. These surveys are used to make inferences about changes from historic to present riparian habitat.

There are two distinct riparian zones in Spencer Creek. Each has unique features and thus interact with the channel system differently. Valley bottom morphology is used to stratify the riparian zones, specifically, into confined and unconfined reaches. Within each stratification there are similarities in floodplain width, vegetative community, and stream gradient.

The discussion is divided into unconfined and unconfined reaches. Each contains historical perspective, changes in the environment, and then current condition and function.

Analysis Discussion

Unconfined Reaches Function

The unconfined reaches of Spencer Creek and the lower reaches of tributaries are characterized by wide floodplains (often exceeding 150 feet), low gradients (less than 2 percent), and multiple channels. The vegetation is dominated by hardwoods and grass/sedge communities, which are displayed as early and mid seral stages in Tables 29 and 30.

Shading is highly variable in unconfined reaches. In grazed areas shading is frequently less than 20 percent and in wet willow dominated areas it is often very high (up to 90 percent). Areas inaccessible to livestock are usually associated with dense willow thickets, beaver dams, and frequent flooding. For Clover Creek and Miners Creek shading can be interpreted from satellite queries as in the Aquatic Ecosystem section. Evidence of beaver activity in the tributaries is light.

The input of large woody debris into the channel system is dependent on stream processes working on the outer edges of the floodplain. The riparian zone is dominated by willows, aspen, cottonwoods, and alder. Periodic inundation of the valley bottom has prevented the encroachment of large conifer species. On the outer edges large pines that fall onto the floodplain eventually reach the channel by either floods carrying to the channel or the stream meanders to the large wood debris. The potential for large wood recruitment from these reaches is low compared to the confined channel segments.

The broad riparian areas of the lower tributaries function to regulate the delivery of water, sediment, and organics (referred to here as upslope products) to Spencer Creek. The hydrology of the basin is insufficient for delivery on an annual basis. Therefore, the tributaries store sediments and organics until a flow capable of mobilization occurs. Large amounts of sediments/organics can be transported, depending on the amount of accumulation. The largest tributaries, Clover and Miners Creeks, have large floodplains at the mouth. During flood flows, the water and associated payload leave the banks and spread out over the floodplain. The increase in width combined with riparian vegetation slows the water velocity, allowing for the deposition of sediment and organics. This acts to reduce the instantaneous input of upslope products into Spencer Creek.

Similarly, in Spencer Creek wide valley bottom areas regulate the transportation of water and sediments through the system. There are alternating high/low gradient reaches in Spencer Creek. The higher gradients are primarily transportational and the lower gradients are primarily depositional. Viewed at a watershed scale the lower gradient reaches act as hydraulic controls, decreasing the rate of transport of water and sediment. The presence of sinuosity, multiple channels and thick vegetation increase channel roughness and slow water velocities. During high water years, flows "backup" and spread out over the floodplain. Organics and sediment, particularly fine sediment, are deposited throughout the floodplain. Likewise, water is ponded and stored throughout the riparian zone. These low gradient, wide riparian areas in the system act to reduce the conveyance of water and sediments. The implications are a decrease in peak discharge, increase in late season water availability, and decrease in-channel sediment deposition.

Mechanisms of Change

Grazing and roads together have modified the function of riparian zones. As a general statement, the vast majority of the watershed area receives little livestock grazing. What easily observable grazing use is made in the watershed tends to be in the lower, moister meadow and riparian areas. Grazing alters plant communities in two ways. First and foremost is through the grazing process of defoliating the plant (Vavra et. al. 1994). In addition, the mechanical action of hoof trampling has effects on the constitution and temporal makeup of plant communities. A review of aerial photographs taken from 1940 to the present indicates that considerable road building has taken place in the watershed. Approximately, 23 miles of road have been constructed in Spencer, Clover, and Miners creeks riparian zones.

Removal of vegetation reduces floodplain roughness, increasing out of bank flow velocities. Roads serve as topographic breaks capable of capturing and routing water and sediment to the stream channel. In these areas, there is most likely a reduction in floodplain deposition and in retention of flood water.

Trends

Two areas of special concern are the lower reach of Clover Creek and Buck Lake. As a result of roads and removing stream side vegetation there is a high potential of accelerating the delivery of water, sediments, and organics from Clover Creek into Spencer Creek. Buck Lake has the highest concentration of livestock in the watershed; Buck Lake approximately 1,500 acres in surface area and up to 5 feet deep, was drained in the mid-1940s. The natural dam was removed, then a series of channels were constructed. This increased efficiency of water delivery through the lake. Consequently, the ability to capture flood flows and attenuate the peak discharge was lost, as well as the storage of water for late season discharge.

Confined Reaches Function

In the confined valley bottoms, mixed conifer species dominate stream side vegetation. Floodplains are small, less than 20 feet wide. Material deposited on the banks and floodplains are coarse and often colluvial, indicating the ability of flows to transport sediments to the lower gradient reaches is high.

The riparian zones in these reaches function to provide large woody debris to the channel and canopy closure for shading. Due to the steepness of side slopes and presence of large conifers adjacent to the stream channel, these areas have the highest potential to deliver large woody debris into the stream channel. According to 1945 data mid to large seral stage species comprised approximately 55 percent of the confined channel segments. Since logging occurred prior to 1945, there was a higher percent of vegetation stands in the mid to late seral stages historically. Historic tree composition and valley form indicate that approximately 75 percent of the perennial streams, excluding Buck Lake, probably had 40 to 90 percent shading in confined reaches.

Mechanisms of Change

Timber harvest and road building has reduced large wood recruitment potential and stream side shading. Assuming mid to late seral stages are the only source of large wood recruitment to the stream channel, this vegetation class has been reduced by 20 to 60 percent throughout the watershed. The proximity of roads adjacent and paralleling stream channels prevents the upslope recruitment of large wood debris into the channel network. See Map 7 for road system information. See Maps 27 and 28 for hydrologically sensitive areas (see the Aquatic Ecosystem section) and problem areas.

Trends

Recruitment of large woody debris and shading will remain low for about 100 years in areas of confined reaches where trees were cut until trees grow to recruitment potential height. In unconfined reaches, recruitment will more be constant and low.

Hardwoods and beaver dams will function as dominant pool forming processes. Undercut banks and root wads from willows are the important structural elements in these areas. Riparian vegetation is in a recovery phase due to recent changes in grazing management, riparian exclosures in three areas, and new state forest practices laws.

Under current conditions at Buck Lake, this area will continue to accelerate delivery of water and fine sediments to Spencer Creek. The road network and accompanying stream crossings will continue to route fine sediments to Spencer Creek and intermittent stream channels during annual runoff periods. The aquatic resources section describes the apparent trends in the aquatic biological communities.

Summary

The riparian function of the Spencer Creek watershed has been negatively impacted by roads, streamside harvest, and grazing. Shading has been reduced in confined reaches by timber harvest. Shading and bank stabability has been reduced below potential in unconfined reaches by loss of streamside vegetation and stream widening. Additionally, the loss of Buck Lake as a functioning wetland has accelerated delivery of water and fine sediments into Spencer Creek. The Aquatic section describes how these changes have affected channel condition and aquatic habitats.

Burnstad and Deming (1994) in Weyerhaeuser Company's analysis of the Spencer Creek watershed detailed the quality of riparian conditions in Spencer Creek below Buck Lake for 19 stream segments. Segments were delineated based on stream gradient and degree of confinement. See Maps 29, 30, and 31 for information regarding stream shading, large woody debris, and stream channel confinement, respectively. Also, see the Aquatic Ecosystem section.

Key Question: How have changes in function and habitat in riparian zones affected riparian dependent biological communities?

Assumption/Analytical Process

The following discussion describes the general function of riparian and wetland habitats for mammals, birds, and amphibians, in addition to more specific functions of these habitat types for individual species determined to be a high priority for analysis. The processes of change and current conditions focuses on those species of most concern.

Analysis Discussion

Function of Riparian Areas for Riparian Dependent Species

Mammals

A large number of mammals are limited to or largely dependent upon riparian or wetland habitats. Key riparian elements for mammals include: riparian vegetation; large overstory trees, snags, and logs; and stand diversity. Other important factors are the availability of water, greater availability of forage than in upland habitats (both plant and animal), more stable temperatures, and the linear continuity of habitat (Chapel et al. 1992).

Those species identified as high priority for analysis are discussed individually below.

Marten

Marten have a strong affinity for riparian areas and meadow/forest edges. One of the two most important prey items for the marten are voles *(Microtus spp.)* which are closely associated with herbaceous meadow or riparian areas (Ruggiero et al. 1994). Voles are taken by marten in excess of their availability in most areas (Buskirk and MacDonald 1984, cited in Ruggiero et al. 1994). In a study of martens by Simon (1980), meadow/forest edges were used disproportionately more by martens than other habitats.

Bats

Feeding activity over ponds and streams and in adjacent riparian habitat have been described for several species, including the California, long-eared, little brown, and silver-haired bats (Anthony and Kunz 1977; Bell 1980; Cross 1976; Kunz 1973; O'Farrell and Bradley 1970, cited in Thomas and West 1991). The feeding rates of *Myotis spp.* were found to be more than ten times higher over ponds and streams in Oregon than in forests (Thomas and West 1991). According to Donna Howell (pers. comm., 1995) all bats will take advantage of insect hatches associated with riparian, wetland, and aquatic habitats at some time during their life cycle.

Deer

The Spencer Creek watershed is exclusively deer summer range. On summer ranges, does with fawns prefer habitats near water and with an abundance of succulent forage (Kauffman and Krueger 1984; Gillen et al. 1985; Loft et al. 1986, cited in Loft et al. 1987). Preferred habitat for fawn rearing is usually within 600 feet of water (Thomas 1979). Optimum fawning habitat is an area consisting of low shrubs or small trees on slopes of less than 15 percent, and within plant communities where forage is succulent and plentiful in June (Thomas 1979). Riparian areas and meadows along unconfined reaches of streams or associated with springs, generally provide the above conditions and are suitable for fawning habitat if forest cover requirements are also met.

Birds

Riparian zones are important to breeding and migrating birds, and birds of prey. Studies of bird community diversity, richness, and overall abundance demonstrate disproportionate use of riparian areas over adjacent habitat types. This has been attributed to several factors including: the presence of diverse and highly productive vegetation; the positive edge effects of streams; the high availability of terrestrial and aquatic insects; the productivity of the surrounding area; and the presence of water (Chapel et al. 1992).

Neotropical Migrants

Optimum breeding habitat for some neotropical migrants is in riparian shrubs and trees (Taylor and Littlefield 1986). The willow flycatcher and yellow warbler are examples. For the willow flycatcher, willow clumps of approximately 5 or 6 feet in height are important for nesting. The presence of moist meadows, perennial streams, and spring-fed or boggy areas are crucial for foraging habitat during the nesting season.

Great Gray Owl

The diet of great gray owls is dominated by voles over most of their range (Hayward and Verner 1994). Pocket gophers were found to be the predominant prey in northeast Oregon (Bull and Henjum 1990). Microtine voles generally occupy moist grass/sedge openings and open herbaceous forests whereas pocket gophers prefer drier meadows (Anderson 1987; Chase et al. 1982, cited in Hayward and Verner 1994).

Food supply is believed to regulate the abundance of great gray owls across much of their range. When prey is scarce, many individuals abandon their breeding range. Winter (1982) maintains that the breeding success of the great gray owl is tied to the cycles of the vole prey base which forms a major part of their diet.

Yellow Rail

Marsh habitats with broad leaf sedges and a minimum amount of standing water provide nesting habitat for the yellow rail.

Amphibians

Riparian systems provide habitat for many amphibian species. Amphibians tend to inhabit small stream, headwater seep, spring, and meadow habitats in forested regions. Many studies have demonstrated or suggested that larger amphibian populations are associated with macrosite conditions that maintain cool, moist stand conditions and microsites that offer large decomposing logs or large pieces of tree bark (Chapel 1992). However, in the Spencer Creek watershed, amphibian populations tend to be closely associated with water due to the drier forest conditions in this area, as compared to forests west of the Cascade crest. Unsilted streams are necessary for maintaining viable populations of amphibians (Gilbert and Allwine 1991).

Historic Condition for Riparian Dependent Species

Prior to Euroamerican settlement, the diversity of wildlife associated with riparian and wetland areas in the Spencer Creek watershed was probably at least equal to the present, although the species composition may have been different. The species present were probably much more widely distributed and the overall health of the population was most likely higher due to the unaltered state of wetlands. Buck Lake probably supported nesting habitat for variety of birds associated with marsh wetlands.

It is unknown if yellow rail were present historically. It is possible they were present given the historical description of Buck Lake as a marsh covering about 1,542 acres (Government Land Office maps dated 1882). It is unknown, however, just how deep the marsh was and if the required vegetation types were present.

The foothill yellow-legged frog was present in the Klamath River before the construction of J.C. Boyle Dam. A single collection of this species was made in 1934 from where Highway 66 crosses the Klamath River (Fitch 1936 and Zweifel 1955, cited in Hayes 1995); this species has not been observed above J.C. Boyle Dam since. According to Hayes (1995), limited habitat would have been available for this species in Spencer Creek.

Based on the historic size of Buck Lake and the amount of shallow marsh that would have occurred around the perimeter of the marsh, habitat conditions for the spotted frog could have been much more extensive than at present, provided water temperatures were suitable for this species.

Process of Change

The alteration of meadow vegetation through grazing can eliminate the prey species favored by marten and great gray owl. Suitable meadows for *Microtus spp.* must be primarily of annual and/or perennial grasses of five to 15 inches tall to support vole populations (Birney et al. 1976 and Eadie 1953). Livestock can negatively affect meadow suitability by making grass too short for voles (Winter 1980, 1981, 1982). In a study of the impacts of domestic livestock grazing on small mammals in Idaho, 85 percent of all montane voles trapped were located within the only two ungrazed, predominantly grass habitats sampled during the study.

Within the Spencer Creek watershed, areas that are of concern on federal land, relative to utilization of meadow vegetation, are listed below. This concern is based on forage utilization levels determined on USDA Forest Service-administered lands during a "Rangeland Analysis" conducted in 1993 (USDA 1993). The results from utilization plots are discussed below.

1. Location - Upstream of Buck Lake in T. 38S, R. 5E, Section 11.

Of greatest concern in terms of utilization is the drier portion of this meadow. Other areas are discussed below. For the three plant species sampled, average utilization levels and grazed heights were as follows in September of 1993: 52 percent and 4 inches; 78 percent and 2 inches; 52 percent and 5 inches. According to Lindsey Pruyn-Sitter (1995), this meadow has been receiving significantly more use in the last three years than what has been noted in the past due to the current dry conditions.

Additional impacts from cattle in this area includes bank sloughing which is frequent along the main channel. Riparian vegetation is essentially absent along portions of the creek.

2. Location - Muddy Spring Meadow - T. 38S, R. 5E, Section 2.

Although no grass height data were available for this seven acre meadow, a trend estimate for two transects showed that in one transect residual vegetation approached four inches and in many cases was as low as one inch. It was also stated that utilization rates approached 80 percent for some vegetation types. Data from the second transect indicated less usage but more soil disturbance. Personal observations of the area indicate a potential conflict with deer fawning habitat due to the bedding of cattle in the forest/meadow ecotone.

In addition to the areas discussed above, several spring, wet meadow, and pond sites are of concern due to the level of trampling by cattle and the fact these areas are important for biodiversity. These areas are described below.

A. Location - Desolation Swamp T. 38S, R. 5E, Section 1, NW1/4.

This area was identified as a problem during the Rangeland Analysis (USDA 1993). From personal observations of the area, two ponds are heavily trampled which has contributed to a lack of vegetation and sedimentation to these water sources. The associated meadows are also trampled.

B. Location - Muddy Springs - T. 37S, R. 5E, Section 34, SW1/4, SE1/16 and T. 38S, R. 5E, Section 3, NW1/4, NE1/16.

The spring at this site is heavily trampled by cattle even though there is a trough. The trough however, is too close to the spring source.

C. Inlet to Buck Lake - T. 38S, R. 5E, Section 11.

This section of Spencer Creek meanders through an extensive meadow system totaling about 72 acres. The upstream half of the meadow is extremely wet and boggy. At least two springs are present in the area, one at the northwest end of the meadow and the other originating in Section 2 on the north side of the meadow and Clover Creek Road (see Map 7). Shallow marshy areas are also present along the creek. Both of the spring areas and portions of the creek and associated wetlands are trampled. However, the majority of the wetlands in the main meadow have not been impacted due to the abundance of downed lodgepole. The lower drier portion of the meadow in this area is discussed above.

Grazing has contributed to the increased amount of siltation and higher water temperatures in Spencer Creek, primarily due to the management of Buck Lake. According to Weyerhaeuser Company's "Spencer Creek Watershed Analysis", Buck Lake is the major problem area contributing to cattle related erosion in the lower watershed (from Buck Lake to the mouth of Spencer Creek). This has contributed to the decrease in the macroinvertebrates intolerant to environmental degradation (see water quality section for more detail).

The distribution of amphibians in the Spencer Creek watershed may have been significantly altered from pre-Euroamerican times. Potential factors altering the distribution include the policy of removing large wood from the aquatic system, grazing management, and the introduction of brook trout (Hayes 1995). Another very important factor is the sediment input from the large number of roads in the watershed.

In general, the most striking physical limitation for amphibian species in the Spencer Creek watershed is the lack of stillwater habitats (Hayes 1995). Prior to human modification, Buck Lake would have provided more extensive areas of shallow marsh habitat for amphibians than occurs today. Some species that would have occurred prior to modification include the spotted frog, cascades frog, western toad, and rough skinned newt. The most limiting factor for the Pacific giant salamander population appears to be the decrease in large woody debris which is crucial for the deposition of egg masses (Nussbaum 1969, cited in Hayes 1995) and as refuge sites (Nussbaum and Clothier 1973; Nussbaum 1976; Nussbaum et al. 1983, cited in Hayes 1995). The population of this amphibian species is currently at very low levels. Increased sedimentation may also be a problem. It is unknown if the increase in sediment levels is directly affecting the Pacific giant salamander.

Current Conditions

Approximately 111 species of wildlife have been documented or have a high potential to occur within the watershed, using riparian areas, meadows, or wetlands for breeding or feeding (see Appendix 5).

Mammals

Marten

The relationship of forest habitats to marten are discussed in the discussion titled "Late-Successional Forest Dependent Species". The condition of the meadows in the Buck Lake area are currently in poor condition and are providing less than desirable habitat for some of the prey species preferred by marten.

Bats

Nine species of bats have been documented in the Spencer Creek watershed and an additional four have the potential to occur (see Appendix 5). These bats were netted at ponds within the watershed, across all ownerships, during a study in 1994 by Dr. Steve Cross (Southern Oregon State College). Many of the ponds and springs within the watershed serve not only as foraging and watering sites for bats, but also as livestock watering sites. Currently, many of these springs and ponds are trampled by cattle. The changes in plant diversity, and the increased sedimentation and nutrient loading at these sites could affect the insect prey base available to the bats.

Birds

Neotropical Migrants

Eighteen neotropical migrants and five other passerine birds which have the potential to occur or have been documented within the watershed are associated with riparian or wetland areas (see Appendix 5).

The differences in the distribution and quantity of riparian vegetation between present and historic times is unknown; however, degradation has been observed within certain areas of the watershed. This degradation has likely resulted in a change in the species diversity and population levels of passerine birds.

Great Gray Owl

The current habitat conditions of wet meadows in the watershed has most likely affected the diversity, distribution, and abundance of prey species for the great gray owl. The assumed low prey base combination with the harvest of nearby late-successional forest, means that breeding habitat suitability is likely low for this species.

Yellow Rail

The yellow rail is designated as Critical by the State of Oregon. Designations of this species by other agencies are listed in Appendix 5.

Habitat conditions favoring continuous use by yellow rail feature wetland habitat dominated by broad leaf sedges with heights from 18 inches early in the season to 3 to 5 inches by mid-July. Water depths are the second most important habitat attribute. Buck Lake presently has moderate potential for the presence of yellow rail. Marshes along the east, north, and west sides have small areas of sedge beds. Marsh at the southwest corner of Buck Lake has the largest area of sedges, but is probably too small and lacks mats of floating dead sedges characteristic of habitat occupied by the yellow rail (Morawski and Stern 1991). This area was surveyed by Morawski and Stern in 1991 and no yellow rails were detected.

Amphibians

Seven species of amphibians have been documented as occurring within the Spencer Creek watershed (see Appendix 5). Most of these were found during a study by Marc Hayes (Herpetologist, Portland State University, Metro Washington Park Zoo) in 1994. One individual of an introduced species, the bullfrog, was found in 1994.

Pacific Giant Salamander

Prior to 1994, amphibians had not been extensively studied in the Spencer Creek system (Hayes 1995a). In 1994, as a result of surveys, a population of Pacific giant salamanders was documented in Spencer Creek downstream of Buck Lake in the T. 38S, R. 6E, Sections 18, 21, and 34, and T. 39S, R. 6E, Sections 13 and 20. Pacific giant salamanders had been previously indentified in Spencer Creek in 1989 or 1990. Pacific giant salamanders may not be found elsewhere east of the Cascades in this region, so this population should be considered unique. Another unique feature of this population is that it remains aquatic with retention of its gills as an adult (Hayes 1994c). More commonly the adult form of this specie lives under logs and bark in moist coniferous forests (Nussbaum, Brodie, and Storm 1983). It is believed that within the Spencer Creek watershed, adults of this species retain their gills in response to a hostile terrestrial environment at the pre sumed eastern periphery of their range (Hayes 1994c).

As discussed above and in the portion of this analysis on water quality, the water temperature and level of sedimentation have increased in Spencer Creek. Other water quality parameters have also changed. According to Marc Hayes, although warming of the flow of water into T. 38S, R. 6E, Section 18 of Spencer Creek is partially due to the influence of Buck Lake, alteration of the channel in this area probably contributes to additional warming. Based on gradient, the segment of Spencer Creek in Section 18 had fewer than expected numbers of Pacific giant salamanders. This is likely due to the pattern of warmer water from Buck Lake (Hayes 1994c). In addition, excessive siltation is prominent in Section 18 of Spencer Creek. Overall, Hayes (1995a) found the numbers of Pacific giant salamanders in Spencer Creek were significantly negatively correlated with the percentage of stream substrate that was mud and silt. This likely contributes to the depressed numbers of Pacific giant salamanders in the system (Hayes 1995a)..

A major factor potentially affecting the reproduction of the Pacific giant salamander is the quantity of downed woody debris, which serves as a substrate for the deposition of eggs. Hayes (1995a) found large (greater than 8 inches or 20 cm) downed woody debris to be very limited in Spencer Creek.

Spotted Frog

The spotted frog is a Category 1 candidate (see glossary) for federal listing as threatened or endangered. The spotted frog is nearly extinct over much of western Oregon (Hayes 1994b). A population of spotted frogs was documented in 1994 on the Winema National Forest and adjacent private property in the canal at the northwest edge of Buck Lake, and in Tunnel Creek on Bureau of Land Management-administered lands. This population represents the third known to occur in the Klamath Basin and makes the portion of Buck Lake on the Winema National Forest extremely valuable, biologically. No other site in the Spencer Creek watershed is likely to harbor this species (Hayes 1995a). The potential extent of this population of spotted frogs is unknown due to the limits of the area covered. Additional areas in the vicinity of Buck Lake could have spotted frogs.

Spotted frogs are most likely to be found at the marshy edges of ponds or lakes, or in algae-grown overflow pools of streams. These frogs are tied to warm water marsh or bog habitats due to the temperature requirements for reproduction, refuge, and foraging (Hayes 1994a, 1994b). In a few high Cascades lakes, these frogs have been found where there is considerable emergent vegetation and a layer of dead and decaying vegetation on the bottom (Nussbaum, Brodie, and Storm 1983). Although shallow marshy habitats are present upstream of Buck Lake, it is unknown if the water temperatures are warm enough to support spotted frogs. One of the water sources for this portion of Spencer Creek are cold water springs. It is possible the spring area could provide overwintering habitat (Hayes, pers. comm. 1995b).

It is uncertain how current grazing management practices may be affecting this population of spotted frogs, except that the extent of habitat is limited by the draining of Buck Lake. A limited amount of grazing, preferably provided by native ungulates, could be beneficial (Hayes, pers. comm. 1995b).

Foothill Yellow-legged Frog

The foothill yellow-legged frog is a Category 2 candidate for Federal listing as threatened or endangered. No recent records for the foothill yellow-legged frog in the Klamath River area exist. This species requires cobble bars and a minimum of siltation (Hayes and Jennings 1988, cited in Hayes 1995a). If this species was present in Spencer Creek, increased levels of siltation may have eliminated it (Hayes 1995a).

Cascade Frog

The cascade frog is a Category 2 candidate for Federal listing as threatened or endangered. A single cascade frog was found in association with Miners Creek in the Spencer Creek watershed during surveys conducted in 1994 (Hayes 1995a). This species requires cold stillwater habitat above 5,000 feet in elevation (Hayes, pers. comm. 1994). They often occupy wet meadows which may contain ponds of various sizes, or the marshy edges of ponds and small lakes (Nussbaum, Brodie, and Storm 1983).

Trends

Because of the low percentage of mid to late-seral stage forest within the 300 foot buffer of the perennial reaches of stream in the Spencer Creek watershed (see Table 29), the recruitment potential of large woody debris is expected to be limited to short sections of Spencer Creek. This could limit the reproductive potential of Pacific giant salamanders.

Desired Future Conditions

Aquatic Conservation Strategy objectives are met for healthy functioning riparian areas. It is recognized that federal lands alone can not meet the needs to restore the watershed to the conditions described in the Northwest Forest Plan objectives. Cooperation, through conservation agreements, Coordinated Resource Management Plan transportation planning, and other cooperative agreements will be necessary to restore riparian function in the Spencer Creek watershed.

Hydrologic function of Buck Lake is improved. The wetlands, spring sites, ponds, and riparian vegetation are restored to a naturally functioning condition and provide for healthy populations of wildlife species of concern. The amount of cattle grazing is limited in these habitat types through application of the management recommendations of this analysis.

Summary

It is uncertain what the extent of the riparian and wetland vegetation was historically relative to present. It is known, however, that riparian condition has been degraded. The diversity of wildlife associated with riparian areas in the Spencer Creek watershed was most likely at least equal to the present, although the species composition may have been different. The species present were probably much more widely distributed and the overall health of the populations was most likely higher due to the unaltered state of the habitat.

The Spencer Creek watershed has relatively few springs, wet meadows, and riparian areas available for wildlife. This makes the wetland and riparian habitats that are present even more valuable to the approximately 114 species of wildlife associated with these habitat types that are documented or potentially occur within the watershed (see Appendix 5). Historically, one of the most extensive stillwater habitats in the watershed was Buck Lake. The alteration of this lake through draining and grazing has likely impacted the abundance and distribution of several amphibian species, including the spotted frog. The population of spotted frogs at Buck Lake is one of three known to occur in the Klamath Basin. This makes the portion of Buck Lake on the Winema National Forest extremely valuable, biologically (Hayes 1994aa, 1994bb). The level of sedimentation contributed by roads and grazing, and increased water temperatures in Spencer Creek have likely been factors affecting the abundance and distribution of amphibians in Spencer Creek, particularly the Pacific giant salamander (Hayes 1995). Another very important factor limiting the abundance of the Pacific giant salamander is the lack of large woody debris in Spencer Creek (Hayes 1995). The population of Pacific giant salamanders in Spencer Creek should be considered unique because this species is unknown to occur elsewhere in the Klamath Basin or east of the southern Cascade Mountains (Stebbins 1985, cited by Hayes 1994c). Unlike other populations of this species, it remains aquatic in the adult form (Hayes 1994c).

Some meadow habitats within the Spencer Creek watershed have been over utilized by cattle. Some of these meadows are currently in poor habitat condition relative to the requirements for voles. Voles are an important component of the diet for the marten and great gray owl (Hayward and Verner 1994; Winter 1982; Ruggiero et al. 1994).

Table 29. Perennial and Intermittent Streams - Combined[1]

Stream Type	Seral Stage	Shading	LWD Recruitment	Connectivity and Thermal	1945 Percent	1994 Percent
P & I	Early	Low	Low	Low	15	18
P & I	Early-Mid	Low to Moderate	Low	Moderate	36	62
P & I	Mid & Late	Moderate to High	Moderate to High	High	49	20

[1]Characteristics of vegetation within 300 feet of streams
LWD = Large Woody Debris

Table 30. Perennial and Intermittent Streams - Separated[1]

Stream Type	Seral Stage	Shading	LWD Recruitment	Connectivity and Thermal	1945 Percent	1994 Percent
PER	Early	Low	Low	Low	21	23
PER	Early-Mid	Low to Moderate	Low	Moderate	30	65
PER	Mid & Late	Moderate to High	Moderate to High	High	49	13
INT	Early	Low	Low	Low	5	12
INT	Early - Mid	Low to Moderate	Low	Moderate	45	58
INT	Mid & Late	Moderate to High	Moderate	High	50	30

[1]Characteristics of vegetation within 300 feet of streams
LWD = Large Woody Debris

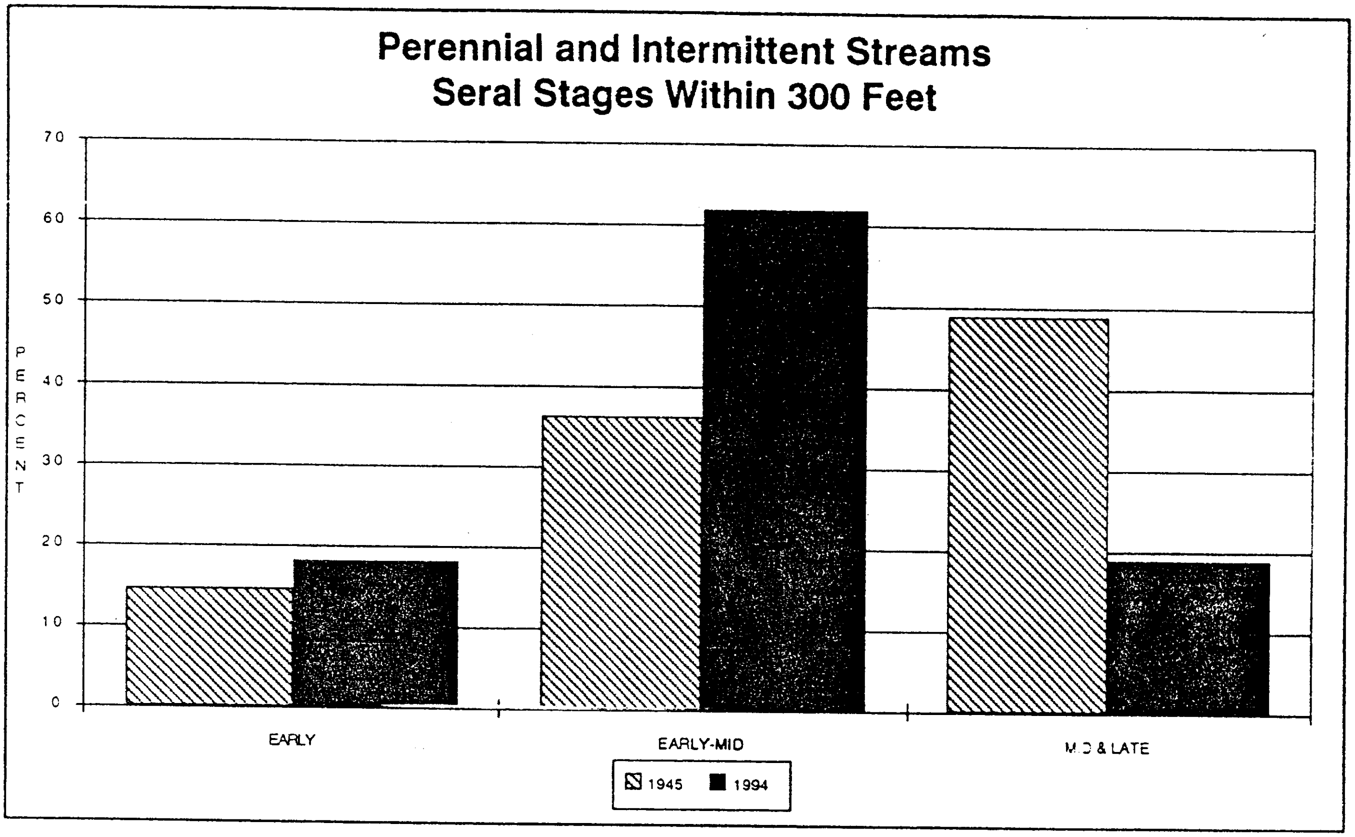


Figure 16. Seral Stages Within 300 Feet of Perennial and Intermittent Streams

Part IV - Aquatic Ecosystems

A. Aquatic Resources

Introduction

This section describes the past and current conditions of aquatic resources and the changes that have altered ecological processes. It starts by describing water quality and channel condition, that is, habitat. Information about aquatic species distributions and ecology in the watershed is then described to link changes in physical processes to changes in community structure and dynamics.

The Aquatic Environment. The headwaters of Spencer Creek originate at an elevation of about 8,000 feet in the Mountain Lakes Wilderness. Two intermittent tributaries flow into Buck Lake following a series of wet meadows with some perennial pools. Buck Lake, a 1,500 acre drained marsh, has an area of high volume springs (average of about 5 cubic feet per second all combined) on the southwest edge of the lake. The upwelling springs are contained and diverted by a series of mounded dikes to canals which transport water north and east around the periphery of Buck Lake for irrigation. Several drainage canals within the interior of Buck Lake converge to discharge water at the northeast corner of the pasture. Spencer Creek then flows southeast about 15 miles to its confluence with the Klamath River at the upper end of J. C. Boyle Reservoir (see Maps 1 and 2). The elevation at the confluence is approximately 3,800 ft. Springs, seeps, and wet meadows are scattered throughout the watershed. None of these flow consistently year-round into Spencer Creek. Two main tributaries, Clover Creek and Miners Creek, have perennial spring fed segments, but subside before reaching Spencer Creek during the summer.

Issue 13: Water Quality has Been Altered in Spencer Creek watershed.

Key Question: Does Spencer Creek (and associated tributaries) meet State of Oregon Water Quality Standards?

Assumptions/Analytical Process

Information on water quality in Spencer Creek is not extensive. Most of the data discussed below are from USDA Forest Service monitoring, with some data on Clover Creek (tributary to Spencer Creek) from the national STORET data base (used by the EPA).

Analysis Discussion

Dissolved Oxygen

Dissolved oxygen is the amount of oxygen available in the water column. The concentration is influenced by such factors as re-aeration and photosynthesis, which add dissolved oxygen to a water column. Carbonaceous oxidation, benthic demands (respiration), algal and macrophyte respiration, and nitrogenous oxidation all diminish dissolved oxygen levels. In salmonid streams intergravel dissolved oxygen should be near saturation to ensure normal growth and survival of eggs and alevin. High dissolved oxygen levels in streams and intergravel areas also are needed to sustain the more sensitive macroinvertebrates. According to Oregon Administrative rules, in the Klamath Basin in salmonid producing waters - dissolved oxygen concentrations shall not be less than 90 percent of saturation (at a given temperature) at the seasonal low flow, or less than 95 percent of saturation (at a given temperature) in spawning areas during salmonid (salmon and trout) spawning incubation, hatching, and fry stages.

In non-salmonid fish producing streams the dissolved oxygen concentrations shall not be less than 6 milligrams per liter. Dissolved oxygen has not been evaluated in Spencer Creek or its tributaries. Because of conditions in some stretches of Spencer Creek, such as near the wetland in the area dominated by slow moving water and with high potential rates of primary production, dissolved oxygen may reach levels below 6 milligrams per liter in the early morning during the warmest months.

Temperature

Removal of streamside tree and shrub canopy by timber management activities can affect stream temperature by increasing stream exposure. Irrigation withdrawal at Buck Lake influences temperature by increasing effects of solar radiation and effects of air temperature. Increased stream temperatures reduce the amount of dissolved oxygen. Highest summer water temperatures are often associated with clear weather, low water flows, and loss of shade from removal of riparian vegetation.

In The Klamath River Basin, in salmonid producing waters, no measurable increases in temperature shall be allowed outside of the assigned mixing zone (zone where mixing is allowed from a point source discharge), as measured relative to a control point immediately upstream from a discharge when stream temperatures are 58 degrees Fahrenheit or greater. No increase of more than 2 degrees is allowed due to a combination of all sources combined when stream temperatures are 56 degrees or less without Department of Environmental Quality authorization.

In non-salmonid producing waters, no measurable increases shall be allowed outside the assigned mixing zone (for a point source discharge) when temperatures are 72 degrees or greater, or more than 2 degrees for all sources combined when stream temperatures are 70 degrees or less.

Data on seasonal fluctuations of temperature in Spencer Creek are not extensive. However, comprehensive temperature information is available for 1993 with some information for 1991, 1992, and 1994, as well as information on the Clover Creek tributary for 1975 and 1976. Spencer Creek exceeded the water quality standard for temperature for salmonid rearing streams at several times during 1992, 1993, and 1994.

The maximum monthly temperatures recorded in Spencer Creek were 76.3 degrees Fahrenheit (24.6 degrees Celsius [May, 1992]), and 66.1 degrees Fahrenheit (18.93 degrees Celsius [June, 1993]). In Clover Creek, a major tributary to Spencer Creek, the maximum temperature recorded between July 25, 1975 and June 8, 1976 was 64 degrees Fahrenheit (17.8 degrees Celsius based on three samples). According to the Spencer Creek watershed analysis completed by Weyerhaeuser Company (1994) temperatures in mid Spencer Creek area in 1992 reached levels as high as 82 degrees Fahrenheit (27.8 degrees Celsius) during some of the lowest flows on record.

With the lack of point source contributions (discharges from a single conveyance) to Spencer Creek, nonpoint sources (unconfined discharges from within a watershed) are probably responsible for exceedances of the state standards. Specifically, riparian disturbance and low flows influenced diurnal fluctuations may be a major cause for not meeting State of Oregon Standards for temperature in Spencer Creek.

Turbidity

Turbidity is an indicator of the relative clarity of water. Turbidity is an important parameter for drinking water mainly for aesthetic reasons. Turbidity also has a direct detrimental effect on the recreational and aesthetic use of water. Most of the biological effects of turbidity are due to reduced light penetration in highly turbid waters. Reduced light penetration may impact primary productivity, with periphyton (see glossary) and attached algae being most affected.

According to Oregon Administrative Rules, turbidity in the Klamath River tributaries should not have an increase greater than 10 percent (from all causes) in natural (background) stream turbidity as measured relative to a control point immediately upstream of the turbidity causing activity. Short term limited duration activities may be approved. Measurements of "natural stream turbidity" in Spencer Creek, for use as background levels, are lacking and should be part of a water quality monitoring program.

pH

For the Klamath Basin, pH values shall not fall outside the range of 7.0 - 9.0. Few data on pH variations in Spencer Creek exist. Measurements taken in the fall of 1994 (single values taken once on a given day) at four different stations along a longitudinal gradient in Spencer Creek ranged from 7.2 to 8.7. The pH can vary diurnally in aquatic systems where there are sufficiently high rates of primary productivity (production of plant biomass). If high primary productivity rates occur in the watershed then pH should be determined on a diurnal basis.

The pH of a system should be monitored as an integral part of any water quality monitoring program.

Bacteria

The bacteria standard in effect as of July 1, 1995 (OAR Chapter 340, Division 41), requires that bacteria of the coliform group associated with fecal sources and bacteria of the enterococci group shall not exceed a geometric mean of 33 enterococci per 100 milliliters based on no fewer than five samples, representative of seasonal conditions and collected over a period of at least 30 days. No single sample should exceed 61 enterococci per 100 milliliters. No studies have been completed on populations of enterococci in Spencer Creek. Cattle grazing concentrated in the upper watershed (Buck Lake) and dispersed throughout the remaining watershed would contribute to enterococci populations in Spencer Creek.

Key Question: How have nutrient levels been altered within the watershed and to what degree?

Assumptions/Analytic Process

No data exist for nitrogen and phosphorous levels in Spencer Creek. However the concentrations are likely to be above historical (prior to Euroamerican settlement) levels because of increased sedimentation.

Analysis Discussion

The impacts of potentially elevated nutrient levels, in addition to increased temperature, have probably led to an increase in primary productivity and a change in algal community structure in some sections of Spencer Creek. Changes in algal community structure can influence important functional groups of grazing aquatic invertebrates (for example, scrapers - see the invertebrate analysis below).

These two factors (increased nutrients and increased temperatures) influence the diurnal dissolved oxygen concentrations with the possibility of depressing concentrations below water quality standards. The most likely season for not meeting the dissolved oxygen standard would be the period of reduced flows and increased temperatures. that is late summer to early fall. As discussed above, dissolved oxygen concentrations would be at their minimum during the warm season at predawn periods.

Trends (ODEQ standards). If the recent past practices in the management of upland and riparian areas continued, Spencer Creek and associated tributaries would not meet State of Oregon Water Quality Standards for salmonid bearing streams of the Klamath Basin. This would have negative impacts on populations of cold-water fish by causing a decline in intolerant species with a resulting shift in the community structure towards those species tolerant of environmental degradation. However, with implementation of the Northwest Forest Plan, the recommendations in the Spencer Creek Coordinated Resource Management Plan, and the Weyerhaeuser Company management recommendations in their watershed analysis this trend would potentially reverse.

Nutrient levels. Future water quality monitoring should include nutrient concentrations and seasonal fluctuations in order to obtain baseline information on which to base management decisions. High rates of primary production are likely to continue with increased light and temperatures, and if nutrients are elevated this will also contribute increased rates of primary production.

Key Question: How have the macroinvertebrates responded to perturbations in the Spencer Creek watershed?

Assumptions/Analytical Process

In the Fall of 1991, the Spring and Fall of 1992, and the Spring, Summer, and Fall of 1993, the Bureau of Land Management funded studies for benthic (bottom dwelling) macroinvertebrate monitoring in the Spencer Creek watershed. This project was initiated by Spencer Creek CRMP group. Four stations in the Spencer Creek watershed were sampled in 1991 (September) and 1992 (May and September). The sites sampled included: below Buck Lake; broken bridge; a site at the mouth of Spencer Creek (0.75 miles above mouth); and a site on Miners Creek (a tributary to Spencer Creek). Sampling methods are described in the reports of (Wisseman 1992, 1993).

Analysis Discussion

Several specific metrics were used in the evaluation of the benthic invertebrate data. Each metric measures the presence or absence of groups of invertebrates known to have certain habitat requirements (both physical and chemical).

The major difference between 1991 and 1992 samples was the tenfold increase in invertebrate numbers for 1992. The most likely reason for this is the severe drought which tended to concentrate the invertebrates into a smaller area. The lack of high spring flows (flushing flows) would result in little or no washout of invertebrates.

The total bioassessment scores for Spencer Creek (40 to 50 percent) were on the low end for western North American montane streams. The numbers for Spencer Creek are difficult to interpret for comparative purposes since little information was found for streams in the Klamath Ecoregion. However, as part of the current studies, both Miners and Cold Creeks were sampled and the total bioassessment scores for these systems, also in the Klamath Ecoregion, exceeded 70 percent. These two systems had a higher biological integrity (based mainly on stability and diversity) because of lower land based impacts.

In most streams, bioassessment scores tend to decrease longitudinally from upstream to downstream reaches. This trend was not evident from the 1991 and 1992 sampling periods on Spencer Creek. The upstream stations appear to be heavily influenced by Buck Lake as well as by disturbances just downstream of Buck Lake that result in elevated temperatures.

The positive invertebrate indicator scores for the three stations were low to very low. This indicates a lack of intolerant taxa (intolerant of perturbations such as high temperatures and/or a lack of taxa associated with micro-habitats due to reduced habitat heterogeneity. Taxa associated with cooler water were not found in Spencer Creek. In Spencer Creek the lack of cool water species, is also associated with the warm water from the Buck Lake area.

Specific invertebrate functional groups were lacking in Spencer Creek. One example is the "scraper" functional group. This group is associated with the diatom (algal) films typically found in streams draining forested ecosystems. The scraper functional group is sensitive to fine sediments which foul rock surfaces during base flow conditions. Another factor that may inhibit this invertebrate group is filamentous algae replacing the diatom algal community on rock surfaces. Increased temperatures, sunlight, and nutrients favor filamentous algae over diatoms.

Invertebrate taxa sensitive to embedding (see glossary) of stream substrates, due to sedimentation, are rare in Spencer Creek. It was noted that crevice space between rocks was filled with fine sediment thus limiting the habitat available for this group of organisms and those of the hyporheic area (area with the intergravel water associated with the stream). Cobble embeddedness has both biological and physical significance. Biologically, areas with high embeddedness have very little space for invertebrates or juvenile fish. The reduction in surface area associated with increasing embeddedness limits the attachment area for periphyton. The fine particles associated with increasing embeddedness adversely affect gravel permeability and intergravel dissolved oxygen and a degradation of spawning habitat. Lastly, an abundance of fine particles in the interstices of the bed may delay the onset of bed movement during high flows, thus leading to further accumulation of fine particles.

The overall rating for total erosional habitat assessment for this site is low. This indicates a lack of cold water (intolerant) species which have been replaced by relatively tolerant species that are generally found in warmer waters. A combination of the ditching of Buck Lake and the removal and/or disturbance of riparian vegetation has impaired the aquatic habitat. This has lead to elevated stream temperatures, increased levels of fine particles, and siltation, resulting in increased embeddedness of gravels.

In summary, based on invertebrate community indicators, impacts are apparent from high summer water temperatures and fine sediment at all stations. These negatively affect the biotic and habitat integrity of Spencer Creek and influence the distribution and abundance of invertebrates and those fish that are dependent on invertebrates as a food source.

Miners Creek. The total bioassessment score for Miners Creek is high. This indicates that overall few negative indicator taxa were found and several positive indicator taxa were present.

In particular, the total taxa and the EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa are present in significant numbers in this region. Several cool water taxa are present indicating that the year round temperatures are relatively low. Of particular interest is the well developed shredder community. The presence of the shredder community indicates a predictable supply of coarse-particulate organic matter in the form of leaves from the riparian zone.

As in Spencer Creek, Miners Creek tends to have a large amount of fine sediment which inhibits the scraper (periphyton feeding) community. Another indication of fine sediment is the lack of a developed hyporheic community. Taxa associated with the open hyporheic pore space, and large crevices between/beneath rocks are rare because of embedding from fine sediment closing off these rocks and associated cavities. There was no indication of significantly elevated temperatures nor nutrient enrichment.

In summary the major problem associated with Miners Creek is excessive fine suspended sediment resulting in a reduction of habitat complexity and integrity.

Summary

There have not been detailed studies of water quality in Spencer Creek. Activities associated with forest practices can influence hydrology and riparian functions as well as affect erosion and mass wasting processes in a watershed. The major pollutants from forest practices that affect water quality are sediment, turbidity, vegetative debris, and temperature. The only parameter consistently measured was temperature and these measurements have occurred only in recent years. Throughout the mainstem of Spencer Creek, temperature, during critical times of the year, exceeds State of Oregon Water Quality Standards for salmonid bearing streams. The exceedance of the temperature standard may be related to two major management changes in the watershed; increased disturbance of the riparian zone due to management practices and the draining and water diversion channeling of Buck Lake for livestock grazing.

Another impact of changing land uses is the degradation of aquatic habitat quality. This change has resulted in aquatic habitat degradation due to elevated temperatures and increased sedimentation. Macroinvertebrate populations throughout Spencer Creek are dominated by species tolerant to environmental degradation. Habitat degradation is also reflected by the apparent changes in the fish communities from those associated with stable conditions to those tolerant to a fluctuating environment.

Issue 14: The hydrograph has been altered in terms of base flow, peak flow, and timing of peak flow.

Key Question: Has the natural draining process in the watershed been altered by timber harvest, road building, and diversion activities?

Note: Stream flow data from both the miscellaneous discharge measurements and at the U.S. Geological Survey gauging stations is good. The historic and present vegetation stand data for this analysis is fair to good. An attempt was made to draw conclusions from research data at experiment stations in other areas to determine possible cumulative effects in Spencer Creek. This creates a level of uncertainty. As various geological/geographic characteristics differ. However, discussions with district silviculturists and foresters counterbalances this discrepancy, as site specific data regarding recovery rates were factored into the models developed in other regions.

The reader needs to have the understanding that the following discussion is not intended to quantify the magnitude of change in streamflow from management activities. Rather, it is a tool to translate past and present research into management considerations. Specifically, the analysis is designed to give a picture of the probable effects given the magnitude of disturbances within the watershed, and to give an understanding of how to view the watershed in terms of hydrologic function.

Assumption/Analytical Process

The watershed was divided into Spencer Creek, and the Clover and Miners Creeks subbasins. The first step was the quantification of the present flow regime. Comparing current flows to historical flows was not feasible due to data limitations, however, based on the distribution and intensity of management activities (cumulative effects) in the watershed, the probabilities of change were estimated.

Base Flow Analysis

Base flow for Spencer Creek was ascertained from sketching hydrographs from the 1992 and 1993 water years (see Figure 17). The hydrographs consist of several miscellaneous measured flows. Inflection points in the hydrograph were identified and used to determine annual low flow. For Clover and Miners Creeks, the limits of ephemerality (extent of perennial flow) were used.

Peak flow analysis procedure

Peak flows at a two-year return interval were used for this analysis. The two-year return interval was chosen because of the inherent channel-forming properties associated with this stage. Because the product of the frequency and magnitude of the forces of discharge determines the effectiveness of sediment transport and the resultant channel characteristics, it can be inferred that the active channel is formed by frequently occurring medium-sized events (Wolman and Miller 1960). While larger events modify floodplains and valley floors, they are too infrequent to maintain the active channel. Peak discharge was quantified using U.S. Geological Survey gauging statistics and miscellaneous flow measurements. Gauging station data indicate that in the Klamath Basin, there was, on average, a 7 to 8 year flood event during the wet year of 1993. Although there are differences in runoff patterns between the rivers with gauging stations and Spencer Creek, it is fairly certain that creeks in the Spencer Creek watershed area experienced similar peak flows. During the peak runoff, discharge measurements were taken. A number of discharge measurements were made during the "over-the-bank stage" (while the floodplain was inundated). While an exact number for the two-year return interval peak flow cannot be made, a range of flows around this interval was measured; peak flow is expected to fall within this range.

Cumulative Effects Analysis

In developing a conceptual model and forming assumptions for factors leading to changes in flow regime, findings from the Pacific Northwest, Intermountain Forest and Range Experimental Stations, and The Rocky Mountain Forest and Range Experimental station (for example, Bethlahmy and Nedavia 1972, Cline et al. 1977, Harr et. al. 1979, J.D Cheng 1980, Troendle and Leaf 1981, Leaf 1975, Troendle and King 1985) were used, as well as Dennis Harr's summaries at Oregon State University (Harr 1975; Harr et. al. 1975) and several papers included in the International Symposium on Forest Hydrology (Dortignac 1965, Pereira 1965). A summary of the key findings follow below:

- There is a net increase in peak water equivalent in harvested/ burned watersheds.
- Snow melt rates were highest in open plots.
- Accelerated snow melts proceeded harvest.
- Low to medium flows on the rising limb of the hydrograph were most altered in timing and magnitude.
- Mean daily peak flows increased.
- Duration of annual floods increased.
- Loss of transpiration accounted for 2/3 of the change in flow with 1/3 from loss of interception.

Using this background information and additional results found in the studies a cumulative effects procedure was developed.

Modification of vegetation distribution and reduction in wetland function was assumed to be the dominant factor influencing changes in base flow. Changes in vegetation structure and the resulting changes in transpiration rates are directly proportional to changes in soil moisture content, which are directly related to base flow conditions. Wetlands function to attenuate flood peaks and to store water to be released in the summer and fall months.

The net effects of wetland function loss, decrease in transpiration, increasing peak water equivalent, and design of the road system were assumed to be most influential in altering quick flow and peak discharge. The fundamental concepts underlying these assumptions follow: loss of transpiration allows quicker recharge of soil; reduction in canopy closure will reduce interception; and the presence of roads add to the drainage network. "Net effect" was chosen because all three factors are simultaneously involved. Consequently, determining the relative contribution of any one variable is not significant.

These assumptions focused the cumulative effects analysis on road densities, wetland function, and on recovery rates of harvested units. "Recovered" in this analysis is considered to be "hydrologically recovered". Harvest units are hydrologically recovered when reestablishment of leaf area is sufficient to return transpiration rates to pre-harvest levels and canopy closure is sufficient to prevent excessive snow loading. Leaf area index is the ideal variable to quantify and express recovery; however, considering the size of the watershed leaf area index is not feasible, and canopy closure was used as a surrogate. To standardize the data and facilitate comparisons among watersheds, recovery was expressed in terms of equivalent clearcut acres (see Appendix 6 for stands and assigned recovery). Roads and areas of compaction are not incorporated in the recovery model as these conditions persist for long periods of time.

Changes in vegetation resulting from alteration of the fire regime were considered, but not quantified during the analysis. In the mid-elevation mixed conifer stands, succession in the absence of fire has likely caused higher stocking levels and increased canopy closure in some stands with a reduction in other stands due to harvesting. The change has likely increased transpiration rates in some stands. Reduction of snow accumulation has probably been minimal, since typical mixed conifer stands originally had 40 to 70 percent canopy closure. Therefore, the largest effect may be on the availability of water during late summer. This process may influence base flows if stocking levels increase on a significant portion of the watershed area.

Note: Stream flow data from both the miscellaneous discharge measurements and at the USGS gauging stations is good. The historic and present vegetation stand data for this analysis is fair to good. An attempt was made to draw conclusions from research data at experiment stations in other areas to determine possible cumulative effects in Spencer Creek. This creates a level of uncertainty. As various geological/ geographic characteristics differ. However, discussions with district silviculturists and foresters counterbalances this discrepancy, as site specific data regarding recovery rates were factored into the models developed in other regions.

The reader needs to have the understanding that the following analysis is not intended to quantify the magnitude of change in streamflow from management activities. Rather, it is a tool to translate past and present research into management considerations. Specifically, the analysis is designed to give a picture of the probable effects given the magnitude of disturbances within the watershed, and to give an understanding of how to view the watershed in terms of hydrologic function.

Analysis Discussion

Spencer Creek is a third order channel. Water input from tributaries, other than during spring runoff is nonexistent; springs and interflow dominate the flow regime nine months of the year. Spencer Creek flows into the Klamath River at J.C Boyle Reservoir.

Baseflow

Currently, the base flow for Spencer Creek ranges from 5 to 15 cubic feet per second. Two sources contribute to baseflow: the springs at the west end of Buck Lake; and the wetland/spring system northwest of Buck Lake. The latter source is responsible for fluctuations in baseflow. The springs appear to have a shallow aquifer. Thus, seasonal precipitation greatly influences discharge into the wetland and then into Spencer Creek. During the summer and fall months flow decreases in a downstream direction. Discharge measurements during the summer of 1994 show a comparison of 4.5 cubic feet per second below Buck Lake to under 1 cubic feet per second at the mouth. It is speculated that water loss due to transpiration accounts for this, specifically, several miles of wide valley bottom dominated by a multiple canopy of willows, aspen, and cottonwoods. Repeat discharge measurements during December, while the hardwoods are dormant, confirm this since flows were not significantly different from the headwaters to the mouth.

Historically, Buck Lake functioned as a large wetland system, attenuating flood peaks and storing water to be released in the summer and fall months. The gradual release of water from the lake system supplemented the spring and interflow discharge. With the draining, this function has been lost. As a result, baseflows have decreased, or at least the number of low flow days has increased. It is difficult to quantify the magnitude of change, but it is fairly certain that water released from the wetland contributed to a higher base flow.

The current management, after the draining of Buck Lake, has little affect on baseflow, in terms of volume. However, the delivery of water from Buck Lake to the channel has been altered. The springs discharge at a constant rate; the delivery to the channel is not. The combination of impounding ditches to flood fields and the draining of other fields determines the quantity of water delivered to the channel at any given time.

Peakflow

Peak flow for Spencer Creek (quantified approximately 1 mile below Buck Lake) is 110 to 140 cubic feet per second. Analysis of possible alteration to the flow regime is described below.

Harvest activity in the last 30 years consists of overstory removals, thinnings, and clearcuts, which removed 10 to 100 percent of the basal area present. Regeneration units are reforested with 300 trees per acre. The process described under cumulative effects procedure was used to estimate that currently, the Spencer Creek watershed has approximately 12,900 of equivalent clearcut acres. This represents approximately 24 percent of the watershed area.

There are 1,047 acres of road surface. Roads cross stream channels 150 times. Field reconnaissance indicates that little overland flow or surface erosion is occurring in the compacted areas, except on non-native surface roads and in valley bottoms where water naturally accumulates. This is due to the buildup of a duff layer and the high percentage of coarse material in the soil, allowing for rapid infiltration in spite of compaction.

The cumulative effects of management activity have altered four processes:

1. Net reduction in transpiration.

2. Reduction in interception.

3. Extension of the drainage network.

4. Loss of wetland function.

In the Spencer Creek drainage, the road system and loss of the wetland system are of most concern in altering the timing and magnitude of peak flow. While reduction of transpiration and interception is occurring, two characteristics in the basin mitigate this - infiltration rates of the soil and the brush component of the vegetative community. The additional water availability does not appear to exceed the capacity of the soil profile to absorb it. The heavy brush invasion in most units behaves to compensate for the removal of the conifer species, in terms of transpiration.

The draining of Buck Lake results in the inability of the wetland to attenuate flood peaks. The design of the road system adds to the channel network. The net result is greater efficiency of water delivery into the stream channel. There is a medium-high potential that peak flow timing occurs earlier in the year.

The same logic can be applied to the magnitude of peak flows. With the road system in place the timing of water delivery into the channel is more uniform. The sycronizing of water delivery to the channel can increase peak flows.

During snowmelt generated peaks this process has little potential to create a detectable increases in peak discharge. Snow melt is slow allowing greater opportunity for percolation. The potential increases in those years when rainfall adds to the snowmelt runoff. On average, this will occur two to three times every ten years. It is important to note that this is not referencing the rain-on-snow event where warm rains greatly accelerate the snowmelt process. In these cases, the volume of water can be extremely large and the added effect of the road system is minimal. The loss of the wetland function at Buck Lake removes the area's ability to act as a buffer during peak runoff. There is a low to medium probability that annual increases in peak flow magnitude occur. For upslope areas having a high potential to accelerate runoff, see Map 27 for hydrologically sensitive areas. Hydrologically sensitive areas occur where there has been removal of greater than 50 percent of the canopy closure, there is a a high road density, and it is located in a natural drainage feature.

Altering the hydrograph changes channel geometry and substrate composition. The reaches most sensitive to these changes are the alluvial reaches (low gradient segments, see Map 31) as these areas are more responsive to changes in inputs. Channel condition is altered but considering the effects of grazing, road building, and direct modification, it is very difficult to assess the relative contribution of channel changes due to alterations in the flow regime.

Fire suppression has led to white fir invasion in the understory, increasing canopy closure by as much as 30 percent. The extent is limited to federal land in the mid-elevation zone, 4,500 to 5,500 feet. In these areas transpiration has likely been altered. Because the relative difference in transpiration rates between stands with an understory of white fir and those without is not fully understood, it is unknown at what point increasing the canopy closure will begin to influence baseflows. It is unlikely that the current spatial extent of stands with increasing canopy closure is large enough to affect the flow regime, because of the offsetting effect of harvests.

In summary, approximately 24 percent of the watershed is in equivalent clearcut area. There has been a reduction in transpiration resulting in greater water availability to the stream channel, but the presence of the brush component and capacity of the soil to absorb the increase in water partly compensates for this. The road system and draining of Buck Lake are determined to be the most influential in modifying peak flows. As a result, changes to the magnitude of peak flows is most evident on those years when spring rains add to the snow melt process. Conversely, with the addition of the drainage network in concert with the draining of Buck Lake, it is reasonable to assume that the timing of peak flows occur earlier. A reduction in base flow has most likely occurred as a result of the draining Buck Lake.

Trends

Past harvest units will recover to pre-harvest conditions. The recovery is a function of canopy removal and time. Expected time to recovery for clear cut units with reforestation is 25 to 30 years. Roads and the drainage system in Buck Lake will continue to provide a more efficient delivery of water into the mainstem. Base flow will continue to be reduced.

Please consult with the Weyerhaeuser Company, Spencer Creek watershed analysis and Map 7 for roads and Maps 27 and 28 for hydrologically sensitive areas.

Clover Creek

Analysis of base flow for Clover Creek consists of observation only. Clover Creek is a second order drainage, and is intermittent. There is a perennial reach beginning at Porcupine Spring and flowing for approximately 1 mile before subsiding.

Discharge measurements during the spring runoff of 1993 were taken and calculated at 9 cubic feet per second. Connectivity with Spencer Creek even during high flows is rare, occurring once every 5 years.

There has been substantial timber harvest and road building activity in the lower Clover Creek basin since the early 1930s. Aerial photographs from 1940 display a road system in place from the mouth of the creek to the wilderness boundary. The road system followed the stream channel and crossed several times. Timber harvest activity was also present throughout the lower basin.

The major concern for Clover Creek is whether management impeded flows and altered the connectivity with Spencer Creek. The intensity of management both spatially and temporally is sufficient to affect the flow regime. Ample sediment has been introduced to cause percolation through gravels reducing surface flow. However, observations in July of 1994 also demonstrated that Clover Creek was dry in the wilderness where very little management has occurred. This was an exceptionally dry year. The conclusion is that water supply, or lack thereof, limits the extent of perennial flow during drought years. During wet years the effect of management is unknown.

Miners Creek

Analysis of base flow for Miners Creek consists of observation only. Miners Creek is a second order drainage and is intermittent. There is a perennial reach beginning in Section 33 and subsiding approximately 0.5 mile above the mouth. The reach is spring driven and appears to be geologically controlled. A break in slope in the valley bottom profile coincides with spring discharge. Connection with Spencer Creek is annual, and generally flows until mid-July.

Issue 15: Channel condition has degraded.

Key Question: What channel forming processes are active in the Spencer Creek watershed?

Key Questions: Have road building, timber harvest, or grazing activities altered channel dynamics? Channel morphology?

Key Question: How do upslope processes influence channel condition?

To analyze channel condition in Spencer Creek, the three questions above needed to be answered simultaneously.

The first two questions focus on the mainstem channel. Answers to these questions include: assessment of historic and present conditions; determination of causal mechanisms; predictions of condition trends; and identifications of denuded channel segments. Due to the connectedness of the first two key questions, they are analyzed concurrently.

The third question defines upslope processes influencing channel condition. The answer speaks to natural erosion rates, functioning of intermittent channels, and effects of the road system.

Analysis Discussion

The initial step to analyzing processes active in the channel is stratification of segments exhibiting similar form and processes. Two distinct stratification segments were chosen - confined and unconfined. Confinement is determined by dividing valley width by stream width at "bankfull" stage. Stream segments within the stratigraphic units have similarities in gradient, substrate, riparian width, width/depth ratios, and scour and fill processes. Additionally, channel responses to management activities are similar.

Confined reaches

Key Question: What channel forming processes are active?

Channel substrate is dominated by subangular gravel and cobble. Gradient exceeds two percent. Bank material is a mixture of sands to small boulders. Side slopes are steep, greater than 40 percent. Floodplain development is minimal. Likewise, riparian zone width is small, generally less than 30 feet. Immediately upslope the vegetation is dominated by mixed conifers.

Lack of fluvial (produced from stream action) sediment deposits such as point bars, lateral bars, and mid-channel bars indicate these reaches are transportational. Corresponding to high gradients, these reaches have higher velocities and more turbulence than do the lower gradient segments. This allows for greater competence in transporting sediments. Consequently, bed and bank material derive from colluvial processes (derived from gravitational forces).

Mechanical bank failures from gravitational forces, or colluvial processes, are active. This occurs in the upper bank region, above the bankfull channel. Areas most susceptible to erosion occur where bank material is loose, unconsolidated volcanics composed of 70 percent sands and gravels and 30 percent larger material. The material becomes saturated during most snow melt/ high intensity rainstorms, increasing material weight. The additional weight increases shear stress. When shear stress exceeds shear resistance, localized slides ensue. Banks composed of 50 percent larger material significantly reduces bank failure potential.

Channel forming processes can be generalized as an A and B system according to the Rosgen Classification System. In the confined channel network, with very low sinuosity and floodplain development, the majority of energy dissipation is turbulence generated by large roughness materials. Substrate and large woody debris create turbulence which directs flow velocities, or kinetic energy, into the channel bottom or adjacent substrate. When the velocities are directed toward the channel bottom, the energy forms pools. Similarly, small pocket pools are formed when turbulence around large substrate removes the smaller material at the base. Spaced between these areas of high turbulence are stretches of less resistance, allowing for increased velocity. This sequencing of high velocities and pool formation creates the pool-riffle sequence.

During large infrequent flow events, substrate occupies but a small proportion of the water column and has little effect on slowing velocities. In this case the stream spreads out in overflow channels or is directed toward the upper banks, resulting in high erosion rates.

Historically, these processes form a pool-riffle system. Due to the high gradient the frequency of pool-riffle sequencing was approximately three to seven channel widths; increasing in frequency with higher gradient. Large wood was a major factor in quantity of pools. Large wood also created dam pools upstream and slowed velocity allowing for the deposition of gravels.

Key Question: Have management activities altered channel dynamics or morphology?

The instream dynamics forming the pool-riffle sequence have been simplified. The causal mechanism is removal of instream structure - wood. The confined reaches are now dominated by shallow riffles; the process of scouring pools has decreased. Likewise, areas of low turbulence and velocity, allowing for the deposition of gravels, has decreased.

Removal of wood and operation of heavy equipment near the stream initiated bank erosion. Changes in both the magnitude and direction of flow velocities increased the potential for bank erosion. Bank failures are associated with flows directed toward the bank, under-cutting the base, initiating bank failures. Areas most susceptible occur where the stream was originally eroding into a terrace. Equipment operation in the channel and on the banks created localized raveling (scars on the banks). Sediment input from these disturbances appears chronic as establishment of vegetation is very slow on steep raveling banks.

There are more than 150 road crossings and 23 miles of road within 100 feet of the stream channel. In many areas, roads are routing water and sediment into the channel. Grazing occurs and creates local disturbances to riparian vegetation, but what little evidence there is indicates an appreciable increase in sedimentation.

Although management activities have increased the sediment input above historic levels, the increase is not affecting aquatic habitat in the confined channel segments, as the material is quickly transported to the lower gradient reaches. Additionally, the sediment input from bank erosion is a relatively small percentage of the total increase in sediment budget.

Logging and road building within 200 feet of the stream channel affected large woody debris recruitment. Removal of large conifers in the riparian zone decreased the potential for near term wood recruitment (see Map 30). Roads paralleling the stream in nearly all sections prevent upslope recruitment of large woody debris.

In the future, altered morphology and increased sedimentation will persist into the near term. The removal of wood from the channel has simplified channel form. And with the combination of harvest and road building, natural recruitment of wood to historic levels is not likely for more than 100 years. Routing of water and sediments from the road system will continue.

Unconfined reaches

Key Question: What channel forming processes are active?

Channel substrate can be silts to gravel, depending on local velocities. Gradients are less than two percent. Valley bottom/floodplain widths exceed hundreds of feet. Streamflows divide into multiple channels. Riparian vegetation is dense with a multiple canopy of grasses/forbs, willows, and cottonwoods. Bed and bank material derive from fluvial processes. Gradients are low, decreasing stream power. Sediments transported through the confined reaches "fall out", building point bars, lateral bars, and an extensive floodplain. Bank material is silts to sands. The combination of fine bank material and wide floodplains allows for channel adjustment. Tractive forces (see glossary), produced by moving water, acting on the banks dominate the erosion process. Historically, bank erosion from these segments provided the majority of the sediment into Spencer Creek's sediment budget.

Channel forming processes can be generalized as a C system according to the Rosgen Classification System. Energy dissipation is from roughness, namely, sinuosity and bar development. Sinuosity occurs through erosion on the outside of the bends and depositing materials on the inside. Sinuosity increases channel length; channel gradient decreases proportionately. As the creek meanders, bars alternately form, providing structure and slowing velocities. Pools are predominately scour holes on the outside of bends. Between bends, or cross over points, the channel is straight with little form roughness. Velocities increase forming riffles. Lateral scour holes, or undercut banks, are prevalent in these areas. This sequence of meander bends and cross over points define the pool-riffle sequence. Beaver activity is common, which raises water elevations and creates large wetland habitat adjacent to the stream channel.

Because the channel is unconfined, flood waters leave the bank and scour channels parallel to the stream. During these events large quantities of sediments enter the channel.

Key Question: Have management activities altered channel dynamics or morphology?

The channel segments of the unconfined reaches, due to their inherent adjustability, are more sensitive to changes in inputs. Changes in the sediment regime and disturbances to bank vegetation readily alter channel morphology.

Grazing has little affected sedimentation rates in the higher gradient reaches due to armoring or inaccessibility. Conversely, cattle have detrimentally impacted many areas in the lower gradient segments. Armouring of banks from vegetation and root mass greatly limits the rate of erosion. Grazing removes the armouring, initiating accelerated adjustment and associated sediment. Additionally, floodplain vegetation is reduced allowing for increased flow velocities during "out of bank" flow events; the process of deposition on the floodplain is reduced proportionally. Bank erosion from these reaches is a relatively high contribution to the total increase in the sediment budget.

Other sources of sediment include bank erosion from the confined channel segments, roads, and upslope processes (discussed below). The combination of mechanical breakdown of banks from trampling and increased sedimentation results in the alteration of bed material composition and channel geometry. The input of sediment is fine materials; therefore, the channel is not aggrading, but a layer of sediment is evident throughout the area. Consequently, gravels are imbedded. Siltation is most profound during low flow periods. During the rise and peak of the hydrograph, sediments are lifted from the channel bed and become entrained. As the flow recedes, sediments are redeposited on the channel bottom. Stream channel adjustment is lateral, increasing width to depth ratios. The prevalence of vertical undercut banks in the cross over areas decreases with the widening of the channel. Sediments accrete in slow velocity areas, reducing residual pool depth.

In the future, the dominance of fine sediment on the channel bed and accelerated bank erosion will persist under current management. Improvement in bank stability, encouraging undercut banks and lateral scour pools as well as decreasing sedimentation from rapidly adjusting banks, can be accomplished in a short time frame, approximately 5 to 10 years. Improvement of channel substrate, from silt dominated to a historic mixture of silts to gravels, will require considerably more time considering the magnitude and spatial extent of the sediment input from roads and the tributary system.

Key Question: How do upslope processes influence channel condition?

Analysis Discussion

The analysis is divided into three categories. 1) Function of intermittent and ephemeral channels with specific reference to Clover and Miners Creeks. 2) Natural geomorphic/erosional processes. 3) Road system effects on erosion rates.

Identification of two processes are examined, area of sediment production and routing of sediment into the stream channel. The combination results in an influence on channel condition.

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Function of Intermittent and Ephemeral Channels

The majority of the channel network, in terms of total stream miles, is first and second order streams. Stream density is low reflecting rapid infiltration rates of the soil. All but a very few stream segments are intermittent or ephemeral. Rarely, do these drainages connect with the mainstem, even during runoff periods. Their function, as it relates to channel condition of Spencer Creek, is the storage of sediment and organic debris. Each channel is a catchment for the respective drainage area. Sediments and organic material migrate downslope and accumulate in the channel. During runoff events of sufficient magnitude, the material is mobilized and delivered to Spencer Creek. The products- sediment, woody debris, and organics are important for bar/ floodplain development, instream complexity, and food production respectively.

Clover Creek. Clover Creek is a second order drainage, 13,886 acres in size. Clover Creek drains the south side of the Mountain Lakes Wilderness. The Clover Creek watershed has very porous soils. The upper watershed has been heavily glaciated; glaciation left thick deposits of till from the headwaters to the wilderness boundary. From the wilderness boundary downstream, soils are a composite of Quaternary basalts, andesites, ash, cinders, pyroclastics, and older tertiary volcanic deposits.

These deposits and formations result in a low discharge to drainage area ratio. Porcupine Spring provides the only source of year round surface flow. Development near the spring, a 1/4 acre pond, captures the flow. Seepage through the earthen dam supplies approximately a 1.2 mile stretch with perennial flow. Connection frequency with Spencer Creek is every 5 to 10 years.

The channel condition in Clover Creek is poor. From the wilderness boundary to Porcupine Spring, the stream is aggraded. Road 230 parallels the creek, crossing it five times. The road is a main thorough fare for wood cutters who have created several secondary roads to access lodgepole pine. As a result, nearly the entire channel and banks are disturbed. Cattle grazing has exacerbated the condition. The most sensitive areas to disturbance are the lateral moraines forming the channel banks. The banks are mechanically broken down by vehicles and vegetation removal. Presently, the banks are in a state of continual adjustment. Void of material strength, the banks are not able to resist the forces of flowing water. Sediments deposit in the channel bottom, widening the stream. Widening the stream increases the shear force on the banks, further increasing erosion potential. The frequency of large woody debris in the wilderness exceeds 20 pieces per mile, while below the wilderness it is less than a fifth of that. Large amounts of small woody debris (branches and cuttings) lie in the channel. High flows, bankfull and greater, float some of it away and the remainder shifts around which redirects flows and prevents establishment of a single thread channel. This process is chronic as establishment of vegetation is very slow for two reasons:

- A harsh climate of freezing winters and dry summers is natural;
- Vehicle traffic, grazing, and debris persist.

Downstream from Porcupine Spring, a combination of streamside vegetation removal, roads, and cattle grazing have denuded riparian zones and altered channel form. Monitoring should help to determine relative cause and effects of various management activities.

Miners Creek. Miners Creek is a second order drainage, 4,197 acres in size. Miners Creek drains the north side of Surveyor Mountain. The lower reach is gentle gradient; valley bottom width is approximately 200 feet. Flows are intermittent, but residual pools are present throughout the summer months. Bank stability is rated good. The middle reach, the perennial reach, begins in the southwest corner of Section 33 and flows to approximately 0.5 mile above the mouth. At the upstream end of the reach a break in gradient appears to allow the ground water flow to become surface flow as many springs discharge at this zone. The channel is characterized as a step-pool system and dominated by cobble size substrate. Bank stability is rated good. The upstream reach extends from the spring source to the headwaters. Flows are intermittent, but a distinct zone of riparian vegetation lines the stream.

Road density is moderate. The system is naturally very stable and response to the road system is subtle.

Other tributaries. There are approximately 60 miles of unnamed tributaries in the Spencer Creek watershed. Field reconnaissance indicates that the majority have altered channel form. Bank failure due to mechanical breakdown from vehicle traffic in the channel and removal of lodgepole pine from the stream banks are the dominant mechanisms. Due to the infrequent flows through the channels, an annual supply of sediment delivered to Spencer Creek is not anticipated; but slugs of sediment every 10 years are likely.

Natural geomorphic processes

Landform processes such as landslides, debris flows, and rill and gully erosion are, for the most part, rare. According to the Soil Resource Inventory and the Jackson County Soil Survey approximately 4 percent of the watershed area is classified as high erosion potential. The combination of highly porous volcanic soils and gentle slopes account for this. The steep slopes of Aspen Butte, Mt. Carmine, and Crater Mt. are the exceptions. These slopes are greater than 60 percent, composed of loose andesites and glacial till. Precipitation is heavy, greater than 40 inches annually. Landslides and debris flows occur when the top soil layer becomes saturated increasing shear force. When shear force exceeds shear resistance, debris movement initiates.

Routing of sediment from these infrequent events into the tributaries is minimal; therefore, sediment production and the influence on channel condition is insignificant.

Management has little affected hillslope erosion processes. Frequency of landslide and debris flows are at historic levels. Rill and gully erosion has increased, but is found almost exclusively on road beds and skid trails (discussed below, also see Map 17 - high, medium, low erosion potential) .

Roads

Roads in the Spencer Creek watershed are the largest contributor to fine sediment input. Soils with the Greystoke-pinehurst complex found throughout the watershed are susceptible to disturbance. The soil is fine textured; the top soil is a composition of sandy loams and organic debris. This horizon has large pore space and provides surface roughness. Road building and skid trails remove this protection and expose the subsoil. The subsoil has decreased pore space, reducing infiltration and when void of organics reducing surface roughness. Consequently, overland flow concentrates in these areas during spring runoff initiating rills and gullies. Erosion in harvest units from landings and skid trails have little effect on channel condition as the routing from point of detachment to the stream is often not present. Hillslope roughness is sufficient in slowing water velocities and "dropping out" the sediment before entering the creek. Sediment from roads, on the other hand, has a high potential to reach the creek. There are more than 150 road crossings in Spencer Creek and tributaries. Many of these crossings deliver sediment and water to the channel.

Issue 16: Management practices have altered habitat conditions and caused changes in species assemblages, connectivity, and distribution.

Key question: How have physical and chemical changes impacted aquatic organisms and other dependent species?

Assumptions/Analytical Process

The causal mechanisms for changes in aquatic species communities are a combination of changes in habitat conditions both outside and inside the Spencer Creek watershed, and exotic species introductions. The answer to this key question describes the effects of logging, road building, and livestock grazing on the biological community within the watershed. The degree and magnitude of these impacts is based on the information provided in the water quality, channel condition, and the timber and grazing discussions. Therefore, the assumptions applied to those discussions apply equally here.

There is great difficulty in assessing the cumulative effects of change to make accurate, long-term predictions about responses to habitat change in the biological community (Chamberlin et al. 1991). However, it is well documented that changes that direct an ecosystem towards simplified habitat structure tend to result in less stable populations (Gregory et al 1987; Owen and Karr 1978) and lower productivity for those species with multiple habitat type requirements such as rainbow trout (Moyle and Liedy 1992) and Pacific giant salamanders (Baltz et al. 1991).

When environmental changes are broken into components that are known to affect species and aquatic habitats, the response becomes more predictable (Hicks et al. 1991). Lack of detailed information on the interactive processes occurring in the Spencer Creek watershed necessitates a generalized approach based on research and observed responses to management practices in other applicable watersheds.

This analysis focuses on processes that met three criteria for inclusion. First, there is existing data which can be quantified to some extent. Second, there is documented evidence within the scientific community that the process limits aquatic ecosystem function. Third, there is evidence or supposition that within the Spencer Creek watershed, health of the aquatic ecosystem is impaired by changes in function due to management activities.

There is a large body of literature which supports some generalizations about the effects of sedimentation (Berkman and Rabeni 1987; Everest et al. 1987), removal of course woody debris (Beschta 1979; Harmon et al 1986; Smith et al. 1993), and reduced shading (Gregory et al. 1987; Platts and Nelson 1989) on stream communities, especially in salmonid habitats (Meehan 1991).

The following processes of stream and riparian ecosystem function were assessed for their effect on the biological community:

- Shading (or incidence of solar radiation).
- Large woody debris (large woody debris, wood greater than 15 inches in diameter).
- Water quality including temperature, dissolved oxygen, and nutrients.
- Transport and deposition of fine sediments in the aquatic environment.
- Flow regimes.
- Channel habitat including pool/riffle ratios, sinuosity, and channel complexity.
- Barriers to movements of aquatic organisms have been created by road building and altered habitat conditions.
- Natural disturbance regimes including precipitation, beavers, insects and disease, and catastrophic events such as large stand replacing fires, landslides, volcanism, and floods.

Limitations of this analysis procedure.

The factors chosen to use for this analysis may not be complete indicators of overall ecosystem health.

Using historic function as a basis for assessing present function may not be appropriate given the magnitude of changes due to management and the changes in natural disturbance regimes.

Incongruence of spatial and temporal scales may hinder the interpretation of findings. Stratification of watershed features may have been inadequate to sample variation occurring in both time and space (Hankin 1984).

Analysis Discussion

Historic Condition and Natural Processes

Background

The natural processes of the aquatic system need to be considered before linking management activities to changes in the aquatic ecosystem health. While few undisturbed areas exist for baseline historic condition in the Spencer Creek watershed, some comparisons to similar areas can be made.

Quantitative data describing historic aquatic habitat condition and communities are lacking. The vegetative condition of riparian areas can be interpreted to some degree from descriptions in Leiberg (1899) which is detailed in the Terrestrial Ecosystem discussion. From that discussion it is apparent that a natural fire regime of approximately 9 to 42 years occurred in the lower elevation pine dominated zones. Fire frequency in the upper elevations was probably more variable with potentially long periods being fire free. This fire regime coupled with insect and disease cycles probably played a role in shaping the vegetative structure in the riparian zones of the watershed. The result was that certain stream segments would be exposed to periods of low canopy closure and high input of large woody debris at various times within the context of the fire and disease cycles.

Natural processes apparently rare in the Spencer Creek watershed but characteristic of other Cascade Range systems include landslides, debris flows, overland water flow, and down-cutting (gully erosion) of stream channels (Weyerhaeuser 1994). Relatively low gradients, porous soils, and deep glacial till in some areas combine to create a system with low stream densities (0.3 mile of perennial streams per square mile, and 0.9 miles of intermittent streams per square mile).

Other processes encompassing a greater temporal scale include floods, volcanism, and climatic changes. Catastrophic events such as floods and landslides tend to have devastating short-term effects on aquatic systems. Healthy aquatic ecosystems are generally resilient to such change and may even benefit by the addition of organic and mineral nutrients supplies and coarse roughness elements. (Swanston 1991). An analysis of past catastrophic events was beyond the scope of this analysis. Obviously, such large uncommon events helped shape the evolutionary outcome of the present Spencer Creek ecosystem. For this reason, they should not be ignored in long-term considerations.

Shading (effects on temperature and productivity)

Some interpretation of historic stream shading can be made. Historic tree composition and valley form indicate that approximately 75 percent of the perennial streams (excluding Buck Lake) probably had 40 to 70 percent canopy closure. The remaining 25 percent, areas with broad flood plains and meadows, is presumed to have had a mixture of cottonwoods, willows, and scattered lodgepole pine patches. These areas were presumed to have been little impacted by fire and therefore shading was probably more constant. Shading in willow dominated reaches (usually coincident with beaver dams) is assumed to have been similar to current conditions (a range of approximately 10 to 70 percent shaded). Buck Lake was a wetland with emergent aquatic vegetation which provided some amount of historic shading. The type and extent of shading in Buck Lake is unknown at the time of this writing.

The aspect of the perennial portion of Spencer Creek is primarily southeast. This exposure provides high incidence of solar radiation compared to many drainages in the Cascade province which tend to run east or west. Spencer Creek was probably a productive stream because of relatively high solar radiation levels. However, it is assumed here that historic shading was sufficient such that the stream corridor had a general cooling effect during the summer on instream water coming out of Buck Lake, a natural wetland. In the other perennial streams segments, including Clover Creek and Miners Creek, shading was very high and probably limited aquatic productivity due to low incidence of solar radiation. Water temperatures in these reaches were probably never in excess of levels considered detrimental to fish populations. Areas susceptible to very low flows were probably subject to short term high temperatures and high diurnal fluctuations in water temperature.

Sedimentation

Sediments, for the purposes of this discussion, are separated into two types, fine sediments and bedload sediments. They are discussed separately because they have fundamentally different biological functions. Fine sediments are defined here as sand, silt, and clay sized particles that become suspended in the water column and are rapidly transported downstream. Fine sediments are generally deposited in low gradient flood plane areas or drop out of the water column as flows subside by settling on or infiltrating into the stream substrate. Bedload sediments are defined as coarse sand or larger particles that do not become suspended and are transported as bedload only sporadically during high flows. Coarse sediments that are free of fine sediments are an important habitat component in stream ecosystems.

The behaviors and biological implications of the two types of sediments are highly dependent on the stream gradient and valley form where they occur. In this discussion stream reaches are distinguished between high-gradient, confined reaches and low-gradient, unconfined reaches. In general, healthy, functioning unconfined-reaches are the most productive and biologically diverse areas in stream systems (Siuslaw National Forest Elk River Watershed Analysis 1994). These areas have high nutrient availability because they are depositional and have complex and dynamic physical and biological processes.

The assumed historic condition was derived by looking at the natural processes that would have delivered, transported, and deposited sediments to the aquatic system. The conclusion from the channel condition assessment was that the amount and proportion of fine sediments entering Spencer Creek was historically low, and that floodplain areas, the wetland at Buck Lake, large woody debris, and floodplain deposition all functioned to capture and store fine sediments. From this it is concluded that the quantity and quality of productive spawning gravels was relatively high and not the only limiting factor for fish production. Clean bedload sediments, and other stream substrate contributed to a diverse and resilient macroinvertebrate community.

Large Woody Debris

Like the sediment transport processes it is useful to describe large woody debris processes in terms of confined and unconfined reaches. The confined reaches had high potential for large woody debris input because floodplains are narrow and the forest edge is near the stream edge. Conversely, unconfined reaches dominated by willow communities had low potential for input of large conifers but may have contained some hardwoods. The assumed historic condition is what would be present in other undisturbed east slope Cascade Range streams. Large woody debris in the streams would be composed of mostly conifer trees including white fir, Douglas fir, lodgepole pine and ponderosa pine. Hardwood species would have been an insignificant component in the confined reaches, but may have formed a higher proportion of the large woody debris in unconfined reaches where aspen and cottonwood trees may have been prevalent. These unconfined reaches are the productive depositional areas with the highest potential to provide quality spawning areas, complex habitat structure, and large, deep pools. Small and medium size classes of woody debris were transported downstream from confined reaches and deposited in low gradient floodplain areas. This, in addition to rootwads of willows, other hardwood species, and beaver dams formed the majority of the coarse, pool-forming structures in unconfined reaches.

Water Quality

The historic water quality conditions in Spencer Creek are not known. From what has been learned of the natural hydrological processes and assumed historic fish faunas, some inferences can be made. In addition, current conditions provide some clues to the site potential for the undisturbed historic condition. Taking these considerations into account it is assumed that water quality was good for cold water salmonids (see water quality issue). The quantity of the flow rather than water quality probably limited fish production. Overall, nutrient concentrations were not excessive. The Buck Lake wetland functioned as a nutrient and sediment sieve. Buck Lake was an area of general solar warming for water entering Spencer Creek. Spring flow at Buck Lake and the concurrent gradual release from the wetland were virtually the only source of non-runoff water entering Spencer Creek. Extremes in temperature, alkalinity, dissolved oxygen, and nutrients including nitrates were probably rare.

Channel Habitat

The historic channel condition is interpreted from the interdependent processes of sedimentation, bank stability, large roughness elements (boulders, large woody debris), beaver activity, and flow regimes (see channel condition issue). All of these factors historically combined to create stream conditions with high sinuosity, frequent deep pools, low width to depth ratios, undercut banks, and low fine sediment production. Refugial habitat including large pools and side channel habitats that became inundated during high flow periods were abundant in low gradient unconfined reaches. In high gradient reaches boulders and large woody debris provided hydrologic roughness to create pools, deposit bedload gravels, and attenuate stream velocity. Buck Lake functioned as a funnel and filter for water flowing in from intermittent tributaries.

Flow

A pattern of declining flow as Spencer Creek proceeds downstream is the suspected historic condition. Subsurface flow and high rates of evapotranspiration are the suspected causal mechanisms for progressively declining flows. Flows limited aquatic productivity by limiting the amount of space available to aquatic organisms. In addition very low flows were accompanied by high diurnal temperature fluctuations. Thus low flows generally result in higher summer temperature extremes and lower carrying capacities for aquatic animals.

Beaver

Beaver played a large role in shaping the vegetative structure of the riparian zone through dam building and subsequent flooding. Beaver ponds function as high quality deep pool habitat important for overwintering salmonids as well as refugia during low flow periods (Swanston 1991). These pools also function like wetlands to trap sediment and promote emergent vegetation and accompanying nutrient filtering. Beaver ponds may or may not increase water temperatures because of increased incident solar radiation and lower water velocity (COPE Report 1994). One significant natural process apparent in Spencer Creek is a high rate of evapotranspiration with a resultant flow reduction in beaver ponded areas.

Natural Migration Barriers

Natural barriers to movement may cause complete or partial isolation between populations and may cause potentially suitable habitat to remain unoccupied. Examples of natural barriers in Spencer Creek are water falls and de-watering events (subsurface flow and drought cycles). There is a one quarter mile cascade in Spencer Creek just below Buck Lake which acts as a partial barrier to upstream migration. This was probably only a barrier to upstream migration during low flow periods. Even in high water however, few fish probably expended the energy necessary to reach the limited quantity of spawning habitat above the cascade. Another significant barrier is the presumed historic seasonal and cyclical de-watering of both Clover Creek and Miners Creek during dry periods. This may or may not have resulted in sufficient isolation such that significant evolutionary differentiation between populations occurred within the system

Log jams have been noted by several observers (Light 1994) and are documented in past stream surveys (Fortune and Gerlach 1965). These are not considered significant barriers since they restrict passage only during seasonal low flow periods (Swanston 1991).

Changes Leading to Current Condition

Timber activities including logging, road building, and silviculture coupled with grazing are the dominant forces resulting in changes from the historic condition. For logging and grazing histories see the Social section. The impacts vary over time and space and depend largely on the physical parameters present. The following discussion briefly describes how these activities have altered the natural processes of change and then provides details for each of the seven dominant processes described above.

Appendix 7 discusses the life histories of aquatic species found in the watershed.

Fire suppression has removed the natural disturbance regimes that would have acted to create openings and increase large woody debris input rates. This process, however has been masked by logging activities and logging is now the dominant process affecting large woody debris input and shading in most stream reaches.

Stream Shading and Water Temperature

Several factors have reduced the level of shading and increased the incidence of solar radiation on streams. In the forested areas within 100 feet of the stream channels, green tree removal and roads adjacent to streams are responsible for reduced shading (see the riparian section and the Weyerhaeuser Company Analysis and Map 29. The quantity of incident solar radiation due to tree removal is compounded by the resulting decrease in large woody debris input. Lack of coarse structure results in fewer deep pools, increased channel width to depth ratios, and fewer undercut banks (Beschta et al. 1987), thus increasing the proportional surface area of water exposed to solar radiation.

Grazing has had its greatest impact on stream shading in wide valley form areas dominated by grass shrub communities. The ability of grass and shrubs to reduce solar radiation is proportional to vegetation height and inversely proportional to stream width. The effects of grazing are compounded when vegetation removal causes channel simplification and increased width to depth ratios (Platts 1991). Some areas in the lower 6 miles of Spencer Creek have remained inaccessible to livestock because of beaver dams, standing water, and dense willow thickets. Areas accessible to livestock have reduced shading as a result of cattle grazing that has suppressed the growth of streamside vegetation (Light, Burnstad, and Deming 1994).

Firewood cutting has substantially reduced the lodgepole component in the unconfined reaches of Spencer Creek.

Off-road vehicle use and firewood cutting has probably contributed to slow vegetative recovery in some areas and continues to be a minor factor in a few areas.

Changes at Buck Lake

The draining of Buck Lake in 1944 eliminated the potential for shading by emergent aquatic vegetation. Also, two hydraulic processes were altered that have an affect on water temperature. First, the potential for subsurface seepage of cool ground water into the stream was eliminated when the natural dam holding water in Buck Lake was removed. Second, the draining by canal systems eliminated the potential for temperature stratification in the water column and subsequent release of cooler water.

Sedimentation

The changes that have resulted in increased fine sediment production are summarized in the channel condition discussion. An increased stream channel network due to roads, road stream crossings, and the channelization and grazing at Buck Lake were concluded to be the primary sources of fine sediment production in streams.

Large Woody Debris

The removal of green trees due to logging and firewood cutting are the leading causes of reduced large woody debris input potential. Other factors affecting input include roads paralleling streambanks, grazing, and removal of logs from the stream channel as part of past timber harvest operations.

Beaver dams and willow root masses are a functional equivalent of large woody debris in low gradient reaches. Beaver activity and associated willow thickets have probably been reduced in their range in the lower watershed and at Buck Lake (Light, Burnstad, and Deming 1994).

Water Quality

The changes that have resulted in lowered water quality are cumulative of road crossings, increased road network, grazing, and channelization of Buck Lake (See the water quality issue for details).

Flow.

See the Flow Issue.

Channel Habitat

Channels have been simplified by fine sediment input, vegetation removal along stream banks, removal of large woody debris, and possibly changes in flow regimes (see the channel condition issue). This is documented in the Spencer Creek watershed throughout mainstem Spencer Creek and in Clover Creek up to the Wilderness Area boundary.

Migration Barriers

The natural barriers restricting fish movements in Spencer Creek watershed are assumed to still exist. These included subsurface flows and a short cascade below Buck Lake. Possible changes in migration may have resulted from road culverts, channelization at Buck Lake, and dewatering events exacerbated by logging and sedimentation. See current condition regarding man-made barriers.

Current Condition and Biological Response

Shading. The 1988 satellite remote sensing imagery was queried to obtain quantitative values for shading along a 300 foot buffer zone in Spencer Creek and its two main tributaries. In general, values were highest in unmanaged areas, in high elevation areas where flood plains are narrow, and on federal lands. They were lowest in grassy meadows, low elevation areas with broad flood plains, and on private timber lands. These values were compared to high, medium, and low shading value ratings for riparian areas interpreted from 1992 1:12,000 aerial photos and values in Light, Burnstad, and Deming (1994). There was general agreement between the two methodologies and it was thought that remote sensing could be used in conjunction with Geographic Information System geomorphic and hydrologic layers to identify areas with high potential for improvements in canopy closure (see Map 29).

The net effect of grazing on stream shading is less than for logging. Dense stands of willow and other shrubs are still found in the unconfined reaches of Spencer Creek. The effects of logging are most pronounced in the upper watershed where valley form is "V"-shaped and conifers grow near the stream edge. The effects of grazing are most evident in the lower watershed where wide flood plains have developed grass/willow communities.

Occasional summer water temperatures in Spencer Creek in excess of 80 degrees Fahrenheit are the result of a combination of factors, including reduced shading, low summer flows, increased proportion of surface area to volume in the streams, and changes in hydrology at Buck Lake.

Solar Radiation. Increased solar radiation and temperature generally result in increases in primarily productivity; but factors including nutrient availability and response of the primary consumers determine the biological outcome (Gregory et al. 1987). It should also be noted that light intensities in excess of 20 percent full sunlight do not generally result in greater productivity for Cascade Range streams (Gregory et al. 1987). Gregory et al. further state that increases in temperature have minimal effects on productivity when there is over 20 percent full sunlight. Even if increased sunlight results in increased primary production, the result may not be greater fish and macroinvertebrate production. Other factors such as temperature, water chemistry, and fine sediments may increase filamentous algae production which is poor quality food for primary consumers. Evidence that this may be happening in Spencer Creek is found in the macroinvertebrate Bioassessments conducted by Vinson (1994) and Wisseman (1992, 1993).

In the well shaded headwater reaches of Miners Creek, solar input may be low such that there are more nutrients in the system than can be used by primary producers. Incidental temperature measurement from various sources indicate that water temperatures do not exceed 60 degrees Fahrenheit.

Biological response by salmonid species to changes in temperature is fairly predictable for certain life history traits, including migration, spawning, incubation, and juvenile rearing (Bjornn and Reiser 1991). In Spencer Creek, trout species are negatively impacted by high water temperatures in the summer. Temperatures at or near 80 degrees Fahrenheit have been recorded in four of five years during recent monitoring. While water temperature will effect the timing of migration, spawning readiness, and embryo development of trout, temperature changes due to vegetation removal probably have their greatest impact on juvenile rearing during periods of high summer water temperatures. High temperatures with corresponding low dissolved oxygen concentrations can slow growth, cause low survival, and increase susceptibility and transmission of disease in trout. Lethal temperatures for rainbow trout tend to be around 84 degrees Fahrenheit in laboratory experiments (Bjornn and Reiser 1991). While outright mortality is rare due to temperature extremes alone (Bjornn 1978), changes in competitive abilities and increased energy consumption due to temperature can influence fish assemblages to favor warm water species over cold water species such as trout (Reeves et al. 1987). Relative abundance estimates are not available for Spencer Creek fish faunas. However, Figure 18 shows an increase in the abundance of temperature tolerant species from a historic condition.

Fine Sediments

Appendix 7 summarizes the expected biological changes resulting from management activities that cause increases in sediment production. The water quality section describes the present macroinvertebrate community. The results of this analysis show that fine sediments may be limiting aquatic production for communities dependent on periphyton production (diatomaceous algae growing on coarse substrate) and species dependent on well-oxygenated, interstitial spaces between rocks and gravel for some part of their life stages (data from Wisseman 1991,1992). Fish species that rely on these communities for food include the Klamath smallscale sucker, marbled sculpin, and to a lesser degree, redband/rainbow trout. The sucker and trout species may also limited by the amount of silt free spawning substrate. Redband/rainbow trout have some ability to physically clean gravel during the construction of spawning redds as long as they are not cemented in. However, it appears that in Spencer Creek fine sediments are filtering into gravel beds after spawning has occurred during spring and summer as flows subside (Hayes 1994). Fine sediments reduce the survival of eggs and alevins by reducing flow of oxygen in the gravel interstices and interferring with the respiration of eggs and gills of larval fish. The largest source of this fine sediment in late spring and summer is the Buck Lake canal system. Fine sediments entering the stream during periods of low flow will infiltrate into gravel beds and settle on rock surfaces rather than being deposited onto floodplain areas. Roads deliver fine sediments only during runoff periods which may or may not be coincident with the incubation period of trout. Additional changes not discussed in detail here include the effects of sedimentation in filling in pools and encouraging subsurface flow in some cases. These topics are discussed in the channel condition discussion and riparian function discussion.

The current condition is that sedimentation is chronic and problematic for the aquatic organisms in the Spencer Creek watershed. The presence of tolerant fish species and a lack of macroinvertebrate taxa intolerant of fine sediments is evidence that aquatic ecosystem function and diversity is limited by fine sediment input. The changes in fish assemblages over time (Figure 18) is probably due in part to the effects of fine sediments. The long-term concern is a change in competitive advantage favoring those species with high tolerance to fine sediments. From the channel condition assessment and the Weyerhaeuser Company Watershed Analysis (1994) it was concluded that the majority of fine sediments in Spencer Creek originate from the road system and Buck Lake canal system. The timing of delivery of sediments is especially important in Spencer Creek below Buck Lake. Due to grazing and irrigation at Buck Lake, the outflow canal delivers fine sediments to Spencer Creek throughout the grazing season (June to October). This sediment input coincides with the low flow period of late summer. Both sediments and low flows can negatively affect aquatic organisms, and when concurrent are particularly harmful to aquatic life.

The amount of embeddedness or "cementing in" of gravel in the Spencer Creek watershed has not been quantitatively described. It has been documented to occur at several locations in the mainstem of Spencer Creek (Light 1994, K. Bail pers. obs.). The effect of embeddedness is a loss of gravels that would otherwise function as spawning and macroinvetebrate habitat. It also reduces the potential for bedload movement which serves to clean and redeposit gravels within the stream channel. Thus the total quantity of available bedload sediments has probably been reduced due to the accelerated input of fine sediments. The amount and effect of both a reduction in bedload sediments and increased infiltration of fines into the gravels have been exacerbated by the effects of other processes, such as loss of large woody debris, channel simplification, and stream bank vegetation removal. The impacts have been greatest in the unconfined reaches where grazing is most intense and channels are most sensitive to change. Remember that these areas are also the areas with the highest potential for aquatic productivity since they are primarily depositional for bedload sediments, suspended sediments, and particulate organic matter.

Large Woody Debris

Large woody debris in stream channels is currently below potential in nearly all perennial reaches except Miners Creek (Light et al. 1994). The effect of the removal of this stream component is fewer deep pools, less cover, increased temperature extremes, and general habitat simplification. The streams ability to trap and retain spawning gravels has also been impaired. In unconfined reaches that are primarily depositional and have relatively low potential for input, smaller size classes of woody debris are important in providing structural complexity. Beaver dams are a functional substitute for loss of woody input is some areas. Map 30shows current near-term large woody debris recruitment potential.

The overall impact of decreased large woody debris supply to aquatic animals is to favor species adapted to shallow water, warm water, and species that have fewer hiding cover requirements. Evidence from fish faunal changes suggests that fish tolerant of these conditions may be expanding their range in this system (see the next key question). However, there are insufficient data to show causal mechanisms for changes in fish populations except in terms of introduced exotic fish.

Water Quality

See water quality Issue for detailed assessment.

Based on invertebrate community indicators, impacts are apparent from high summer water temperatures and fine sediment at all stations in Spencer Creek. These negatively affect the biotic and habitat integrity of Spencer Creek and influence the distribution and abundance of invertebrates and those fish that are dependent on invertebrates as a food source. In Miners Creek, overall indicators were good. However, the macroinvertebrates appeared to be limited by fine sediments there as well. It is assumed that roads are the primary contributor of fines in this reach.

Channel Habitat

Channel simplification equates to habitat simplification and results in lower carrying capacities for aquatic animals with diverse habitat requirements. Many species in the watershed have multiple microhabitat needs for various life history stages and behaviors. That redband/rainbow trout populations have been negatively impacted by channel simplification and fine sediments is intuitive, lack of relative abundance information on fish populations makes trends difficult to interpret.

Flow

It was determined that peak flows and base flows have not changed significantly from the historic condition (Sullivan 1994). However, changes at Buck Lake and current irrigation operations may cause periodic low flow periods. In addition, the timing and duration of flows have changed due to changes in snow interception rates and the draining of Buck Lake. Confidence in the assessment of changes in flow due to management actions is low. Reduced flow, like habitat simplification, will cause a reduced carrying capacity for aquatic animals. It will also increase diurnal temperature fluctuations, thus increasing the frequency of harmful temperature extremes. Low summer flows may encourage earlier out migration of juvenile trout. This may in turn decrease survival rates since these trout would be exposed to harsh water quality conditions present in the Klamath River and J.C. Boyle Reservoir.

Key question: How have species and communities changed from assumed historic distributions?

All known and suspected fish species occurring in the Spencer Creek watershed are listed in Appendix 5. Also listed are aquatic invertebrate species listed in the Northwest Forest Plan as "Survey and Manage" species and species with special management status at the state and federal level and are known or suspected to occur in the watershed.

Assumptions/Analytical Process

Explanatory notes on species naming. An attempt was made to use the best common and scientific names possible to accurately describe species and population relationships. Throughout this document, the populations of native trout *Oncorhynchus mykiss* living in the Spencer Creek watershed are described by the name "redband/rainbow trout". Anadromous rainbow trout are called "steelhead trout" in this document and have the same scientific name (*O. mykiss*) as the resident redband/ rainbow trout. The taxonomy of various *O. mykiss* populations in the Klamath basin is confusing and is presently unresolved among ichthyologists and taxonomists (Logan and Markle 1993a).

For some mollusc species, the common and scientific names are those suggested by Frest (1993). These species have not been described yet but are currently under review by the U.S. Fish and Wildlife Service for listing under the Endangered Species Act.

No attempt was made to analyze all species and their habitats in the watershed. This discussion is focused on species that were identified during the issue development process and includes species of special legal status, species of concern to the public, and species identified by specialists solicited for input who have expertise on the life histories of these species and their relevance in the watershed. There exist much data regarding the migratory population of redband/rainbow trout. In comparison, little is known historically and currently about the distribution and abundance of other species, especially invertebrates. Throughout this document, the focus on changes in the biotic communities is centered on fish. The assumption is that changes in the fish communities will revea useful information regarding future management, restoration, and long-term planning efforts.

The information used in this distribution discussion includes research data, oral history accounts (Appendix 3), past stream survey data, professional judgments of researchers and local fisheries managers, and interpretive assumptions based on the documented life histories and ecology of the species considered.

Analysis Discussion

This section begins by describing Spencer Creek watershed fish faunas within the context of fish distributions in the Klamath drainage. Appendix 7 contains a more detailed description of the distribution and ecology of aquatic animal species found in the Spencer Creek watershed.

Historic Distribution

The distribution of fish in the Klamath drainage indicates two distinct fish faunas, reflecting a geologically recent connection between upper and lower Klamath drainages (Gilbert 1897 Moyle 1976). The upper Klamath drainage is delineated as the area upstream of Copco Reservoir. The lower Klamath drainage is delineated as the area below Link River dam (See Map 1, Logan and Markle 1993a). Upper basin fish taxa are dominated by lacustrine (lake) adapted species, whereas the lower Klamath drainage consist of mostly palustrine (River) species, many of them anadromous. Spencer Creek drains into the area between the upper and lower basin so it is not surprising that the fish assemblage reflects a mix of both faunas. Taxa with distributions shared by both upper and lower Klamath drainages have the highest representation in Spencer Creek. Figure 18 lists species occurring in Spencer Creek and their geographic association within the Klamath Basin.

Changes in Distribution and Species Assemblages

Figure 18 summarizes changes to fish assemblages from the condition suspected to exist prior to major Euroamerican settlement (before 1900). Fish species are grouped to distinguish between upper Klamath basin, lower Klamath River, and species distributed in both basins. The list of historic species is partly speculative and is based on the conclusions made from the individual species accounts contained in Appendix 7.

Interpretation of Findings

Three significant changes from the assumed pre-Euroamerican condition are noteworthy. First, anadromous fish including salmon and steelhead are now absent from the upper and middle Klamath River. Secondly, at least three species of introduced non-indigenous species are now well established in the Spencer Creek watershed. Lastly, there is an apparent increase in upper Klamath basin lacustrine taxa with the recent addition of two Klamath basin chub species. Other species endemic to the upper Klamath basin (including suckers and lampreys) may have increased in abundance in the lower basin and now have better access to Spencer Creek because of man-made lakes, such as J.C. Boyle Reservoir (M. Buettner pers. comm.). Except for the presence of species common to both upper and lower Klamath drainages (anadromous salmon, redband/rainbow trout, marbled sculpin, and speckled dace), confidence in the accuracy of the list of historic species occurring in Spencer Creek is fairly low. Less visible aquatic species could have been extirpated from the watershed before their presence was documented. The cold headwater streams and springs would probably have provided habitat for Klamath Basin bull trout (*Salvelinus confluentus*) which are currently found only above Klamath Lake in headwater streams.

The introduced Eastern brook trout dominates fish assemblages in cooler headwater regions of Spencer Creek. This is consistent with other headwater streams in the Klamath Basin (Ratliff and Howell 1992). In general, evidence suggests that rainbow trout have a competitive advantage over eastern brook trout (Fausch 1988). There is apparently a substantial amount of habitat partitioning between the two species allowing them to persist sympatrically (see glossary) in many instances (Canjak and Green 1983). How the relative abundance of these two species (when sympatric) is affected by changes in habitat is not clear (Fausch 1988). The uncertainty of the taxonomy and viability of stream resident redband/rainbow trout in the Spencer Creek watershed is cause for some concern regarding the possible effects of Eastern brook trout competition. Regardless of potential competitive interactions, sustaining a representative complex of diverse habitat structure and good water quality will encourage stable populations of both species (Owen and Karr 1978).

Eastern brook trout may be of greater concern for their role as vectors of pathogens in fish and amphibian egg embryos (see amphibian discussion). In many cascade lakes and headwater streams in Oregon and Washington, the presence of introduced brook trout is coincident with a lack of amphibians in otherwise suitable habitat (Marc Hayes pers. comm. 1994). In Buck Lake, Eastern brook trout are inhabiting the same areas as the spotted frog, but habitat preferences are quite divergent between these two species (M. Hayes pers. comm. 1994). While Miners Creek is not suitable habitat for spotted frogs, a complete lack of amphibian species was documented in preliminary surveys conducted by Marc Hayes in 1994.

Fish species diversity is currently higher than the assumed historic condition (see Figure 18). This is due to the presence of exotic species and species which may have had their natural range extended due to habitat changes within and outside the Spencer Creek watershed (See Trends below). The number of tolerant species adapted to warm water and simplified habitat structure has increased (see Figure 19).

Trends

Lower Spencer Creek. The complexity caused by introduced species and habitat alterations makes it difficult to determine cause and effect relationships to changes in species assemblages. As reported in the aquatic habitat discussion, high temperatures, channel simplification, and siltation will favor those species well adapted to those conditions (Li et al. 1987). In Spencer Creek these include introduced species such as the fathead minnow and the brown bullhead (a catfish), and native upper Klamath basin species like the tui chub and blue chub. Some evidence suggests that the current trends are favoring the minnow species (see the Life History Appendix 7). Any of the aforementioned species, in high densities, could be expected to cause detrimental competition for food and space as well as increased predation on native species (Tayler and Courtenay 1984, Dunsmore 1993). Further reduction in shading, loss of large woody debris, and increased sedimentation from roads and grazing would favor high tolerance species over cold water species like trout. Appendix 7 summarizes the expected biological response to changes in habitat condition and shows the relative risk from certain management activities occurring in Spencer Creek watershed. Man-made, physical barriers to fish migration such as culverts are thought not to have significantly altered fish assemblages in Spencer Creek. The large culvert on Spencer Creek limits fish movement to some extent, but is probably not causing a downward trend in trout populations. The risk of culvert and road failure due to flood and debris accumulation is more of a concern than any apparent population trend.

Headwater regions. Trends in aquatic ecosystem health are less apparent for the headwater regions of the Spencer Creek watershed. This is due largely to a lack of information on community structure and populations. Management activities have been generally less intense in the upper watershed (except at Buck Lake), but impacts may be significant to the species that occur there. This is because aquatic populations there tend to be restricted to small isolated areas where suitable habitat occurs. The redband/rainbow trout in Clover Creek are highly susceptible to smallscale impacts because they are restricted to a quarter mile of perennial stream in the summer. Small isolated populations of mollusk and insect species that are restricted to springs and seeps are also at risk from logging, grazing, and road building. These species have yet to be surveyed. This characteristic of restricted and isolated populations makes their protection relatively simple since entire populations can be buffered with little conflict with other resources. The management recommendations section of this report and the Northwest Forest Plan lists species and habitats that should be surveyed before management activities proceed.

Buck Lake. Little is known about the abundance and composition of species living in and around Buck Lake. Most habitat changes over the last 50 years have tended to favor the species tolerant to simplified habitat structure and high water temperature. The most significant trend and impact has been a reduction in water storage capacity. The natural drainage channel running through the middle of Buck lake is filling in gradually with sediments (Hugh Charley oral history, Appendix 3). Current and proposed management changes at Buck Lake including fencing and water control structures will likely lower water temperatures, increase water storage capacity, and decrease delivery of fine sediments to Spencer Creek. These changes will reverse a downward trend in habitat quality, but will not bring the system to its assumed historic condition.

Summary

Water Quality

If recent practices in the management of upland and riparian areas continue, Spencer Creek and associated tributaries will not meet State of Oregon Water Quality Standards for salmonid bearing streams of the Klamath Basin. This will have negative impacts on populations of cold-water fish species by causing a decline in intolerant species, with a resulting shift in the community structure towards those species tolerant of environmental degradation.

Based on invertebrate community indicators, impacts are apparent from high summer water temperatures and fine sediment in Spencer Creek. Fine sediment alone probably limits aquatic productivity in Miners Creek. These negatively affect the biotic and habitat integrity of Spencer Creek and influence the distribution and abundance of invertebrates and those fish that are dependent on invertebrates as a food source.

Altered Hydrograph

The loss of wetland function and road system design are the mechanisms of change that are most influential in altering run-off patterns. Along with the loss of wetlands is an associated loss in the system's ability to attenuate peak discharge. Concurrently, the design of the road system routes water into the stream channel. The net effect is more efficient delivery of water into the channel system. These activities have a high probability of increasing peak flow. Similarly, the timing of peak flow most likely occurs earlier in the year.

Baseflows have likely decreased with the loss of wetland function. The ability to store water for slower releases throughout the summer months has decreased.

Channel Condition

The two conditions of concern are the delivery of fine sediment from the road system and Buck Lake, and the alteration in scour processes from the removal of large woody debris.

Altered Habitat and Fish Communities

Three changes in habitat condition were determined to be chronic and problematic for native fish in Spencer Creek; fine sediments, high temperature, and low flows. The significant causal mechanisms for a ownward trend in habitat condition are road crossings, streamside timber harvest, and channelization and grazing at Buck Lake.

Changes in habitat conditions in the Klamath River coupled with the introduction of exotic species makes it difficult to predict future responses to habitat changes. Observed changes in fish communities over time indicated that species adapted to simplified habitat structure are increasing in number (see Figure 19).

Table 31. Relative Tolerance Ratings for Fish Species in Spencer Creek

High Tolerance

Speckled dace (*Rhinichthys osculus*)
Marbled sculpin (*Cottun klamathensis*)
Brown bullhead (*Ameiuris nebulosus*)
Fathead minnow (*Pimephales promelas*)
Tui chub (*Gila bicolor*)
Blue chub (*Gila coerulea*)

Medium Tolerance

Pacific lamprey (*Lampetra tridentata*)
Pit-Klamath lamprey (*Lampetra lethophaga*)
Klamath River lamprey (*Lampetra similis*)
Klamath smallscale sucker (*Catostomus rimiculus*)

Low Tolerance

Chinook salmon (*Oncorhynchus tshawytcha*)
Steelhead trout (*Oncorhynchus mykiss*)
Rainbow redband trout (*Oncorhynchus mykiss*)
Eastern brook trout (*Salvelinus fontinalis*)

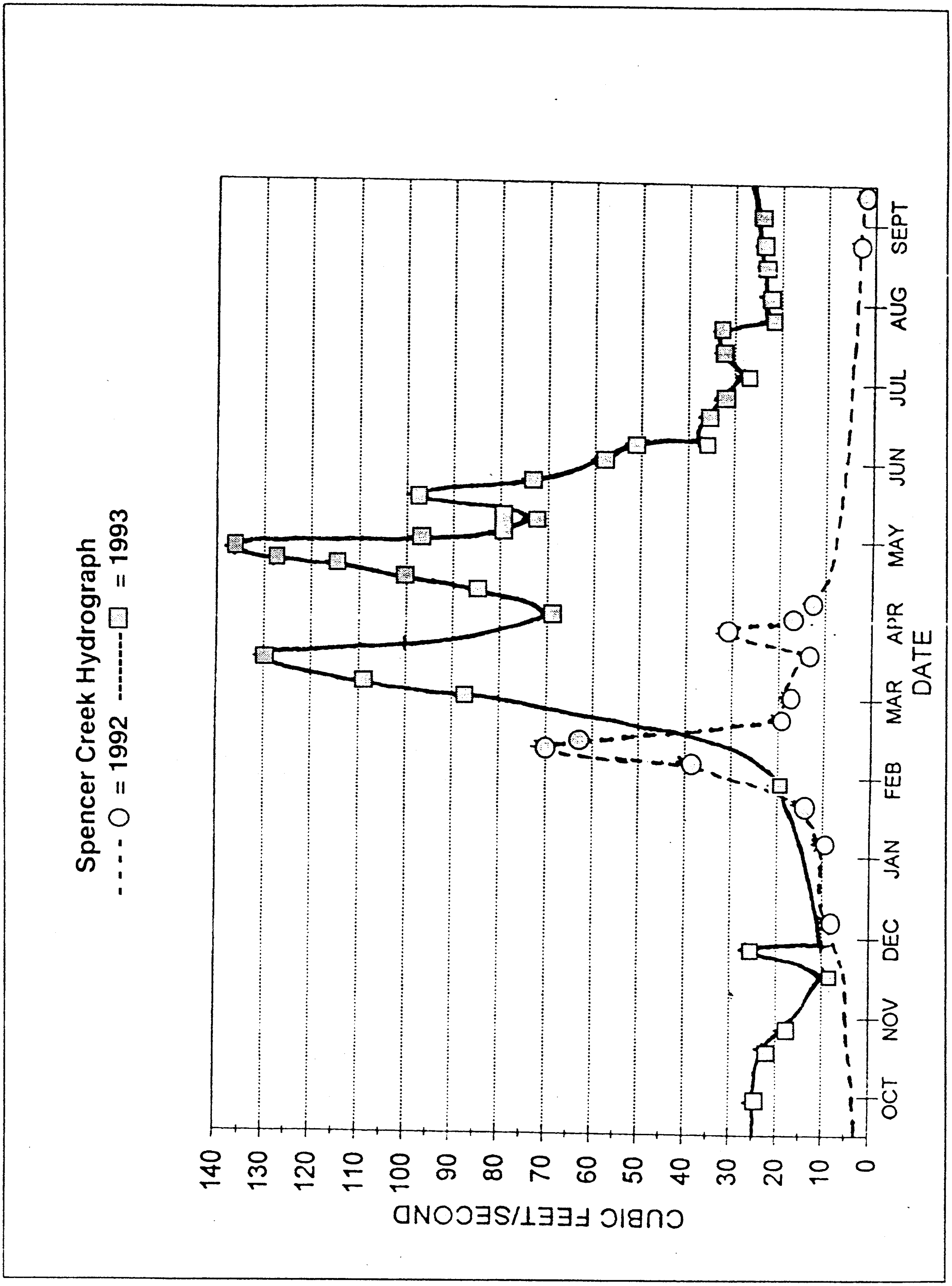


Figure 17. Spencer Creek Hydrograph

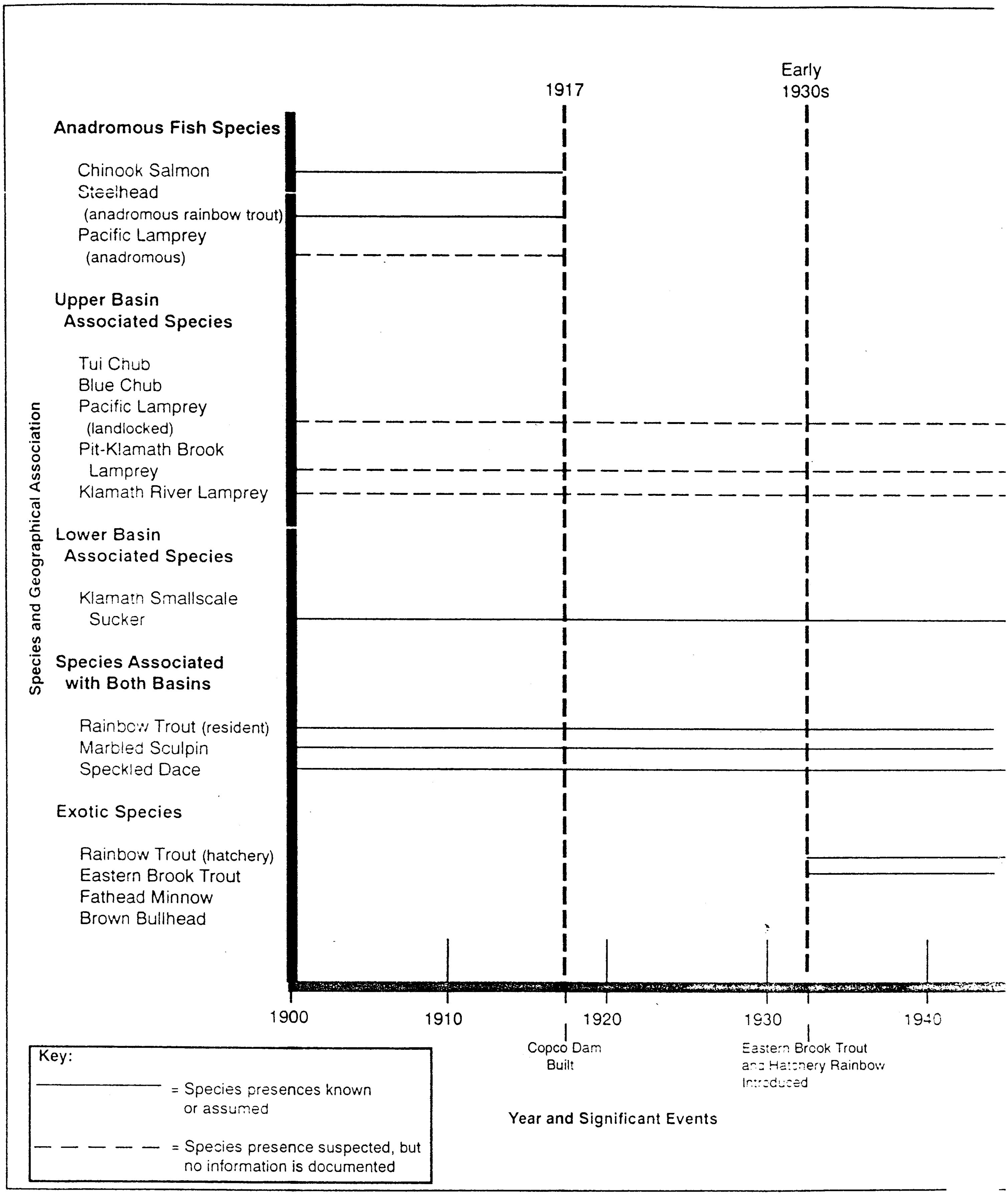
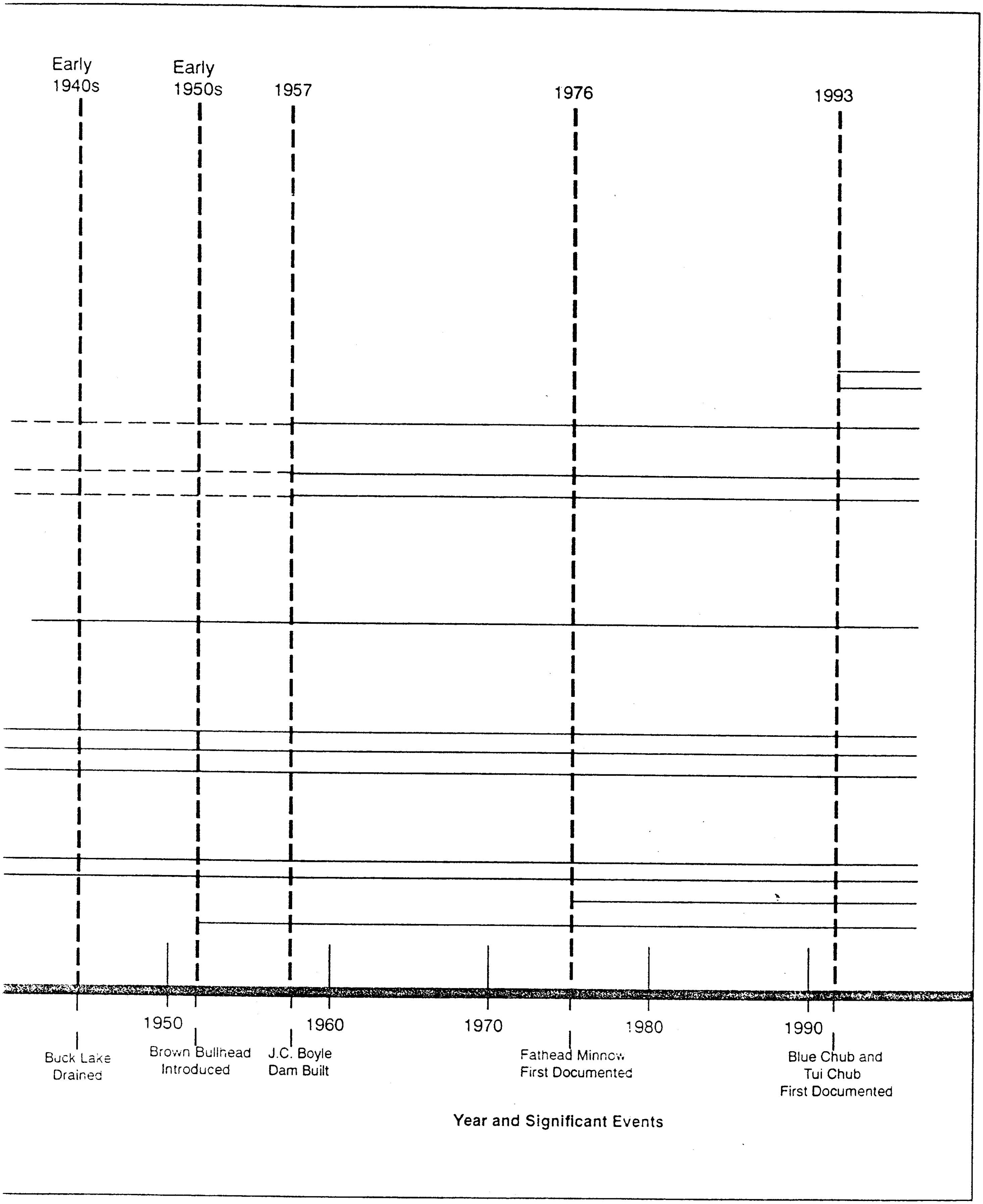


Figure 18. Summary of Changes in Spencer Creek Fish Assemblages After 1900. Species are gouped based on Geographic Association Within the Klamath Drainage (Adapted from Logan and Marke 1993; Moyle 1976; Gilbert 1897).


Early 1940s
Early 1950s
1957
1976
1993
1950
1960
1970
1980
1990
Buck Lake Drained
Brown Bullhead Introduced
J.C. Boyle Dam Built
Fathead Minnow First Documented
Blue Chub and Tui Chub First Documented
Year and Significant Events

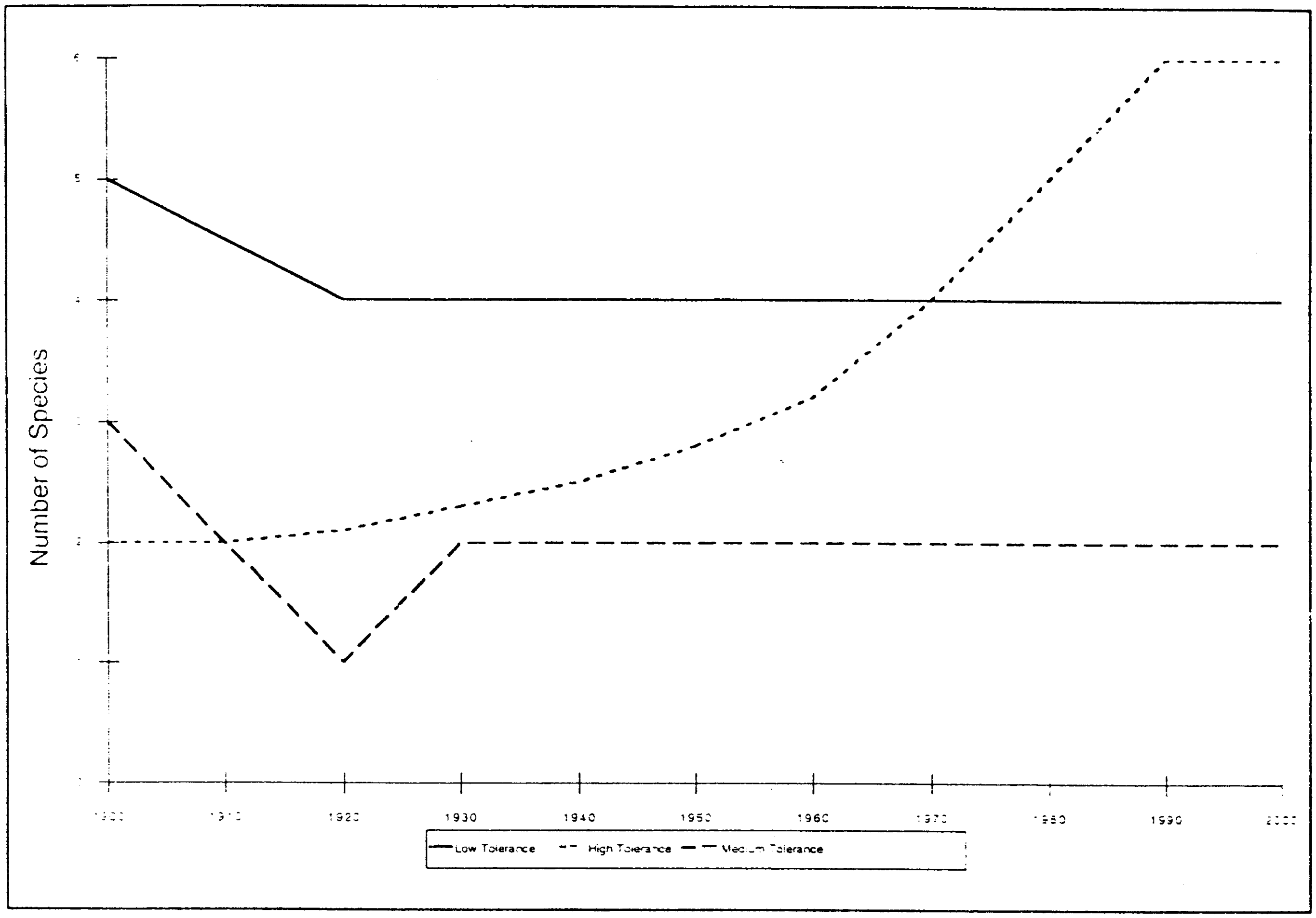


Figure 19. Change in Number of Species with High, Medium and Low Tolerance to Fine Sediments, by Year

Chapter 5
Management Recommendations

Table 32. Restoration Project Opportunities - High Priority/Red Flag Items

Restoration Opportunity	Concern/Objective	Cooperative Agreements
1. Construct security fencing around Spencer Creek Cemetery.	The Cemetery has been badly vandalized.	Yes-Weyco
2. Restore the wetland function of Buck Lake (CRMP initiated project) through fencing and cross fencing (up to 10 miles of fencing). Implement a grazing system and reseed/replant dikes and channels in and below Buck Lake with native seed/species. Improve/install headgates and culverts. Reduce duration of low flow periods.	Decrease sediment and nutrient input from Buck Lake into Spencer Creek. Decrease water temperatures.	Yes-Hugh Charley, NRCS (formerly SCS), ERO and the Spencer Creek CRMP[1] group.
3. Short Term: Build exclosure fencing around specified USFS riparian areas including Desolation Swamp, unnamed area in the vicinity of Buck Lake, and Muddy Springs and develop off-site watering facilities.	Short Term: Enhance control of livestock use over important riparian areas and increase the use of underutilized upland areas. Address adverse grazing impacts on habitats and species at risk.	Yes-Hugh Charley, USFS, and Weyco.
Long Term: Implement the rest rotation grazing system outlined in the USFS "Range Analysis Narrative". Up to 24 miles of fencing would be needed to implement this system.	Long Term: To implement the recommendations of the "Range Analysis and meet the growth requirements of critical riparian and meadow plant communities.	None identified.
4. Address adverse recreation impacts through the following: decrease OHV/ATV use above the mouth of Spencer Creek by closing and rehabilitating inappropriate ATV/social trails and roads; and discourage inappropriate camping along streams and restore impacted areas through road closures and rehabilitation.	Decrease fine sediment input into streams.	Yes-Weyco.

[1] See Appendix 8 for more information on the Coordinated Resource Management Plan

Table 32. Restoration Project Opportunities - High Priority/Red Flag Items (Continued)

Restoration Opportunity	Concern/Objective	Cooperative Agreements
5. Thin forested communities mechanically and/or with prescribed fire to reduce stand densities. Place emphasis on drier sites, south-facing slopes, and the lower portion of the mixed conifer zone.	Maintain, enhance, and/or restore the existing pine component in the vegetative communities once dominated by one species and are presently dominated by shade tolerant species (such as white fir). Improve the currently poor recruitment potential for ponderosa pine and address the associated long-term wildlife pine habitat dependency problems.	Yes-Weyco is already intensively pursuing these thinning treatments.
6. Close and/or obliterated roads, OHV/ATV trails, and skid trails to reduce road densities toward the goal of 1.5 miles per square mile. Reduce the number of roads crossing streams and obliterate roads paralleling streams within 100 feet of the stream channel.	Reduce fragmentation of habitat and disturbance to many wildlife species, including deer, from high road densities. Reduce sediment delivery to streams, increase stream shading and increase the large woody debris input potential.	Yes-Weyco.
7. Place large woody debris structures in those confined channel reaches that lack coarse structure and have low potential for short-term recruitment of large woody debris.	Increase the amount of coarse structure in confined reaches to dissipate stream energy and create pool habitat.	None identified.

Table 32. Restoration Project Opportunities - Moderate Priority/Yellow Flag Items

Restoration Opportunity	Concern/Objective	Cooperative Agreements
1. Fence the Tunnel Creek Meadow. Allow periodic grazing consistent with plant community objectives.	Protect the areas from current and potential future detrimental effects of livestock grazing.	Yes-Divide Resources (the affected private landowner).
2. Construct 3 additional water developments on the Grub Springs allotment on BLM-administered and Weyco lands.	Increase use of upland vegetation and decrease use of riparian/wetland vegetation.	Yes-Weyco.
3. Construct fencing along the Clover Creek Road (all Weyco land ownership).	To divide the Grub Allotment into two pastures and reduce livestock and vehicle interactions.	Yes-Weyco.
4. Construct fuel breaks around unmapped LSRs consistent with NWFP requirements (pages C-12 and C-13).	Reduce the risk of stand replacing fires by reducing continuity of fuels in LSRs (mapped and unmapped).	Yes-BLM and USFS.
5. Pre-commercial thin, hand pile, and burn submerchantable material (1 to 4 inches dbh) within LSRs. When possible, combine with commercial thinning and gross yarding activities. Treatments must be consistent with requirements of the NWFP (pages C-12 and C-13).	Reduce the risk of higher intensity fires and accelerate development of late-successional conditions.	None needed.
6. Transport cull logs in decks near accessible roads to locations lacking in large woody debris. Place highest priority on riparian areas and scarified areas within connector blocks.	Restore large wood in areas where intensive piling and burning has taken place and where logging has occurred within riparian areas.	Yes-Weyco.
7. Develop and implement a noxious weed control contract. Reseed or replant treated areas with native vegetation.	Reduce concentrations of noxious weeds in the watershed.	Yes-all landowners in the watershed.
8. Work with the USFS Region 6 Silviculture Lab to conduct experiments in control of blister rust. If pruning is proven to be effective as a control, set up experimental pruning areas in the watershed.	Arrest the spread of blister rust.	None identified.
9. Hand pile and/or burn, grind, or chip woody material in areas containing excessive fuel loads (for example, old precommercial thinning sites where the size of the average down log is less than 10 inches dbh).	To reduce an extremely high fire hazard in areas where underburning is not safe or feasible.	Yes-possibly Weyco.

Table 32. Restoration Project Opportunities - Moderate Priority/Yellow Flag Items (Continued)

Restoration Opportunity	Concern/Objective	Cooperative Agreements
10. Plant hardwoods and conifers along streambanks where shading and recruitment potential are low.	Increase stream shading and reduce extreme water temperatures. Increase the potential for future large woody debris to input into streams.	None identified.
11. Remove tailings from a gravel crushing operation on Clover Creek.	Reduce the input of fine sediment from the tailings.	None needed.
12. Replace the culvert on Spencer Creek with a bridge or open arch structure. Reduce the amount of fill needed for this stream crossing.	Reduce the risk of culvert failure (currently moderate) and the possible subsequent devastation ofdownstream aquatic habitat. Improve troutmigration through this section of SpencerCreek.	Yes-Weyco.
13. Fence the following areas to protect Special Status Species: Porcupine Spring/Clover Creek, Tunnel Creek, and specific segments of Spencer Creek.	Protect populations at high risk from adverse grazing impacts.	Yes-Weyco.
14. In areas where high compaction levels exist, use a winged or self-drafting subsoiler to rip skid trails and landings that are not needed for future timber harvest activities or where management activities are not expected to occur for five to ten years.	Maintain and improve soil productivity and hydrologic function.	None identified.

Abbreviations used in this table:

ATV	=All-Terrain Vehicle	CRMP	=Coordinated Resource Management Plan
DBH	=Diameter at Breast Height	ERO	=Ecosystem Restoration Office
LSR	=Late-Successional Reserve	NRCS	=Natural Resource Conservation Service (Formerly the Soil Conservation Service)
OHV	=Off-Highway Vehicles	Weyco	=Weyerhaeuser Company
USFS	=Forest Service	NWFP	=Northwest Forest Plan

Table 33. Management Considerations for Future Project and Program Planning - High Priority/Red Flag Items

Management Recommendation	Concern/Objective	Design Features
1. Develop the rest-rotation grazing system as recommended in the USFS "Range Analysis Narrative" for the Buck Allotment and, if feasible, include the BLM's Buck Lake Allotment. Develop Allotment Management Plans for these allotments.	Provide livestock control and management to meet meadow and riparian utilization and condition objectives and to increase use of the under-utilized upland areas.	Construct up to 24 miles of fencing to divide the Buck Allotment into 7 pastures. Implement a 2 herd, 7 pasture rest-rotation system. Include BLM's Buck Lake Allotment into the rotation if feasible.
2. Provide Enhanced law enforcement, educational efforts and OHV closures to protect resources and control inappropriate behavior at the mouth of Spencer Creek and control unauthorized firewood cutting elsewhere.	Protect riparian resources and address public concerns about uncontrolled recreation and illegal activities.	Develop a cooperative law enforcement contract with Weyco and PP&L for use of Reserve Deputies on weekends. Develop a site specific plan for the area around the mouth of Spencer Creek to address resource damage, educational needs, and law enforcement efforts. Continue Oregon State Forestry fire patrols in summer.
3. Short Term: Focus harvesting activities in residual early-mid and mid seral stage forests in the Matrix. Long Term: Conduct thinning and light underburning projects to achieve fuels and forest management objectives. Through thinnings and underburning, control densities and species composition to meet stand-specific objectives.	Enhance the sustainability of some existing forest communities in the watershed.	Reduce fuel loads to natural levels. Reduce stand densities, particularly in areas where understory densities are competing with over-story component and where the overstory component needs to be retained. Increase the composition (percent) and vigor of shade-intolerant species (especially pines). Thinning and removal of material must include the smaller diameter classes (2 to 8 inches dbh). Give higher priority to treatment of drier sites, south slopes, and in the lower portion of the mixed conifer zone.

Table 33. Management Considerations for Future Project and Program Planning - High Priority/Red Flag Items (Continued)

Management Recommendation	Concern/Objective	Design Features
4. Enhance, maintain, and restore the ponderosa, sugar, and western white pine component wherever feasible.	Address reductions in these species from past harvesting. Protect remaining stands where threatened by dense stands of shade tolerant species (except in plantations). Address the loss of habitat for wildlife species dependent upon large ponderosa pine.	Reduce stand densities around residual natural stands of pine in the watershed. During thinning treatments, retain and enhance the pine component where shade tolerant species predominate.
5. Manage lands north or south of Buck Lake as a connector for late-successional dependent wildlife and to optimize the use of unmapped Late Successional Reserves. Consider adoption of Corridor 3 as the preferred option; Maintain the opportunity for providing connectivity where the potential is the greatest.	Provide habitat connections between Late-Successional Reserves that are not being provided by Riparian Reserves. The Riparian Reserves are disjunct due to private ownership and run north/south. Desired connectivity pathways would be most beneficial in an east/west direction.	Develop a corridor with a minimum width of 600 feet. Maintain at least 40 percent of the forest with connectors in late-seral condition (50 to 60 percent canopy closure) and the remainder in mid-seral condition with at least 40 percent canopy closure. Place logs in deficient areas. Close or obliterate unnecessary roads. Minimize the disturbance to wildlife from planned snowmobile trails in the vicinity of corridors by implementing specifications listed in the Management Recommendations chapter.
6. Develop a comprehensive road management plan for the watershed across all ownerships.	Reduce fragmentation of wildlife habitat and disturbance to wildlife from high road densities. Reduce sediment delivery to streams and increase stream shading.	Close and/or obliterate roads to reduce density, especially in high impact areas. Establish Transportrtation Management Objectives as specified in the NWFP.
7. Consider thinning and prescribed fire in Riparian Reserves to meet Aquatic Conservation Strategy objectives.	Reduce the risk of fire and stand densities and improve the health of forested riparian areas.	Treatment must meet Aquatic Conservation Strategy Objectives. Treatment objectives would address mostly trees 3 to 18 inches in diameter.

Table 33. Management Considerations for Future Project and Program Planning - Moderate Priority/Yellow Flag Items

Management Recommendation	Concern/Objective	Design Features
1. Create a living history park at the confluence of Spencer Creek and the Klamath River. Replicate the Spencer Station, Spencer Mill, Camp Day, The Fords of Spencer Creek (Applegate Trail), and the Klamath River.	Provide interpretation of the unique history of the area. Commemorate the Applegate Trail.	Create the following displays: Modoc representing Captain Jack's Band; teamsters and immigrants on the Applegate Trail; soldiers at Camp Day and Spencer Mill in operation. Have artisans working in the park as living exhibit. Use this project to create jobs in Klamath County and generate income from tourism.
2. Ensure that utilization levels on USFS and BLM riparian and meadow areas are within Northwest Forest Plan and RMP levels.	Provide for the long term stability and condition/functionality of important riparian/wetland areas.	Periodically monitor grazing use and make grazing use adjustments.
3. Increase herding activities by grazing permittees to minimize the time spent by cattle in important meadows and riparian areas.	Minimize utilization of riparian area and meadow vegetation and to keep within agency utilization objective levels.	Ride designated riparian and meadow areas at least twice after July 15th or as determined by agency personnel.
4. Expand the opportunities for environmental education and interpretation in the watershed for the following areas; Clover Creek Forest Educational Area, Pelican Guard Station, the Mountain Lakes Wilderness, and the Tunnel Creek Wetlands.	Meet the regional demand for nature study the interpretative exhibits and picnicking by providing suitable recreation facilities. To protect resources through educational efforts.	Develop site specific management plans and projects suitable for the Jobs-in-the-Woods Program.
5. Obtain an easement or cooperative agreement and develop a hiking/fishing trail along Spencer Creek north of the Hookup Road.	Meet regional demand for hiking and fishing opportunities.	Develop a trail plan and minimize disturbance to wildlife and riparian resources.
6. Expand the opportunities for snowmobiling and cross country skiing by developing a trail system and a parking area.	Meet regional demand for winter sports and to reduce pressure on adjacent recreation areas (such as Lake of the Woods).	Develop a trail network while minimizing disturbance to wildlife. Utilize Sno-Park money and registration fees for grooming. Make this a volunteer project utilizing a local snowmobile club.

Table 33. Management Considerations for Future Project and Program Planning - Moderate Priority/Yellow Flag Items (Continued)

Management Recommendation	Concern/Objective	Design Features
7. **Late Successional Reserves** (mapped and unmapped). Enhance, protect, and maintain late successional habitat within LSRs on BLM- and USFS-administered lands.	Increase the sustainability of some of the existing habitat within LSRs that is threatened due to the extended drought, past harvesting, dense stands, rising insect populations, increased fire risk, and changes in species composition.	Design treatments (thinnings, prescribed fire and fuel breaks) to maintain and/or protect structural components (large live trees, large snags, large down logs, a specified canopy closure and scattered openings). Include District Designated Reserve and District Designated Reserves Buffers in the BLM's approved RMP.
8. **Late-seral stands in the Matrix.** Enhance and/or maintain late-seral stands and treat where necessary. Give highest priority to stands showing the highest rates of mortality and those most susceptible to stand replacement disturbances (fire, insects and disease).	Protect late successional forests from further reductions and fragmentation.	Design treatments (thinnings and prescribed fire) to maintain structural components (large live trees, large snags, large down logs, a specified canopy closure, and scattered openings). Consider treating only the understory component when the overstory component is limited and needs to be retained. Green trees and down log retention guidelines stipulated in the NWFP should be sufficient.
9. Reintroduce prescribed natural fire into vegetative communities.	Reduce fuel loads and biomass levels that have increased in some areas as a result of fire exclusion. Reintroduce a historic disturbance agent.	Use prescribed fire to reduce fuels and biomass levels. Combine prescribed fire with light understory thinnings in appropriate areas. South slopes, drier sites, and the lower part of the mixed conifer zone is of the highest priority for treatment.
10. Maintain sufficient snags and down wood component in the lodgepole pine vegetative zone.	Address the reduction of snags and down woods in areas where firewood cutting has reduced them.	Monitor the removal of snags and down wood from this zone and control access and firewood cutting where they are lacking.

Table 33. Management Considerations for Future Project and Program Planning - Moderate Priority/Yellow Flag Items (Continued)

Management Recommendation	Concern/Objective	Design Features
11. Reduce the spread of blister rust	Reduce the threat to western white pine and sugar pine populations from the continued spread of blister rust.	Continue to plant with rust resistant stock. Improve vigor of existing populations through thinning and/or prescribed fire. Favor western white pine and sugar pine in thinning treatments to maintain existing populations.
12. Arrest the spread of diseases where feasible, especially annosus root rot.	Reduce the incidence of this disease, which has been shown to increase with increases in forest management activities.	Continue to apply borax to freshly cut stump surfaces in harvest units. Maintain vigor in individual trees. Plant resistant species in known problem areas.
13. Reestablish a fire regime in the Mountain Lakes Wilderness Area.	Allow lightning to function within the Wilderness to restore the dominant historic disturbance agent.	Develop a policy for allowing prescribed natural fire in the Wilderness.
14. Minimize ground disturbance in population sites of green-flowered ginger.	Populations of this Special Status Species exist in the watershed.	Encourage winter logging over snow to protect large, dense populations wherever feasible.
15. Maintain the following plant communities of interest: The white bark pine community, the lodgepole pine/huckleberry/forb swamp community; wetland shrub communities; and wet meadows dominated by tufted hairgrass and few-flowered spikebrush.	These unique communities are affected by harvest and livestock grazing.	Encourage private landowners to conserve the lodgepole pine/huckleberry/forb swamp community by deferring harvest of the lodgepole pine in these areas. Regulate livestock utilization patterns to avoid adverse impacts to these communities.
16. Control the spread of noxious weeds in the watershed.	Address the spread of noxious weeds associated with physical disturbances (clearcuts, landing, and road cutbanks) that provide colonization opportunities.	Implement an integrated noxious weed management plan on all lands in the watershed.
17. Provide habitat for a stable bald eagle population.	Maintain populations through development and implementation of specific management considerations.	Prepare a site management plan for the nesting bald eagles in the watershed, based on Bald Eagle Recovery Plan recommendations.

Table 33. Management Considerations for Future Project and Program Planning - Moderate Priority/Yellow Flag Items (Continued)

Management Recommendation	Concern/Objective	Design Features
18. Meet the desired future conditions in the NWFP for Protection Buffer species.	Implement specific management requirements as outlined in the NWFP.	Follow NWFP recommendations in the Matrix for snag levels and green tree recruitment. (If necessary run a snag recruitment simulation to determine appropriate species mix and density.)
19. Meet the NWFP requirements for Survey and Manage species.	Implement specific management requirements as outlined in the NWFP, including those for the great gray owl, bats, and molluscs.	Follow NWFP recommendations. Survey prior to management activities for Survey Strategy 2 species. Survey for bat roosting sites between mid-April to late May or (preferably) from September 1 to mid-October. Verify whether rare and endemic mollusc species occur in the watershed and where they have a high potential of occurring. Follow protocols for molluscs when they become available.
20. Manage livestock grazing to maintain desirable grass heights.	Improve degraded habitat for the prey populations of the great gray owl and marten.	Maintain grass heights at levels between 5 and 15 inches in meadows.
21. Improve and maintain the viability of northern spotted owl sites inside LSR RO-227 and RO-228 that lie within 1.2 miles of the LSR boundary.	Mitigate the compromising of those owl sites along the edges of the LSRs from activities in the matrix for the short-term.	Evaluate conditions and viability of LSR owl sites within 1.2 miles of the project during site-specific planning. Avoid reducing viability of LSR sites.

Table 33. Management Considerations for Future Project and Program Planning - Moderate Priority/Yellow Flag Items (Continued)

Management Recommendation	Concern/Objective	Design Features
22. Apply additional widths to Riparian Reserves and riparian buffers in specified reaches of perennial and intermittent streams.	Increase the recruitment of large woody debris into riparian areas where it is lacking.	Increase the Riparian Reserve or riparian buffer width to include an additional 50 feet of upland vegetation.
23. Require the use of a winged subsoiler, or self-drafting subsoiler, rather than a rock ripper, for site preparation.	Decrease soil disturbance and increase effectiveness of treatment. Maintain and improve soil productivity.	Follow practices outlined in Appendix D of the approved Klamath Falls Resource Area Resource Management Plan for the use of winged or self-drafting subsoilers.

Abbreviations used in this table:

ATV =All-Terrain Vehicle
DBH =Diameter at Breast Height
LSR =Late-Successional Reserve
OHV =Off-Highway Vehicles
USFS =Forest Service
CRMP =Coordinated Resource Management Plan
ERO =Ecosystem Restoration Office
NRCS =Natural Resource Conservation Service (Formerly the Soil Conservation Service)
Weyco =Weyerhaeuser Company
NWFP =Northwest Forest Plan
PP&L =Pacific Power and Light Company

Table 34. Information and Monitoring Needs - High Priority/Red Flag Items

Information/Monitoring Need	Concern/Objective	Why	How
1. Monitor forage utilization and physical impacts from livestock in riparian areas periodically throughout the grazing season.	Improve long term conditions and functionally of important meadow and riparian areas.	Ensure that agency utilization objective standards are not exceeded.	Follow respective agency methods and procedures for the establishment and reading of range monitoring studies.
2. Monitor insect activity, particularly mortality caused by the fir engraver.	Assess the level of activity, which appears to be increasing with the increase of shade tolerant true fir in forested stands.	Assess uncontrollable habitat change that could be occurring in late successional habitat in the Matrix and in LSRs, with corresponding adverse impacts to wildlife.	Conduct stand exams and yearly aerial monitoring flights done by ODF and the USFS.
3. Monitor disease activity, particularly annosus and blister rust.	Assess apparent increased incidence of these diseases.	Assess declining forest health and resiliency.	Conduct stand exams and establish control plots.
4. Monitor livestock use in riparian, wetland, and spring areas after short-term restoration or long-term grazing management is implemented.	Improve the condition of plant communities and riparian, wetland, and spring-associated wildlife populations.	Monitor the effectiveness of restoration and/or grazing management changes.	Track movements of livestock on a weekly basis to monitor the effectiveness of changes in grazing management. Check fenced sites periodically throughout the season to ensure that fenced exclosures are functioning as designed.
5. Survey for Survey and Manage species (animals, plants, amphibians, molluscs, and fish) listed in the NWFP.	Verify the existence of species that are likely to occur in the watershed.	Implement requirements of the NWFP.	Follow survey protocols. Conduct spawning redd count surveys to monitor redband trout.

Table 34. Information and Monitoring Needs - High Priority/Red Flag Items (Continued)

Information/Monitoring Need	Concern/Objective	Why	How
6. Determine and/or verify classifications for streams in the watershed (perennial, intermittent, and ephemeral; fishbearing and non-fishbearing).	Update existing delineations to reflect actual on-the-ground conditions.	Apply Riparian Reserves and the Aquatic Conservation Strategy.	Survey for each project area. Update GIS and stream maps.
7. Monitor harvest prescriptions within the matrix to determine if owl dispersal conditions are being met.	To verify the assumption that the dispersal habitat needs of the northern spotted owl will be met through the green tree retention requirements in the Northwest Forest Plan.	To fulfill the federal agency obligation to the U.S. Fish and Wildlife Service under the Endangered Species Act, and the obligation under Agency Resource Management Plans.	Based on biologists' judgement of adequate dispersal condition, evaluate the quantity and size of downed woody material for adequate prey base opportunities, and cover for protection and movement.
8. Evaluate the percentage and arrangement of suitable spotted owl dispersal habitat available within the time period harvest is planned for a given area (e.g. subwatershed), to determine the type of harvest prescription and the area which could be harvested while maintaining adequate dispersal conditions.	To evaluate if the dispersal needs of the owl are being met within the watershed.	To fulfill the federal agency obligation to the U.S. Fish and Wildlife Service under the Endangered Species Act, and the obligation under BLM's Resource Management Plan and the Winema National Forest Land and Resource Management Plan.	Evaluate future harvest plans, stand inventories, aerial photographs and/or Pacific Meridian Resources data.

Table 34. Information and Monitoring Needs - Moderate Priority/Yellow Flag Items

Information/Monitoring Need	Concern/Objective	Why	How
1. Conduct cultural resource surveys and inventories on private lands if permission is given.	Protect existing cultural resources on private lands.	Prevent further vandalism from occurring.	Follow respective agency methods and procedures. Provide mitigation per Section 106 of the National Historic Preservation Act during earth disturbing activities where permission is given. Purse opportunities for cooperation with private landowners to protect unique cultural resources.
2. Obtain permission to monitor and protect Spencer Cemetery.	Protect a historic site.	Prevent further vandalism from occurring.	Install security fencing and restore disturbed grave sites.
3. Continue to monitor the USFS Clover Creek primitive campground for motorized vehicle use and unathorized firewood cutting.	Keep visitors on existing campground roads and eliminate OHV travel into riparian areas. Reduce unauthorized firewood cutting.	Protect riparian resources.	Include this area in patrols, install signs, and install additional rock barriers.

Table 34. Information and Monitoring Needs - Moderate Priority/Yellow Flag Items (Continued)

Information/Monitoring Need	Concern/Objective	Why	How
4. Complete stand exams before and after thinning and underburning projects. Monitor vegetation response, soil impact, fuel loading changes, and structural changes (especially canopy closure).	Monitor responses to treatments to determine if treatments are achieving desired future conditions.	Determine whether to modify subsequent treatments.	Complete standardized stand exams that measure soil impact, residual stand density, understory composition, species composition, fuel loadings, and canopy changes.
5. Monitor response of green-flowered ginger to winter logging versus summer logging. Continue to inventory for additional population centers.	This species tends to occur in managed forests with less than 60 percent crown closure.	Requires consideration because it is a Special Status species.	Contract out botanical inventories and survey during botanical clearances for projects.
6. Continue to monitor the response of Newberry's gentian to continued livestock grazing. Quantify monitoring surveys to determine response of plants. Continue to inventory for additional population centers.	The affects of livestock grazing on this species is not yet understood.	Requires consideration because it is a Special Status species.	Contract out botanical inventories and survey during range monitoring.
7. Monitor for the occurrence of other Special Status species; red-root yampa, pygmy monkey flower, Bellinger's meadowfoam, Green's mariposa lily, and thelypody.	These species are suspected in the watershed but as yet not found.	Requires consideration because they are Special Status species.	Contract out botanical inventories.

Table 34. Information and Monitoring Needs - Moderate Priority/Yellow Flag Items (Continued)

Information/Monitoring Need	Concern/Objective	Why	How
8. Monitor other species of concern: Buxbaum's sedge and Pacific Yew. Monitor plant communities of interest.	Determine if impacts are occurring to these species and/or communities from ongoing management activities.	Avoid listing of additional species.	Contract botanical inventories and vegetation monitoring.
9. Monitor changes in vegetation in the Mountain Lakes Wilderness Area. Monitor changes in seral stages, composition, structure. Monitor white pine blister rust infection levels within white bark pine communities.	Determine if forest health problems are being perpetuated due to lack of fire, a natural disturbance agent.	Evaluate the results of fire suppression for many years. Evaluate spread of blister rust in communities never altered, with the exception of fire suppression.	Conduct through stand exams. Pursue research opportunities.
10. Identify areas deficient in downed logs, snags, and recruitment trees in corridor areas.	To provide the habitat characteristics necessary for use of the connector by late-successional dependent wildlife.	To identify areas which may be deficient in the structural components necessary for a properly functioning corridor.	Conduct through stand exams.
11. Monitor the population of Pacific giant salamanders in Spencer Creek and amphibian populations with federal status, subsequent to completion of restoration projects and/or implementation of new grazing management.	Determine the health of these populations, as they are surviving under degraded habitat conditions and limited suitable habitat. Meet management requirements for these species in appropriate habitat types.	Track trends in population and monitor the effectiveness of restoration projects and management changes.	Develop monitoring protocols.

Table 34. Information and Monitoring Needs - Moderate Priority/Yellow Flag Items (Continued)

Information/Monitoring Need	Concern/Objective	Why	How
12. Monitor harvest prescriptions outside designated potential connectivity corridors.	Evaluate whether harvest prescription treatments designed to meet the ROD requirements also meet the specifications for habitat characteristics desired in the connectors.	To determine if the harvest prescriptions need to be different than those already specified in the ROD.	Evaluate canopy closure, size structure, percentage of the forest in mid-seral versus late-seral condiition, and the density and size class distribution of down logs and snags through the use of stand exams.
13. Monitor the use of potential connector areas for the presence of marten.	Determine if marten are currently utilizing potential connector areas.	To determine if the existing habitat within potential connectors is providing the necessary habitat characteristics needed for a minimum of presence by marten.	Winter snow tracking over at least a two year period. Monitoring should continue after harvest treatments.
14. Evaluate the type of harvest prescriptions needed within potential connectivity corridors and the volume capable of being generated.	To determine if the volume generated would be different than under prescriptions for green tree retention under the Northwest Forest Plan.	To determine if it is practical to adopt a connectivity corridor.	Post sale monitoring through stand exams and reconnaissance.
15. Field verify preferred habitat mapped for NWFP Protection Buffer species.	Verify the classifications made through the Pacific Meridian Resources system and determine where suitable tree species composition needed for Protection Buffer species exists as classified.	Meet management requirements for these species in appropriate habitat types.	Conduct walk-through surveys of stands identified as secondary habitat by species habitat queries through GIS.
16. Field verify secondary habitat mapped for NWFP Protection Buffer species.	Verify the classifications made through the Pacific Meridian Resources system and determine whether suitable tree species composition needed for Protection Buffer species exists as classified.	Meet management requirements for these species in appropriate habitat types.	Conduct walk-through surveys of stands identified as secondary habitat by species habitat queries through GIS.

Table 34. Information and Monitoring Needs - Moderate Priority/Yellow Flag Items (Continued)

Information/Monitoring Need	Concern/Objective	Why	How
17. Develop a standardized method to inventory and document structures and other sites valuable as bat roosts.	Locate potential bat roosting sites.	Meet management requirements for bat roost sites as outlined in the NWFP.	Develop in coordination with cultural resources staff.
18. Create a standardized list of specific data needed for wildlife, vegetation, and fuels.	Obtain data needed for planning and NEPA analysis that is often not available.	Eliminate duplication of effort and provide adequate information for site-specific planning and analysis.	Conduct stand exams using the standardized list of data.
19. Continue interagency cooperation for water quality and flow monitoring.	Monitor success of restoration efforts. Monitor compliance with DEQ water quality standards. Monitor ecosystem health.	Assess effectiveness of projects and on-going management.	Conduct macroinvertebrate assessments and base station monitoring. Install constant temperature and dissolved oxygen monitoring devices.
20. Verify the fluvial connectivity of Clover Creek to Spencer Creek.	Resolve uncertainty regarding management effects on connectivity and flows in Clover Creek.	Assess effects of management on the flow regime of Clover Creek.	Conduct surveys to determine extent and duration of flow in Clover Creek.
21. Resolve the taxonomic status of trout in the watershed (redband or rainbow).	Identify and manage distinct evolutionary populations of trout and determine whether populations are resident or migratory).	Direct management to protect distinct fish populations.	Conduct genetic analyses.

Table 34. Information and Monitoring Needs - Moderate Priority/Yellow Flag Items (Continued)

Information/Monitoring Need	Concern/Objective	Why	How
22. Monitor fish populations.	Assess whether changes in habitat have altered species assemblages.	Monitor changes in habitat quality.	Conduct fish faunal surveys every 7 to 10 years.
23. Monitor and map noxious weed concentration areas.	Arrest the spread of noxious weeds.	Reduce competition with native vegetation.	Annual weed control contracts.

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CRMP =Coordinated Resource Management Plan
ERO =Ecosystem Restoration Office
NRCS =Natural Resource Conservation Service (Formerly the Soil Conservation Service)
Weyco =Weyerhaeuser Company
NWFP =Northwest Forest Plan
DEQ =Department of Environmental Quality

Management Recommendations

Introduction

The following management recommendations follow from the actual analysis contained in the Issues, Key Questions, and Analysis Chapter. For rationale regarding a particular recommendation the reader should refer to the analysis.

Part I. Social Ecosystems

A. Recreation

Background: Projections of recreation activity demand in southern Oregon from the 1988-1993 Statewide Comprehensive Outdoor Recreation Plan (SCORP) for Oregon show that activities such as Nature Study (wildlife observation, outdoor photography, visiting interpretive exhibits, and picnicking) will be the single most sought after recreation activities on public lands for the year 2000. Activities associated with sightseeing and exploring, non-motorized travel (hiking, mountain biking, horseback riding), camping, and off highway vehicle travel will also be highly sought after. Therefore, management emphasis on programs related to these recreation activities would be indicated to accommodate this demand.

1. Restoration Opportunities

The mouth of Spencer Creek (Weyerhaeuser Company lands) receives a considerable amount of dispersed, unstructured use, including camping, off-highway vehicle/all terrain vehicle use, and hunting/target practice shooting. There are opportunities to provide more structured recreation in this area through appropriate developments and/or provide enhanced law enforcement or road closures to deal with some of the inappropriate behavior.

2. Management Considerations

As mentioned in the Wilderness and Environmental Education portion of the Beneficial Uses and Values chapter, The Mountain Lakes Wilderness, Clover Creek Forest Educational Area, and the Tunnel Creek Wetlands area offer opportunities for environmental education/interpretation.

The Klamath Ranger District is currently working on a proposal to use the former Pelican Guard Station located in the Rocky Point area, as a wilderness and outdoor education center. The facility would help meet the Forest Service's management objective for the development of wilderness education programs to increase the public awareness of the local wilderness, including Mountain Lakes. The Pelican Guard Station could serve as a base camp for conducting wilderness education and field studies.

The Clover Creek Forest Educational Area will be managed and maintained by the BLM for values as presented in the annual elementary school forestry tour, and for recreation. A short, site-specific plan for the educational area would help meet the long-term goals for forestry education and forest health.

The Tunnel Creek area could also be used as an area for conducting scientific research, studies and environmental education of lodgepole pine/western bog huckleberry wetlands. The area offers an opportunity for education regarding protection, maintenance, and/or restoration of natural wetland systems.

Several areas offer recreational opportunities that would help meet regional demands for snowmobiling and hiking that are otherwise limited. A snowmobile trail system along Spencer Creek Hook-up road, across Surveyor Mountain, and tying in with the existing groomed snowmobile trail system between Hyatt Lake and Lake of the Woods has been identified by a local snowmobile organization for development. The Klamath Basin Snow drifters would be responsible for signing and grooming these trails. An associated parking area, for snowmobilers, would provide a safer winter parking area than the existing Clover Creek/Spencer Creek Hook-up junction. The parking area would be plowed by Klamath County using fees from snowmobile registrations. The parking area would also provide an opportunity for providing picnic tables and restroom facilities for snowmobilers and the nearby forest education classes. The additional snowmobile trail network would provide a groomed trail alternative to the heavily used Lake of the Woods trail complex.

The Forest Service has also identified potential snowmobile/cross country ski trails leading from two of the plowed snowpark areas on Clover Creek road. However, this is not an immediate priority for development at this time.

The Forest Service Clover Creek Road primitive campground enclosure provides a primitive camping alternative to the busy Lake of the Woods campgrounds. It is often used as an overflow area on busy weekends. The Forest Service has no plans for upgrading this primitive campground in the future. The rock barriers and campground enclosure should be monitored and some positive signage could be used to encourage people to stay on existing roads, and to not chop down snags or trees in the campground, and along the upper reaches of Clover Creek.

In the Klamath Falls approved Resource Management Plan, the BLM has identified the area along Spencer Creek, north of the hook-up road for a future fishing/hiking trail and walk-in camping. This trail would follow existing foot/cow paths along the creek where possible, and would provide hiking and walk-in camping alternatives to the Lake of the Woods/Fish Lake area.

After the fenced closure of the mouth of Spencer Creek to motorized vehicle occurred, one of the recreation needs identified by the public was an off-highway vehicle/all terrain vehicle play area with associated trail network. No area with sufficient capability to absorb concentrated use is available in the Spencer Creek watershed. Several cinder pits and an old rock quarry near Clover Creek could be used as off-highway vehicle/all terrain vehicle play areas. For an off-highway vehicle/all terrain vehicle play area to be successful, an associated trail network of sufficient challenge is needed. No trails of sufficient challenge are available nearby these rock pits to provide a suitable trail network.

The Applegate Trail crossing on Spencer Creek, Spencer family homestead, and Spencer Cemetery are some of the areas historical features which could be interpreted. The sesquicentennial (150th year) anniversary of the Applegate Trail in 1996 will provide additional interest in highlighting this historical trail crossing.

3. Information and Monitoring Needs

Additional monitoring, educational efforts, law enforcement, and use restrictions may be needed to identify and reduce impacts from recreation use.

B. Livestock Grazing

Background, BLM: This section is a list of possible management actions that could be implemented in the future to reduce or eliminate grazing related problems noted throughout this document. The management recommendations listed, if implemented, would cause favorable responses in land conditions by reversing some or all of the current negative trends and/or accelerating the positive trends already evident. This document does not make implementation decisions. Every potential project and most grazing actions would need to be further analyzed in accordance with the National Environmental Policy Act (NEPA) and other applicable laws, regulations, and/or policies prior to implementation.

One general but obvious management option would be to eliminate livestock grazing in the watershed. This option, though appealing from some perspectives, has several inherent problems:

- Since the vast majority of the watershed receives light to no use, eliminating all grazing without first pursuing other avenues or management strategies (as in the following section) may not be perceived as a "thoughtful" approach to the problem. In the case of the USFS- and BLM-administered lands, which have legal mandates directing them to manage their lands for a variety of uses within the framework of multiple use, this may or may not be an acceptable course of action.

- Similarly, actions taken on the federal lands are subject to appeal by those affected. If the agencies do not have enough adequate, reliable, and specific information to support a decision as a reasonable course of action, then management decision are subject to change and reversal upon appeal. Regardless of outcome, the cost in time and dollars can be substantial, if in order to effect change, administrative and legal avenues must be pursued, instead of through consensus and cooperation.

- If grazing leases are not eliminated on the intermingled private lands in the watershed, then by unilaterally cancelling grazing on the public lands the potential for range administration problems increases dramatically. The same problem would occur if the opposite happens: if grazing leases on the private lands were eliminated, without a similar cancellation on the public lands.

Background, U.S. Forest Service: Within the "Range Analysis Narrative" (USDA Forest Service 1993) problem areas and issues were noted, and excerpted as follows:

Meadow and riparian areas. At issue is the level of utilization upon the forage base within these areas. As the situation currently exists, the meadows and riparian areas on the allotment receive very heavy use. Utilization levels often exceed 70 percent of the available forage. At most the forest plan currently allows for a maximum of 50 percent use of the forage in these areas provided they are in good condition otherwise allowable utilization levels are lower. The heavy levels of utilization to which the meadows are subjected appear to be the result of poor livestock distribution not the result of excessive stocking levels.

Streambanks. Streambanks in riparian areas provide an additional concern. The current forest plan allows for trampling damage to no more than 5 (Class I, II and III streams) or 10 (Class IV streams) percent of streambanks.

Livestock mortality. Mortality of livestock resulting from heavy traffic on both Dead Indian Memorial Highway and Clover Creek Road. Last year (1992) the permittee lost 5 calves and 3 cows to traffic on these roads.

Livestock drift. As the situation currently exists livestock can, and in many cases do, drift off the allotment onto Bureau of Land Management allotments, Rogue National Forest allotments, the Mountain Lakes Wilderness area, or the campgrounds around the south end of Lake of the Woods. This creates problems with respect to administering the allotment as well as gathering cattle.

Conflicts between livestock and recreation. The potential for conflicts between livestock and recreation exist in several areas including the south end of Lake of the Woods, Spencer Creek and Rainbow Creek. The portion of Spencer Creek which is currently fenced in is heavily used by recreationists as is the area outside the exclosure. Several campsites along Rainbow Creek are exposed to livestock when cattle are in the Rainbow Creek drainage.

Conflicts between livestock and timber harvesting. The potential for conflicts between livestock and timber production exists during both the harvesting and reforestation phases of timber management. Livestock may interfere with harvesting activities (such) as log hauling and may browse and/or trample planted seedlings during the regeneration phase when associated forage is either unpalatable or heavily utilized.

Conflicts between livestock and scenic resources. Livestock may reduce scenic value of meadows or riparian areas near roads by either heavy utilization, excrement, displacing wildlife or, in the eyes of some, their presence.

All of the USFS options and recommendations, to remedy the above issues and concerns, are also drawn from their "Range Analysis Narrative" (USDA Forest Service 1993) for the Buck Allotment. Consult that document for further details.

1. Restoration Opportunities

Bureau of Land Management

Buck Lake Allotment

Fence the Tunnel Creek meadow/swamp area as a separate riparian pasture. Approximately 1 miles of fence would be needed to fence the entire BLM portion of the meadow and, if permission is given, include the small upper portion of the meadow which is owned by Divide Resources. This pasture would typically exclude livestock during most or all of the grazing season, but would be scheduled for short term grazing use, as conditions warrant and the grazing operator desired. The primary effect of this option would be to, at a minimum, maintain the meadow area in the current good ecological conditions, while having no detrimental effect on the current livestock operation. (Note: this project is already being pursued by the BLM and is tentatively funded for FY 1995).

Grub Springs Allotment

In conjunction with Weyerhaeuser Company, develop three additional water sources within the upland portions of the allotment. (See the Spencer Coordinated Resource Management Plan for details and locations). Some of these water sources could be on BLM-administered and some on Weyerhaeuser Company lands.

Investigate the necessity and utility of, and pursue as appropriate, fencing of critical portions of the Spencer Creek and/or Miners Creek riparian areas to exclude livestock grazing.

U.S. Forest Service

Five water developments are proposed in order to provide adequate water distribution for livestock. These include two guzzler water developments proposed for Burton Butte, one pond southeast of Ichabod quarry, another pond northwest of the highway at Spencer Creek, and another guzzler near the wildlife guzzler west of Little Aspen Butte (see map in "Range Analysis" for more precise locations). Additional water developments may be necessary if more timber were harvested or shrubfields were converted to plantations with a grass understory.

Weyerhaeuser Company

- Also see Coordinated Resource Management Plan

Fence along the Clover Creek Road from the USDA Forest Service boundary to the Keno subdivision in order to divide the allotment for grazing management purposes and to increase safety of those driving the road (See the Coordinated Resource Management Plan for details). This fence would be entirely on Weyerhaeuser lands and may not be feasible to build or desirable to the Weyerhaeuser Company. The County (which has a right-of-way for the road) has already indicated that they would not fund this fencing as it is designated open range and funding is not available (Hinton 1995 pers. comm.)

In conjunction with the BLM, develop three additional livestock water sources within the upland portions of the allotment. (See the Coordinated Resource Management Plan for details and locations). Some of these water sources could be on BLM-administered and some on Weyerhaeuser Company land.

Charely Livestock Company

- Also see Coordinated Resource Management Plan

As proposed in the Spencer Creek Coordinated Resource Management Plan, complete the internal cross fencing within the Buck Lake allotment on private lands. This approximately 10 mile fencing project would enable the land owner to rotate the cattle around the allotment allowing for regrowth of the grass/sedge species dominant in the area. A predicted increase in meadow stability would result and reduce sedimentation into Spencer Creek with increased water quality. It would also allow the land owner to graze as many if not more cattle with favorable trends in his land resource condition.

2. Management Considerations

Bureau of Land Management

Buck Lake Allotment

In conjunction with the USDA Forest Service recommendations listed below, fence the north boundary of the allotment for enhanced livestock control. Also, investigate the opportunity to combine the Buck Lake allotment with the USDA Forest Service proposed allotment grazing rotation schedule as summarized later. This would allow for the periodic rest and/or deferment of use on the allotment and give the USDA Forest Service one extra pasture to work with in their proposed rotation scheme.

Grub Springs Allotment

Herding of cattle by the livestock lessee, could be increased during the late summer period (after August 1) to push the cattle from the expected improved riparian and wetland areas to the upland areas. This could include the bi-weekly herding removal of cattle from the riparian areas of Spencer and Miners Creeks. This would help lighten the use and commensurate impacts on all ownership portions of Spencer Creek and other important riparian areas.

U.S. Forest Service

Season of Use. No change in season of use recommended at this time.

Fencing. A two herd, seven pasture rotation system is proposed in the "Range Analysis". This would entail the construction of up to 24 miles of fence for interior pasture definition and allotment perimeter/boundary control. Type of fence, cattleguards, gates, use of landforms, etc. would be determined during the allotment management planning process.

Salting. Salting should be used as an additional tool for the improvement of animal distribution. Hence salt should be placed away from water on higher ground and salting areas should be moved about within some pastures in order to achieve better utilization of the forage resource.

Riding. Occasional riding to move livestock from one area of a pasture to another can also improve livestock distribution and alleviate problems.

Grazing System. The recommended grazing system effectively divides the allotment into two management areas. The Burton Butte/Buck Meadow area would be managed under a one herd-four pasture deferred rotation grazing system utilizing approximately 55 to 60 percent of the allotted number of animal unit months. The Buck Indian area would be managed as a three pasture-deferred rotation grazing system utilizing approximately 40 to 45 percent of the allotted number of animal unit months. Again see the USDA Forest Service "Range Analysis Narrative" for specific details.

Features and Benefits. Some of the features and benefits of implementing this system are listed below:

- ♦ The recommended system provides for the physiological needs of the vegetation on the allotment by allowing for deferment of grazing until after seed ripening for all pastures in at least one year out of two. The pasture containing Burton Butte receives deferment by being lightly grazed early and then being allowed to regrow and set seed before being heavily grazed later in the season. Less utilization of the vegetation in the highly visible Buck Meadow does not occur until later in the season thus improving scenic qualities of the meadow. Using the pasture containing Burton Butte first allows for flooding and moist soil conditions in the lodgepole pine forests to dry out before being grazed.

- The fencing plan improves livestock distribution and hence increases upland livestock utilization of the forage.
- Problems with livestock drift are alleviated.
- There is less exposure of streambanks to grazing livestock thus reducing the potential for streambank damage.
- Once livestock learn that there is no reason to cross Dead Indian Memorial Road and Clover Creek roads they should spend less time on them thus posing less of a traffic hazard.
- The recommended system provides for uninterrupted deer fawning and elk calving activities over much of the allotment by controlling livestock movements.
- The proposed system reduces conflicts between livestock and recreation by controlling livestock movements.
- The system is relatively simple and flexible to implement and operate.

Weyerhaeuser Company

- Also see Coordinated Resource Management Plan

None Identified.

Charely Livestock Company

- Also see Coordinated Resource Management Plan

None Identified.

3. Information and Monitoring Needs

Bureau of Land Management

Buck Lake and Grub Springs Allotments

Periodically monitor and evaluate the grazing use of the allotment, in accordance with the Klamath Falls Resource Area's "Coordinated Monitoring and Evaluation Plan for Grazing Allotments". Since the evaluation of the grazing performed for this analysis was based mostly on just one years use pattern mapping and field observations, continued monitoring needs to be done in future years to have sufficient information to adequately re-evaluate the grazing.

Also, the BLM needs to conduct an Ecological Site Inventory on the BLM-administered lands within the allotment. Ecological Site Inventory is the BLM's range survey and condition ranking system. Such a survey is currently scheduled for the Klamath Falls Resource Area no earlier than the late 1990s. The Ecological Site Inventory will determine the current ecological status of a specific vegetative community as compared to the Potential Natural Community. Once Ecological Site Inventory is completed, then vegetative related management objectives based around the Desired Plant Community concept can be determined through the appropriate publicly reviewed processes. If monitoring studies show that reasonable movement towards or maintenance of the objectives is not being accomplished, then management changes would be implemented to ensure the meeting of the objectives within reasonable timeframes.

U.S. Forest Service

None Identified.

Weyerhaeuser Company

- Also see Coordinated Resource Management Plan

None Identified.

Charely Livestock Company

- Also see Coordinated Resource Management Plan

None Identified.

C. Cultural Resources

1. Restoration Opportunities

None Identified.

2. Management Considerations

Determine if it is feasible to restore anadromous fish runs to Spencer Creek. Would this require restoration of the Buck Lake wetland and lake area?

Determine the net effect of the extensive road system within the Spencer Creek watershed, (both public and private roads).

Acquire where possible the historic resources located near the confluence of Spencer Creek and the Klamath River and protect them for the public trust. They are listed as follows:

- ♦ The crossing of the Applegate Trail at Spencer Creek.
- ♦ The crossing of the Applegate Trail at the Klamath River.
- ♦ The site of Camp Day.
- ♦ The site of Spencer Station and Spencer Cemetery.

This area is easily accessed by automobiles and would make the core of an extremely valuable Living History Park which could be managed by the National Park Service. This point on the Applegate Trail can make a major contribution to the broad outlines of the history of the United States, and an important contribution to the history of the State of Oregon, and Klamath County, Oregon. There are historic photographs available which would enable historians and architects to replicate Camp Day and Spencer Station.

3. Information and Monitoring Needs

Undertake a 100 percent cultural resource survey and inventory of the federal lands in the Spencer Creek watershed. This may well be an excellent project for a "Jobs-in-the-Woods" contract.

Part II. Terrestrial Ecosystems

Vegetation Section

A. Vegetation

1. Restoration Opportunities.

Within Late-Successional Reserves and Riparian Reserves. Potential restoration opportunities for vegetation applicable to the Spencer Creek watershed are discussed on pages C-12 and C-13 and C-31 and C-32 of the Record of Decision of the Northwest Forest Plan. For areas east of the Cascades and within Late-Successional Reserves, silvicultural treatments are recommended that accelerate the development of late-successional conditions while making future forested communities less susceptible to catastrophic disturbances (fires, insects, diseases, and drought). In addition, the Northwest Forest Plan recommends that treatments should be designed to provide effective fuel breaks. For Riparian Reserves, silvicultural practices are allowed to control stocking, reestablish and manage stands, and acquire desired vegetation characteristic needed to attain Aquatic Conservation strategy objectives.

Restoration treatments within the Spencer Creek watershed in both Late-Successional Reserves and Riparian Reserves should involve prescribed burning and/or light understory thinnings, along with a reduction of excess ladder and ground fuels in some areas to reduce the threat of catastrophic disturbances. In addition, these treatments could help protect and maintain the areas within the Late-Successional Reserves and Riparian Reserves where a residual pine component is threatened by excessive stem densities. Even with some light treatments of Late-Successional Reserves, late-successional habitat on federal lands within the watershed should remain above the 25 percent level presently existing in the watershed. Within the wilderness area, prescribed natural fire should be allowed because it is the only way to manipulate densities, composition, and possible patch size and distribution.

Other restoration treatments within Late-Successional Reserves and Riparian Reserves might include; constructing fuel breaks, hand piling and burning, and/or chipping of excess slash from past treatments (precommercial thinnings); placing large woody debris from cull decks back into areas lacking in large woody debris (scarified areas); treating concentrations of noxious weeds; and revegetating deforested riparian areas and obliterated roads with native shrubs and conifers.

Within the Matrix. Restoration opportunities within the matrix would be very similar to those as described for Late-Successional Reserves and Riparian Reserves. The objective of protecting the forested areas from a catastrophic disturbance applies within the matrix as well. Thinning of overstocked understories in many areas of the matrix is needed. Controlling of noxious weeds, meeting large woody debris needs, treating excess fuel loads, and revegetating disturbed areas are all potential restoration treatments in the matrix.

2. Management Considerations

Within existing Late Successional Stands (All Zones). Maintain the structural components of existing late successional stands within the watershed as specified in the Northwest Forest Plan (See green tree retention requirements, pages C-41 and C-42). These structural components include; large live trees, large snags, large downed logs, and a specified canopy closure, as well as scattered openings. Structural components will vary by vegetation zone. For example, ponderosa pine and lower elevation mixed conifer zones historically had less large down wood and canopy closure than the upper mixed conifer and red fir zones because of the historic frequent fires (Agee 1993 and Hopkins et al. 1993). The large downwood objectives specified in the Northwest Forest Plan can likely be met in all zones except in areas where most of the large overstory has been removed. By maintaining the structural components of these stands, the functional capacity should also be maintained.

Late successional stands showing the highest rates of mortality (normally the drier sites; low elevation and/or south slopes) should be inventoried first and then treated first (see Map 16). Within the Spencer Creek watershed, this would include areas on the west slopes of Aspen Butte and Clover Butte in the Clover Creek subdrainage. In addition, this would include areas in the lower part of the watershed where historically more pine was found. Treatment objectives should stress the maintenance and/or enhancement of **any** residual old growth or understory pine and/or Douglas fir within the areas where these components are presently limited due to past harvesting. In addition, understory thinning down to a 2 to 3 inch diameter limit with complete utilization of the stems (chipping), followed by a prescribed burn should help reduce stress on the larger trees, reduce biomass and subsequent fuel loads, as well release individual understory pine trees. Keane et al. (1990a, cited by Morgan et al. 1994) speculated, based upon simulation modeling results, that partial timber harvest could be combined with periodic prescribed fires at 20-year intervals to maintain the nutrient cycles, stand structures, regeneration, growth and mortality of plants, and the range of stand and landscape compositions experienced when fires historically burned every 10 years.

Within Mid Seral Stands. Focus harvesting activities in the short term (less than 5 years) in early-mid and mid seral stage forests. Treatments should be located in areas historically dominated by ponderosa pine, sugar pine, and Douglas fir, but are now dominated by true firs and presently at high risk to fire, disease, and for insects. Conduct thinning and light underburning projects to achieve fuel and forest management objectives. Through thinnings and underburning, control densities and species compositions to meet stand specific objectives. Thinning needs to be done down to a 2 to 3 inch diameter limit with complete utilization of excess biomass (gross yarding and chipping so fuel objectives can be achieved concurrently). If a large overstory tree component is present but limited, retain and enhance individual remaining large trees. The desired future condition is to have stands more resistant to insects, diseases, and stand replacing fires. Highest priority and least sustainable areas are presently in the lower portions of the mixed conifer zone, on drier low elevation sites, and on the south slopes. Some mid-seral areas in the Shasta red fir zone are showing high fir engraver activity as well (see Map 16).

Insects and Diseases. Control of densities as well as species composition should help reduce remaining trees' susceptibility to insects and diseases (Oliver et al. 1994). Rust resistant western white pine and sugar pine need to be planted to begin replacing the continuing loss of this component of the forests. Applying borax to freshly cut stumps as well as planting resistant species should help to control the spread of annosus.

Reintroduction of Fire. Prescribed natural fire needs to be introduced into many of the vegetative communities within the Spencer Creek watershed on a regular basis. In some areas, this may be the only restoration treatment needed depending upon the fuel loadings, species composition of the stands, and overall objectives.

Maintain sufficient snag and downwood component in lodgepole pine areas. Control firewood cutting in areas deficient in snag and down wood component and where Riparian Reserve habitat is being impacted.

3. Information and Monitoring Needs

Within Late-Successional Reserves and Riparian Reserves. Riparian Reserves and unmapped and mapped Late-Successional Reserves should be inventoried (stand exams) to determine which areas are presently most susceptible to stand replacing fires because of ladder fuel arrangements, fuel loads, densities, aspect, and other characteristics. Late-Successional Reserves and Riparian Reserves should be monitored to determine if there is a significant threat from ongoing insect attack to the existing late-successional habitat that these reserves were designed to provide. For example, is the large tree component and/or pine component in these reserves being threatened by ongoing insect attack, and if so, should anything be done? Riparian Reserves should be surveyed to determine where planting of native shrubs and conifers is needed. Components of the monitoring and evaluation plan stipulated on pages E-4 to E-12 of the Northwest Forest Plan should be reviewed and applied to the Spencer Creek watershed.

Within the Matrix. Continue to monitor insect and disease levels. Stand exams prior to and after treatment should assist in determining if large woody debris, canopy closure, green tree retention, snag levels, soil impact, and species composition objectives are being met. Components of the monitoring and evaluation plan stipulated on page E-4 to E-12 of the Northwest Forest Plan should be reviewed and applied to the Spencer Creek watershed. Predicted versus realized probable sale quantities from Matrix lands should be monitored to determine if amendments are needed to resource management plans.

B. Special Status Plant Species Including Threatened, Endangered, and Sensitive Plant Species

Survey and Manage Species, Other Species of Interest, and Plant Communities of Interest

1. Restoration Opportunities

Plant Communities of Interest. A fencing project around the Tunnel Creek wetlands is currently under development. The current proposal will include the private lands in the area if the landowner is willing to cooperate. The fencing should allow more control over season and duration of grazing in this area.

2. Management Considerations

Green-flowered Ginger. Management recommendations are difficult to make because of the large ecological amplitude where this species is found. However, an ongoing research project (Baldwin and Brunsfield 1991) will likely produce a conservation strategy for this species. Logging over snow can also be recommended for large, dense populations of this species to protect the plants from direct mechanical damage from timber harvest activities.

Plant Communities of Interest. The three communities associated with wetland areas (lodgepole pine/huckleberry/forb swamp, wetland shrub, and wet meadows dominated by tufted hairgrass, and few-flowered spikebrush) should be adequately protected on federal lands from the impacts of timber harvest through the implementation of

Aquatic Conservation Strategy that includes buffers around these wetland communities. However, private landholders within the watershed should be encouraged to conserve the lodgepole pine/huckleberry/forb swamp community by deferring harvest of the lodgepole pine within this community-type.

The white bark pine communities are adequately protected under current management because of the remote location of this community within the watershed that is entirely within a designated wilderness area.

Other Species of Interest. Buxbaum's Sedge and Pacific Yew.

Both of these species are associated with wetlands, springs, and riparian areas. Therefore, implementation of the Aquatic Conservation Strategy that is part of the Northwest Forest Plan, which includes buffers that will extend beyond the edge of these communities, should be adequate to conserve these species.

3. Information and Monitoring Needs

Newberry's Gentian. Qualitative observations indicate that even heavy forage utilization does not negatively affect this species. However, quantitative monitoring is needed to verify this observation. If populations were documented to be declining under current range management, then adjustments to carrying capacity and/or season of use could be recommended.

Other Special Status Species. Red-root yampa (*Perideridia erythrorhiza),* Pygmy monkey (*Mimulus pygmaeus*), Bellinger's meadowfoam (*Limnanthes floccosa spp. bellingeriana*), Green's mariposa lily (*Calochartos greenei*), Thelypody (*Thelypodium brachycarpum*)

More complete inventories for these species are needed to determine if they occur in the watershed. If populations are located, the status and trend of the species under current management can be determined.

Survey and Manage Species. *Sarcondon imbricatum, Phgeocollybia scatesiae, Cantharellus cibarius, Cantharellus subalbidus, Cantharellus tubaeformis*

Since five of the species have been found in other areas of the Klamath Ranger District, it seems likely that at least some of the survey and manage species occur in the Spencer Creek watershed. Under the Northwest Forest Plan the BLM and Forest Service are required to initiate extensive surveys for some of these species by 1996, and surveys for other of these species must be completed prior to ground-disturbing activities that will be implemented in FY 1999 or later. Therefore, it would be beneficial to begin inventories for these species as soon as possible in order to be able to assess their status and trend under current management.

Plant Communities of Interest. Quantitative monitoring is needed to assess the effects of livestock grazing on the three communities associated with wetland areas. While qualitative observations indicate that some of these areas are heavily utilized by livestock, quantitative monitoring is needed to determine if grazing is having negative impacts on these communities. A negative trend is documented, then adjustments in carrying capacity and/or season of use can be recommended.

C. Noxious Weeds

1. Restoration Opportunities

Develop and implement an annual noxious weed control contract. Reseed or replant treated areas with native vegetation.

2. Management Considerations

Implementation of an integrated weed management plan is recommended for lands in the watershed. Integrated weed management includes a combination of cultural, physical, biological, and chemical control methods. Cultural methods include prevention of introduction of new weed species into an area through appropriate cleaning of machinery and equipment prior to implementation of a project. It also includes the use of weed free seed materials, and choosing project design features that produce a minimum of disturbance to a site in order to limit the creation of environmental conditions favorable for weed invasion. Cultural methods also include competitive plantings on disturbed sites composed of native species derived from local genetic stock. Physical control can include manual and mechanical methods as well as prescribed fire. Classical biological control involves the introduction of species specific pests of the target weed in order to limit its ability to spread and compete with native vegetation. Chemical control includes the use of herbicides appropriate to the target species and the environmental conditions at the treatment site. More information on integrated weed management can be found in a Bureau of Land Management integrated weed control plan (1994).

3. Information and Monitoring Needs

Continue to monitor and map noxious weed concentration areas. Monitor control methods to determine most efficient mechanisms for control.

D. Soils

1. Restoration Opportunities

If there are known areas where high compaction levels exist, use a winged subsoiler or a self-drafting subsoiler to rip skid trails and landings that are not needed for future timber harvest activities or where management activities are not expected to occur for five to ten years or more.

In high road impact areas and where the opportunity exists and Transportation Management Objectives allow, close, obliterate, and/or stabilize selected roads and reseed or replant with native vegetation.

2. Management Considerations

Fully prescribe and implement all appropriate Best Management Practices on BLM-administered lands (see Appendix D in the Klamath Falls Resource Area approved Resource Management Plan). Fully prescribe and implement all appropriate Standards and Guidelines on Forest Service-administered lands (see Appendix D in the Winema National Forest Land and Resource Management Plan and Final Environmental Impact Statement).

Require the use of a winged subsoiler or a self-drafting subsoiler, rather than a rock ripper for site preparation.

3. Information and Monitoring Needs

During site-specific planning and analysis and when practicable, conduct inventories to assess where detrimental soil conditions exist (compaction, displacement, and loss of soil cover) above levels allowable on federal lands (20 percent of the total acreage in an activity area). Incorporate measures to reduce existing acreage or, at the least, not increase the acreage in the planning area where detrimental soil conditions exist.

Encourage and support research to quantify the effects of compaction on soil productivity for soils in this region.

E. Late Successional Forest Wildlife Species

1. Restoration Opportunities

None identified.

2. Management Considerations

There are two or three areas with the long-term potential to provide late-successional habitat connectivity corridors within the Spencer Creek watershed between existing late successional habitat blocks (Map 32). These potential corridors are north and south of Buck Lake and are the areas most likely to be used for travel by species, such as the marten. These areas could provide a connection between the mapped Late Successional Reserve within the Spencer Creek watershed and late-successional forest blocks to the west in the Jenny Creek watershed. Similar management for a connector would also have to take place within the Jenny Creek watershed to maintain the continuity of the connection at least between the watershed boundary and the Riparian Reserve in the headwaters of Johnson Creek. The areas potentially affected in the Jenny Creek Watershed would be T. 38S, R. 5E, Sections 21, 27, and 28 or T. 38S, R. 5E, Sections 8 and 17, depending upon the connector location on the Spencer Creek side. It is outside the scope of this analysis to determine if the Riparian Reserve network in the Jenny Creek watershed would provide for the movement of some late-successional dependent terrestrial animals.

A corridor north of Buck Lake would directly tie wetland habitats to desirable forest habitat. A corridor south of Buck Lake would take advantage of the Bureau of Land Management's owl management areas. The advantages and disadvantages of the options are discussed in more detail below.

Suitable corridors would have the following characteristics:

- Be a minimum of 600 feet wide;
- at least 40 percent of the connector would be late-seral forest with a minimum of 50 to 60 percent canopy closure;
- within the portion of the connector which is not managed as late-seral, maintain as mid-seral forest with at least 40 percent canopy closure.

To help ensure the function of potential connectors, the following should be considered:

- Place logs in deficient areas;
- discourage development of snowmobile trails in the connectors and minimize crossings;
- snowmobile trails should not run parallel to connectors if they are within 1/4 mile of each other unless they are separated by a topographic sound barrier such as a ridgeline; and
- close or obliterate unnecessary roads.

The optional locations, advantages and disadvantages of each potential corridor are described below.

Potential Connector Number 1: T. 38S, R. 5E, Sections 15, 11, 12, and 1.

Advantages

A connection would be provided over a saddle between the headwaters of Johnson Creek and the upper reaches of Spencer Creek in the area of Buck Lake.

The development of a connector in this area would provide access from the mapped Late Successional Reserve to the valuable riparian and meadow habitats associated with Spencer Creek in the vicinity of Buck Lake.

Disadvantages

Due to the presence of private land in T. 38S, R. 5E, Sections 16 and 22, the connection would be very narrow in the southeast corner of Section 15.

Currently most of this area is mid-seral forest, not late seral. There are several areas that are plantations and pole-sized stands.

The Keno Access Road and the Clover Creek Road would transect this connector.

Potential Connector Number 2: T. 38S, R. 5E, Sections 9, 15, 11, 12, and 1.

Advantages

Most of Section 9 is already late-successional forest and 100 acres of it is in an unmapped Late Successional Reserve.

Land ownership patterns in Sections 9 and 10 would allow for a wider connection into Section 15 than under option Number 1.

The Keno Access Road would not transect the connector.

Since the remainder of the connector to the east would be the same as for option Number 1, the other advantages would be the same.

Disadvantages

The location would be over Burton Butte rather than through a saddle which could affect its use by certain species.

The connector would transect Clover Creek Road.

The connection to the headwaters of Johnson Creek would be indirect.

Potential Connector Number 3: T. 38S, R. 5E, Sections 23, 26, 25 and T. 38S, R. 6E, Sections 19, 18, and 7.

Advantages

The Bureau of Land Management's Unmapped Late Successional Reserves (many associated with spotted owl sites) would provide a portion of the late-successional habitat desired.

Marten have been recently documented in the area.

There would be a connection to Tunnel Creek at the southwest end of Buck Lake, and a portion of Spencer Creek.

Disadvantages

The Keno Access Road transects portions of the area.

This option is the least direct route between large late seral forest blocks and the headwaters of Johnson Creek.

The connector would cross Kent and Surveyor Mountains rather than go through a saddle.

3. Information and Monitoring Needs

If a corridor is chosen, identify areas deficient in downed logs, snags, and recruitment trees.

Monitor harvest prescriptions outside of designated potential connectivity corridors prior to harvest within the potential corridors. This monitoring is needed to determine if treatments designed to meet requirements in the Northwest Forest Plan for green tree retention also meet the specifications for habitat characteristics desired in the connectors. Forest characteristics which should be evaluated through stand exams include canopy closure, size structure, percentage of the forest in mid-seral versus late-seral condition, and the density and size class distribution of downed logs and snags.

If management chooses to adopt a connectivity corridor, and green tree retention prescriptions do not result in the habitat characteristics desired, evaluate the volume obtainable through harvest prescriptions within potential corridors.

Potential connectivity corridors should be monitored for the presence of marten by snow tracking, to determine if these animals are currently utilizing the potential connector areas. This monitoring should take place for a period of two years to collect baseline data. If a connectivity corridor is adopted, monitoring should continue after harvest treatments.

Evaluate the type of harvest prescriptions needed within potential connectivity corridors, and the volume capable of being generated, to determine if it is practical to adopt a connectivity corridor.

F. Northern Spotted Owl

1. Restoration Opportunities

None Identified.

2. Management Considerations

To ensure that the population within Late Successional Reserve RO-227 remains above 20 reproductively-capable sites and the viability of the individual sites is maintained, the individual Late Successional Reserve owl sites within 1.2 miles of the watershed boundary should be evaluated prior to any operation or activity that might alter currently used habitat. Activities that would drop the habitat for these sites below 40 percent in the home range radius should be deferred until 20 reproductively-capable pairs are confirmed in the Late Successional Reserve.

3. Information and Monitoring Needs

A new query of the Pacific Meridian Resources data needs to be run to more accurately reflect the dispersal conditions and to compare to the conditions determined from stand exam and aerial photo interpretation. If large discrepancies remain, a more careful evaluation of dispersal condition should be conducted for those areas shown to be deficient in dispersal condition, prior to activities that might further affect the condition.

Monitor harvest prescriptions within the matrix to verify the assumption that the dispersal habitat needs of the northern spotted owl will be met through the green tree retention requirements in the Northwest Forest Plan. Dispersal habitat will be evaluated based upon the biologists' judgement of the quantity and size of down woody material for adequate prey base opportunities, and cover for protection and movement.

Evaluate the percentage and arrangement of suitable spotted owl dispersal habitat available within the time period harvest is planned for a given area (e.g. subwatershed), to determine the type of harvest prescription and the area which could be harvested while maintaining adequate dispersal conditions.

G. Ponderosa and Mixed Pine Associated Wildlife Species

1. Restoration Opportunities

None Identified.

2. Management Considerations

Do a site management plan for the bald eagle territory on BLM-administered land (Oregon State University Site No. 561) and any additional bald eagle territories discovered. Adhere to the specific recommendations in the Pacific Bald Eagle Recovery Plan for management of the nesting territory.

Manage suitable and capable habitat to provide for both the short and long-term needs of the white-headed woodpecker, black-backed woodpecker, pygmy nuthatch, and flammulated owl. How this may be accomplished is discussed under Information and Monitoring Needs.

> Manage existing mid and late seral ponderosa pine stands by maintaining a large pine component in the potential habitat locations shown in Map 25 and where habitat for the white-headed and black-backed woodpeckers has been verified.
>
> Manage for recruitment of pine in potential habitat locations, including those shown in Map 25.

Manage for snags and green-tree replacements in the matrix according to the *"Standards and Guidelines for Management of Habitat for Late-Successional and Old Growth Forest Related Species Within the Range of the Northern Spotted Owl"* on pages C-45 through C-47. This incudes site-specific analysis, and application of a snag recruitment model taking into account tree species, diameters, falling rates, and decay rates, which may be necessary to determine appropriate tree and snag species mixes and densities. If snag requirements cannot be met, then harvest should not take place".

As stated in the Standards and Guidelines, "provisions of snags for other cavity-nesting species, including primary cavity nesters, must be added to the requirements for these two woodpecker species" (white-headed and black-backed woodpeckers).

3. Information and Monitoring Needs

Field verify all preferred habitat mapped for the white-headed woodpecker, black-backed woodpecker, pygmy nuthatch, and flammulated owl (Map 25 shows preferred habitat for the white-headed woodpecker). Additional maps for the other species can be found in the Klamath Falls Resource Area BLM office.

Field check the secondary habitat mapped for the white-headed and black-backed woodpeckers (Map 25 shows secondary habitat for the white-headed woodpecker). Additional maps for the other specie can be found in the Klamath Falls Resource Area BLM office. Determine where additional suitable habitat may occur.

Survey for "Survey and Manage" species listed in the Northwest Forest Plan.

H. Deer and Elk

1. Restoration Opportunities

Evaluate the obliteration or closure of roads in the areas described below to facilitate more effective use of cover in the vicinity of forage, and in fawning/calving areas for big game. Road densities should be managed for the goal 1.5 miles of open road per square mile. The areas listed below are areas that may be used for foraging and calving/fawning. Other areas in the vicinity of forage also need consideration for road closure or obliteration. Field reviews are necessary to identify these areas.

Priority One: Riparian areas where there is adjacent cover.

Along Spencer Creek in T. 38S, R. 6E, Sections 7, 18, and 19.

In the vicinity of Buck Lake in T. 38S, R. 5E, Sections 15, 23, and 25.

Next to Clover Creek in T. 38S, R. 6E, Sections 4, 9, 10, 15.

Priority Two: Riparian areas where there is an absence of adjacent cover.

In T. 39S, R. 6E, Sections 2, 3, and 11.

In T. 38S, R.6E, Sections 17, 22, 27, and 35.

In T. 39S, R. 6E, Section 2.

2. Management Considerations

None Identified.

3. Information and Monitoring Needs

None Identified.

Part III. Riparian Ecosystems

1. Restoration Opportunities.

Restore wetland function at Buck Lake. Follow through with initial Coordinated Resource Management Plan efforts to reduce sedimentation and lower water temperatures through fencing, grazing rotation system, and water level control. Continue to implement projects within the Buck Lake pasture that will reduce the delivery of fine sediments and decrease water warming. This includes additional dike protection through fencing and planting of hardwoods along canals. Also consider a range of options for restoring a portion of the pasture to a functional wetland through purchase, conservation easements, or other means. Restoring wetland function at Buck Lake is critical to the recovery of Spencer Creek. Outflow temperature and fine sediments from Buck Lake are considered leading limiting factors for aquatic animals in Spencer Creek.

Plant conifers and/or /hardwood species in areas where streamside shading and large woody debris recruitment potential is low due to past management practices. Plant long-rotation conifers in mixed conifer zone and in confined valley segment areas that have not regenerated after logging. These areas have not been specifically identified however Map 30 and Map 31 show confined segments with low near-term large woody debris potential and low shading. In unconfined valley segments areas with low shading streambanks could be planted with native willows and cottonwoods. Specific areas with high potential for improved shading are indicated on Map 29. This project will help meet Aquatic Conservation Strategy objectives by improving streamside riparian conditions, increasing stream shading and improving long-term potential for large woody debris recruitment.

Fence and protect areas considered important to special status aquatic species. Areas identified for protection are indicated on Map 28 and include the following areas:

1) Porcupine Spring, associated pond, and the one-quarter mile reach of Clover Creek below the pond. This project requires that off-site watering be provided. The objective for this fence would be to protect a potential population of redband trout in Clover Creek.

2) Tunnel Creek wetland and spring area. The objective of this project would be to protect the area from negative effects from livestock grazing to spotted frogs, rare freshwater molluscs, and unique plant communities.

3) Fence off selected areas along Spencer Creek which are susceptible to overgrazing and streambank damage. Potential areas are identified on Map 28. Additional spring and wetland areas may need to be considered for protection as new sites are discovered which contain species listed in the Survey and Manage Guidelines of the Northwest Forest Plan. These projects will help ensure the viability of special status species in the watershed.

2. Management Considerations

Manage the grazing in a way that the vegetation height of grasses and forbs in the meadows is maintained at levels between 5 and 15 inches (13 to 38 cm) to support vole populations.

Fence the following springs and meadows and provide alternate watering sites:

Portions of the inlet to Buck Lake in T. 38S, R. 5E, Section 11;

Muddy Spring Meadow, T. 38S, R. 5E, Section 2;

Muddy Spring, T. 37S, R. 5E, Section 34, SW1/4, SE1/16 and T. 38S, R. 5E, Section 3, NW1/4, NE1/16; and

Desolation Swamp - both ponds, meadow, and meadow edge in T. 38S, R. 5E, Section 1, NW1/4.

The above sites should be fenced using specifications for a wildlife friendly fence. The top strand of such a fence should be no greater than 42 inches off the ground. The bottom strand should be 16 to 18 inches off the ground. The top and bottom stands of the fence should be barbless.

Off-site watering troughs should be designed with floats to regulate the amount of water piped from the source. The troughs should be located in upland habitat away from the riparian or wetland habitat.

Riparian Buffers. Apply all riparian reserves as recommended in the federal standards and guidelines of the Northwest Forest Plan for perennial, fish bearing, and intermittent streams except as noted below. For Clover Creek, in the intermittent reach below Dead Porcupine Spring to the confluence with Spencer Creek, the 300 foot buffer for fish bearing intermittent streams may be in excess of what is required for proper hydrological and biological function. It was determined that there were sufficient information gaps to preclude a recommendation for reducing the standards and guidelines recommended buffer widths at this time. Information on frequency and duration of connectivity to Spencer Creek, fish distribution patterns, and the status and taxonomy of redband/rainbow trout is needed to make a determination of minimally acceptable buffer widths (See information and monitoring needs below).

Apply additional riparian buffer width protection to perennial and intermittent streams where the forested edge of a riparian area is located beyond the maximum buffer width recommended in the standards and guidelines. This will ensure that areas with riparian meadows extending more than 300 feet from stream edges will have a forested edge from which recruitment of downed logs into the riparian areas and floodplains can occur. The recommended width of additional buffered areas is 50 feet of forested edge along the edges of riparian areas and meadows along streams. This additional protection does not apply where riparian areas are considered meadows and are applicable to protection buffer guidelines for the great grey owl (See page C-19 standards and guidelines). The areas which would fall under this additional protection are not specifically mapped. Map 9 shows the riparian reserve areas as a reconciliation of the Northwest Forest Plan, the BLM Resource Management Plan, and the Record of Decision. Sections 11 and 23 of Township 38, Range 5 are areas likely to fall under this recommendation for increased buffer widths.

Thermal Protection Buffers. Provide thermal protection for spring areas, seeps, and ponds under one acre. There is a high likelihood that these areas contain rare molluscs and special status amphibian species. The Northwest Forest Plan standards and guidelines state that riparian reserves for wetlands less than one acre must include the wetland area and extend to the outer edges of the riparian vegetation (page C-31 standards and guidelines). In some pump chance ponds and spring areas this may not provide adequate protection from solar radiation or the effects of freezing in winter. It is recommended that springs, seeps, and artificial ponds be buffered with a distance equal to one site potential tree from the edge of the wetland area.

Fire Risk Management. If it is determined through an assessment process that riparian reserves are or will become a high risk for catastrophic fire, then consider thinning and/or prescribed fire within riparian reserves to meet Aquatic Conservation Strategy objectives. The process for implementing such fire protection measures needs to be interdisciplinary and interagency. No current fire risk assessment exists pertaining to Riparian Reserve designations (See management recommendations in the Terrestrial section).

Livestock Grazing. Eliminate late season use of riparian areas and respond quickly to ameliorate water shortage problems which result in overuse of riparian areas by cattle. This includes building in flexibility to the range use plans and taking emergency measures to provide additional off-site watering when necessary. (See the Riparian section)

3. Information and Monitoring Needs

Monitor livestock use in riparian/wetland/spring areas after changes in grazing management are implemented, both short and long term.

Monitor the population of Pacific giant salamanders in Spencer Creek and amphibian populations with federal status, subsequent to completion of restoration projects and/or implementation of grazing management.

Part IV. Aquatic Ecosystems

1. Restoration Opportunities

Background. Siltation and high summer water temperatures were found to be the most serious threats to aquatic health in the watershed. The primary causal mechanisms for the current condition are roads, streamside timber harvest, and pasture systems at Buck Lake. In identifying areas with the greatest potential for restoration we considered the amount of threat or risk to the resource, the relative importance of the resource, and the potential for measurable improvement through implementation of restoration projects. We identified opportunities that appeared to be reasonable measures towards achieving Aquatic Conservation Strategy objectives.

Opportunity 1. Place logs in Spencer Creek below Buck Lake in confined reaches where instream large woody debris is below potential and near-term recruitment levels are low. Areas identified for instream wood placement are indicated on Map 28. The objective for this restoration project is to replace coarse stream structure lost from road building, timber harvest, and stream channel cleaning until such time as riparian buffer areas are again a reliable source of input for large woody debris. This project would help meet Aquatic Conservation Strategy objectives by increasing amount of pool habitat and cover, and encouraging the maintenance of spawning gravel beds.

Opportunity 2. Encourage a more natural sinuous channel in the outflow canal at Buck lake on federal land by placing in-channel structures. This would help achieve Aquatic Conservation Strategy objectives by increasing habitat complexity and reducing sediment routing through canal system. Boulders and /or logs would be placed in the channel. Work with adjacent landowners to develop similar coordinated restoration work on private lands.

Opportunity 3. Implement road closures on a priority basis relative to risk to aquatic systems. Reduce the total number of stream crossings and eliminate roads which parallel streams within 100 feet of stream edge. Road closures refers to a range of options for closure, including re-grading to natural contours, obliteration and planting, and seasonally gated closures during wet periods. Priority areas for road closures are identified on Map 33. Road closure planning needs to be done on an interagency level in conjunction with other transportation planning efforts. The objective for reducing stream crossings is to reduce the input of fine sediments into stream channels and extend runoff timing by reducing the drainage network. Closing and obliterating roads that parallel streams would reduce sedimentation over the short and long term and would restore the long-term potential for shading and large woody debris recruitment.

Opportunity 4. Remove or make innocuous gravel crushing operation tailings which are piled at a specific location on BLM-administered land along the edge of Clover Creek. This is a major source of sediment for the intermittent portion of Clover Creek in the lower, moderately unconfined reaches. This project will require heavy equipment to either level or pick up and truck out approximately 300 cubic yards of material. Some site rehabilitation through seeding and /or planting would also be required. This project would help meet Aquatic Conservation Strategy objectives by removing a major point source of sediments.

Opportunity 5. Replace the culvert at the Spencer Creek crossover road. There is over thirty feet of fill on this culvert which poses a high risk to downstream aquatic resources if this culvert were to fail and move this material downstream. In addition, the water velocity through this culvert compounded with its length makes it a partial barrier to upstream migration for smaller fish. Thus, some potentially suitable habitat may be inaccessible and/or underutilized. Therefore, it is recommended that the culvert be replaced with an open arch structure or bridge. This structure should be designed to withstand a peak flow that corresponds to the 100-year flood return interval (a Northwest Forest Plan standard) and fill material should be minimized. This project would help achieve aquatic conservation strategy objectives by improving fish passage and reducing the risk of sediment input. In addition, and open arch or bridge would aid in the downstream passage of organic debris and reduce the potential for culvert plugging, debris jams, and subsequent failure or wash-out. This project will require a thorough impact assessment.

Other potential migration barriers need to be assessed. There was insufficient information to conclude that the culverts on Miners Creek were harmful to native trout populations. It was concluded however, that two of these culverts would be complete migration barriers to upstream migration of trout and other aquatic organisms. These culverts need to be considered for removal within the context of overall transportation planning.

2. Management Considerations

Background. The following recommendations are discussed because they either deviate from the standards and guidelines in the Northwest Forest Plan or there are especially pertinent guidelines which need to be exemplified or clarified for their application to the Spencer Creek watershed.

Survey and Manage Guidelines. Conduct surveys as needed to comply with Survey and Manage guidelines. For aquatic species, there was determined to be a high likelihood for the occurrence of rare and endemic molluscs in the Spencer Creek watershed. Table C-3 in the Northwest Forest Plan lists mollusc species with survey strategies 1 (manage known sites) and 2 (survey prior to activities and manage sites). While no surveys have been conducted in the Spencer Creek watershed for molluscs, other Klamath basin survey efforts including the adjacent Jenny Creek watershed and Upper Klamath Basin springs have yielded a high number of the Survey and Manage mollusc species. The number of high volume Springs in the Buck Lake region makes it likely that some of the cold water spring obligatory species occur there. Once survey protocols become available, habitats such as springs that are at risk from livestock grazing or other management activities, should be surveyed for these species.

Roads. Reduce stream crossings and road densities. Comprehensive transportation planning needs to be conducted with aquatic resource protection objectives as a primary consideration. This will require coordination between the Forest Service, BLM, Weyerhaeuser Company, and State Forestry, as well as other affected landowners. In this analysis document, areas of greatest concern for aquatic resources were identified (Map 27), but no attempt was made to create a comprehensive transportation plan.

3. Information and Monitoring Needs

Background. Monitoring change over time and evaluating the effectiveness of restoration and management activities is an integral component of the iterative watershed analysis process. In addition, important information needs were identified during the initial Spencer Creek watershed analysis. Land ownership patterns and associated resource values dictate that any effective monitoring will require cooperation and coordination between federal, state, private, and other interested entities. Obviously the individual proposed restoration projects will require monitoring for implementation and compliance. Furthermore, monitoring needs to be established to determine that standards and guidelines were correctly applied and are effective in meeting planned objectives. The following is a list of questions and monitoring elements that were found to be important in the Spencer Creek watershed analysis. It is recommended that these be incorporated into a comprehensive monitoring plan for the watershed.

Water Quality. Oregon state water quality standards should to be monitored for alkalinity, temperature, organic pollution, and bacterial levels. See Oregon State Water Quality Standards guidelines (Oregon DEQ, 1993).

Siltation. Quantitative measurements to determine source and relative contribution of fine sediments into the aquatic system should be conducted to better direct restoration efforts. A plan for this type of study has not been developed at this time.

Temperature monitoring. Continue year-round temperature monitoring in Spencer Creek and expand monitoring to include Miners Creek and Clover Creek. This will be an effective means to monitor the effects of shading and the effectiveness of restoration projects in lowering water temperatures. Four locations are suggested for the mainstem of Spencer Creek and Buck Lake and one each at Miners Creek and Clover Creek.

Macroinvertebrate Bioassessments. Baseline data already exists from three years of sampling at specific sites on Miners Creek and Spencer Creek. This effort should be continued as an effective means for monitoring changes in aquatic health, specifically as it relates to the effects of siltation, imbeddedness of gravels, and water temperature.

The use of Rapid Bioassessment Protocols using aquatic macroinvertebrates can be very informative when addressing long term goals. As a minimum, an annual assessment should be continued to follow progress towards recovery of the system due to changes in management priorities. The use of benthic invertebrate biomonitoring could prove to be useful in evaluating specific restoration projects. The use of biomonitoring in conjunction with selective water quality monitoring using guidance such as MacDonald et al. (1991) should allow cost effective measurements on recovery of the watershed to designated changes in management practices.

Fish Faunal Surveys. Monitoring changes in fish assemblages will be an effective method for monitoring the relative health of cold water habitat for resident and migratory fish populations. Extensive surveys throughout the watershed using a variety of methods such as electroshocking, snorkeling, and trapping are suggested. Relative abundance and presence are the data elements to be evaluated. These surveys should be conducted every 5 to 7 years for a representative sample of stream reaches.

Fish Distribution. The distribution patterns of resident and migratory fish needs to be further refined. Variation in timing and methods of past surveys and variation in environmental conditions from year to year has created a high degree of uncertainty regarding the upper limits of fish populations, especially in the upper watershed. Specifically, use of Miners Creek and Clover Creek by migratory fish needs to be determined. Also, the distribution of resident redband/rainbow trout in the intermittent reaches of Spencer Creek and Clover Creek needs to be determined. Species composition and reproductive information about fish populations in Buck Lake is not known. Much of the information gathering to answer these questions could be accomplished in conjunction with fish faunal surveys as suggested above.

Redband/rainbow trout taxonomy. The taxonomic status of resident trout populations should be resolved to determine whether evolutionary distinct populations exist within the watershed. The relative risk to trout populations can only be evaluated if the extent of the population is well understood. This type of analysis will assist in resolving the broader bioregional uncertainties regarding trout taxonomy.

Connectivity. There was a high degree of uncertainty regarding the frequency and duration of connectivity between Clover Creek and Spencer Creek. It is known that Clover Creek does not connect every year and that when it does connect the duration is often for only a few weeks or less. Historic data are not available to ascertain the effects of past management on the flow regime. It is recommended that this subject be further studied through monitoring of flows and monitoring of restoration efforts. This, in conjunction with fish distribution information will be necessary to implement appropriate riparian buffers for the intermittent portions of Clover Creek.

Chapter 6
Glossary and Bibliography

Glossary

Introduction

Many of the glossary entries below were taken directly from the Forest Ecosystem Management Assessment Team's (FEMAT) report. These entries are indicated with a FEMAT at the end of the entry.

50-11-40 Rule - One of the standards and guidelines of the Interagency Scientific Committee strategy designed to provide dispersal habitat for northern spotted owls on lands outside reserves. Calls for maintaining 50 percent of forested land within each quarter township (9 square miles) in forested condition with stands of trees averaging at least 11 inches diameter at breast height and with a stand canopy closure of at least 40 percent. **FEMAT**

Administratively Withdrawn Areas - Areas removed from the suitable timber base through agency direction and land management plans. **FEMAT**

Alevin - The larval form of salmon and trout.

Animal Unit Month (AUM) - The amount of forage necessary for the sustenance of one cow and calf, or the equivalent, for one month.

Annual plant - A plant that completes its life-cycle and dies in one year or less.

Biological Diversity - The variety of life forms and processes, including a complexity of species, communities, gene pools, and ecological functions. **FEMAT**

Biomass - The total quantity (at any given time) of living organisms of one or more species per unit of space (species biomass), or of all the species in a biotic community (community biomass). **FEMAT**

Candidate Species - Those plants and animals included in Federal Register "Notices of Review" that are being considered by the Fish and Wildlife Service for listing as threatened or endangered. Two categories that are of primary concern: Category 1 - Taxa for which there is substantial information to support proposing the species for listing as threatened or endangered. Listing proposals are either being prepared or have been delayed by higher priority listing work. Category 2 - Taxa information indicates that listing is possibly appropriate. Additional information is being collected. **FEMAT**

Canopy Closure - The degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy as openings in the branches and crowns must be accounted for. **FEMAT**

Carbonaceous Oxidation - See Oxidation.

Climax Community - see Potential Natural Community.

Commercial Thinning - The removal of generally merchantable trees from an even-aged stand, usually to encourage growth of the remaining trees. **FEMAT**

Congressionally Reserved Areas - Areas that require Congressional enactment for their establishment, such as National Parks, Wild and Scenic Rivers, National Recreation Areas, National Monuments, and Wilderness. **FEMAT** (These are also referred to as Congressional Reserves).

Cumulative Effects - Those effects on the environment that result from the incremental effect of the action when added to the past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. **FEMAT**

Debitage - The refuse left after flaking stone tools.

Dendiform - Treelike in form or structure.

Desired Plant Community (DPC) - A plant community that contributes to meeting the management objectives for a given piece of land.

Disturbance - A force that causes significant change in structure and/or composition through natural events such as fire, flood, wind, or earthquake, mortality caused by insect or disease outbreaks, or by human-caused events, e.g., the harvest of forest products. **FEMAT**

Duff Layer - As specifically defined in the FEMAT Report, the layer of loosely compacted debris underlying the litter layer on the forest floor.

Early-Successional Forest - Forest seral stages younger than mature and old-growth age classes.

Eastside - Generally, east of the crest of the Cascade Range.

Ecological Condition (ecological status) - Status of the current plant community on a site compared to the potential natural or climax community.

Ecological Site (ecotype) - A locally adapted plant community that has a distinctive limit of tolerance to environmental factors and is distinctly different than other plant communities that may exist under other environmental parameters.

Effects - Effects, impacts, and consequences, as used in this analysis, are synonymous. Effects may be direct, indirect, or cumulative and may fall in one of these categories: aesthetic, historic, cultural, economic, social, health, or ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems).

Embedding - Degree to which large particles (such as boulders, rubble, and gravel) are surrounded or covered by fine sediment.

Endemic - A species that is unique to a specific locality. **FEMAT**

Ephemeral Streams - Streams that contain running water only sporadically, such as during and following storm events. **FEMAT**

Ethnic: Relating to large groups of people classed according to common traits, customs, and culture.

Even-Aged Management - A silvicultural system which creates forest stands that are primarily of a single age or limited range of ages. Creation of even-aged stands may be accomplished through a clearcut, seed tree, or shelterwood method.

Extirpation - The elimination of a species from a particular area. **FEMAT**

Exotic Plant - A plant species that is not native to the region in which it is found.

Forbs - Any herbaceous plant other than those in the **Gramineae** (grasses), **Cyperaceae** (sedges), and **Juncacea** (rushes) families.

Forest Land - Land that is now, or is capable of becoming, at least 10 percent stocked with forest trees and that has not been developed for nontimber use. **FEMAT**

Forest Types - A classification of forest land based on the tree species presently forming a plurality of basal area stocking or crown cover of live trees.

Forest Watershed - The forested drainage area contributing water, organic matter, dissolved nutrients, and sediments to a lake or stream. **FEMAT**

Fuelbreak - An area of land on which the native vegetation has been removed or modified so that fires burning into it can be controlled more readily. Some fuelbreaks contain firelines which can be quickly widened with hand tools or by burning.

Fuel Loading - The weight of fuel (such as leaves, branches, and other debris) present at a given site; usually expressed in tons per acre. This value generally refers to the fuel that would typically be available for consumption by fire. Fuel loading varies as a result of disturbance (including human activities), the magnitude of that disturbance, the successional stage of the vegetation, and other conditions of the site.

Fuel Profile - The amount and characteristics of live fuel and large woody debris in a given area. The amount is referred to as the fuel loading, while the characteristics include the horizontal and vertical arrangement and continuity of fuels that affect the spread and intensity of fire.

Green Tree Retention - A stand management practice in which live trees as well as snags and large down wood are left as biological legacies within harvest units to provide habitat components over the next management cycle. There are two levels:

> **High level** - A regeneration harvest designed to retain the highest level of trees possible while still providing enough disturbance to allow regeneration and growth of the naturally occurring mixture of tree species. Such harvest should allow for the regeneration of intolerant and tolerant species. Harvest design would also retain cover and structural features necessary to provide foraging and dispersal habitat for mature and old-growth dependant species.
>
> **Low level** - A regeneration harvest designed to retain only enough green trees and other structural components (snag, coarse woody debris, etc.) to result in the development of stands that meet old-growth definitions within 100 to 120 years after harvest entry, considering overstory mortality. **FEMAT**

Herbaceous Vegetation - grasses and forbs as a group; excludes shrubs and trees.

Heterogeneity - The condition or state of being different in kind or nature.

High Intensity Fire - A fire with the capability to be stand replacing or to cause excessive damage to late-successional forest characteristics.

High Severity Fire - A wildfire event with acute ecological impacts; usually, but not always of high intensity. **FEMAT**

Intermittent Stream - Any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two criteria. **FEMAT**

Key Watershed - As defined by National Forest and Bureau of Land Management District fish biologists, a watershed containing (1) habitat for potentially threatened species or stocks of anadromous salmonids or other potentially threatened fish, or (2) greater than 6 square miles with high-quality water and fish habitat. **FEMAT**

Landscape - A heterogenous land area with interacting ecosystems that are repeated in similar form throughout. **FEMAT**

Large-Scale Fire - A very large-sized fire compared to the natural range of fire sizes of the fire regime in the geographic area considered. Fires that greatly exceed the typical fire size are often of high intensity and may cause profound fire effects.

Large Woody Debris (LWD) - Portion of a tree that has fallen or been cut and left in place.

Late-Successional Forests - Forest seral stages that include mature and old-growth age classes.

Late Successional Reserve - A forest in its mature and/or old-growth stages that has been reserved under each option in this report. **FEMAT**

Litter Layer - The loose, relatively undecomposed organic debris on the surface of the forest floor made up typically of leaves, bark, small branches, and other fallen material. **FEMAT**

Log Decomposition Class - Any of five stages of deterioration of logs in the forest. Stages range from essentially sound (class 1) to almost total decomposition (class 5). **FEMAT**

Long-Term Soil Productivity - The capability of soil to sustain inherent, natural growth potential of plants and plant communities over time.

Macrophyte - a macroscopic form of aquatic vegetation (such as vascular aquatic plants).

Managed Late-Successional Areas - Selected harvest areas and managed pair areas. **FEMAT**

Matrix - Federal lands outside of reserves, withdrawn areas, and Managed Late-Successional areas. **FEMAT**

Merchantable Trees, Stands, Timber - Trees or stands that people will buy for the wood they contain. **FEMAT**

Mesic - Pertaining to or adapted to an area that has a balanced supply of water; neither wet nor dry. **FEMAT**

Mitigation measures - Modifications of actions that (1) avoid impacts by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree or magnitude of the action and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or (5) compensate for impacts by replacing or providing substitute resources or environments. **FEMAT**

Monitoring - A process of collecting information to evaluate if objective and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned. **FEMAT**

Multistoried - Forest stands that contain trees of various heights and diameter classes and therefore support foliage at various heights in the vertical profile of the stand. **FEMAT**

Noncommercial Tree Species - Minor conifer and hardwood species whose yields are not reflected in the commercial conifer forest land allowable sale quantity. Some species may be managed and sold under a suitable woodland allowable sale quantity and, therefore, may be commercial as a woodland species. **FEMAT**

Native Plant - A plant species that is part of the original flora of the area in question.

Nitrogenous - See Oxidation.

Nonforest Land - Land developed for nontimber uses or land incapable of being ten percent stocked with forest trees. **FEMAT**

Noxious Species - A plant species that is undesirable because it conflicts, restricts, or otherwise causes problems under the management objectives.

O & C Lands - Public lands granted to the Oregon and California Railroad Company or the Coos Bay Wagon Road Company and subsequently revested to the United States, which are managed by the Bureau of Land Management under the authority of the O&C Lands Act.

Old-Growth Forest - A forest stand usually at least 180-220 years old with moderate to high canopy closure; a multilayered, multispecies canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground. **FEMAT**

Overstory - Trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage. **FEMAT**

Oxidation - combination of a substance with oxygen.

Partial Cutting - Removal of selected trees from a forest stand. **FEMAT**

Passerine Bird - A bird belonging to the order Passerifarmes which consists of perching birds known as the songbirds.

Patch - A small (20-60 acre) part of the forest. This term is often used to indicate a type of clearcutting (patch cuts) associated with the "staggered setting" approach to distributing harvest units across the landscape. **FEMAT**

Perennial Plant - A plant that has a life-cycle of 3 or more years.

Perennial Stream - A stream that typically has running water on a year-round basis. **FEMAT**

Periphyton - Sessile organisms that live attached to surfaces projecting from the bottom in a fresh water aquatic environment.

Plant Community - (also vegetation community) A group of one or more populations of plants in a common spatial arrangement.

Potential Natural Community (PNC) - The biotic community (living organisms) that would become established if all successional sequences were completed without interferences by man under the present environmental conditions. The term PNC is synonymous with climax community.

Precommercial Thinning - The practice of removing some of the trees less than merchantable size from a stand so that remaining trees will grow faster. **FEMAT**

Prescribed Fire - A fire burning within an approved, predefined, and planned prescription. The fire may result from either a planned or natural ignition. When a prescribed fire exceeds the prescription and/or planned perimeter, it may be declared a wildfire.

Proper Functioning Condition (PFC) - Riparian-wetland areas are functioning properly when adequate vegetation, landform, or large woody debris is present to dissipate stream energy associated with high waterflows, thereby reducing erosion and improving water quality; filter sediment, capture bedload, and aid floodplain development; improve flood-water retention and ground-water recharge; develop root masses that stabilize streambanks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity. The functioning condition of riparian-wetland areas is a result of interaction among geology, soil, water, and vegetation.

Quarter-Township - An area approximately 3 miles square containing nine sections of land. **FEMAT**

Range Condition - The current productivity of a particular rangeland relative to what that rangeland is naturally capable of producing.

Record of Decision - A document separate from but associated with an environmental impact statement that states the management decision, identifies all alternatives including both the environmentally preferable and selected alternatives, states whether all practicable means to avoid environmental harm from the selected alternative have been adopted, and if not, why not. **FEMAT**

Reforestation - The natural or artificial restocking of an area with forest trees; most commonly used in reference to artificial stocking. **FEMAT**

Resource Management Plan (RMP) - A land use plan prepared by an agency under current regulations in accordance with the Federal Land Policy and Management Act. **FEMAT**

Rhizomatous Grass - Grass with an underground stem, usually sending out roots and above-ground shoots from the nodes. These type grasses have good soil holding abilities and are typically more desired than non-rhizomatous grasses.

Riparian Area - As specifically defined in the FEMAT Report, a geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplain, woodlands, and all areas within a horizontal distance of approximately 100 feet from the normal line of high water of a stream channel or from the shoreline of a standing body of water.

Riparian Reserves - Designated riparian areas found outside Late-Successional Reserves. **FEMAT**

Riparian Zone - As specifically defined in the FEMAT Report, those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics. Normally used to refer to the zone within which plants grow rooted in the water table of these rivers, streams, lakes, ponds, reservoirs, springs, marshes, seeps, bogs, and wet meadows.

Ripping - The process of breaking up or loosening compacted soil (e.g., skid trails or spur roads) to better assure penetration of roots of young tree seedlings. **FEMAT**

Rotation Grazing - System of pasture utilization using multiple pastures and generally having short periods of grazing use followed by periods of rest for herbage recovery during the same season.

Saprophyte - an organism using dead organic material as food.

Second Growth - Relatively young forests that have developed following a disturbance (e.g., wholesale cutting, serious fire, or insect attack) of the previous old-growth forest. **FEMAT**

Selection Cutting - a method of uneven-aged management involving the harvesting of single trees from stands (single-tree selection) or in groups (group selection) without harvesting the entire stand at any one time. **FEMAT**

Seral Stages - The series of relatively transitory planned communities that develop during ecological succession from bare ground to the climax stage. **FEMAT**

For the Spencer Creek Watershed Analysis, seral stages were divided into the five categories and are defined as follows:

Non-forested - grass, snow, rock, agriculture;

Early-seral - Brush, clearcuts, plantations, and forest stands which have undergone shelterwood or seedtree harvests; seedling and sapling canopy layer is about even or below the brush. The brush still dominates the vegetative canopy layer.

Early-mid-seral - Forest stands dominated by pole (5 to 9 inches in diameter at breast height) sized trees; trees begin to dominate the vegetative canopy layer.

Mid-seral - Forest stands dominated by small (9 to 21 inches in diameter at breast height) and some medium (21 to 32 inches in diameter at breast height) sized trees;

Late-seral - Forest stands dominated by medium (21 to 32 inches in diameter at breast height) and large (greater than 32 inches in diameter at breast height) sized trees.

Shelterwood - A regeneration method under an even-aged silvicultural system. A portion of the mature stand is retained as a source of seed and/or protection during the period of regeneration. The mature stand is removed in two or more cuttings. **FEMAT**

Silvicultural Prescription - A professional plan for controlling the establishment,a composition, constitution and growth of forests. **FEMAT**

Snag - Any standing dead, partially dead, or defective (cull) tree at least 10 inches in diameter at breast height and at least 6 feet tall. A hard snag is composed primarily of sound wood, generally merchantable. A soft snag is composed primarily of wood in advanced stages of decay and deterioration, generally not merchantable. **FEMAT**

Soil Productivity - Capacity or suitability of a soil, for establishment and growth of a specified crop or plant species, primarily through nutrient availability. **FEMAT**

Stand (Tree Stand) - An aggregation of trees occupying a specific area and sufficiently uniform in composition, age, arrangement, and condition so that it is distinguishable from the forest in adjoining areas. **FEMAT**

Stocked/Stocking - The degree an area of land is occupied by trees as measured by basal area or number of trees. **FEMAT**

Structural Diversity - The diversity of forest structure, both vertical and horizontal, that provides for a variety of forest habitats for plants and animals. The variety results from layering or tiering of the canopy and the die-back, death, and ultimate decay of trees. In aquatic habitats, the presence of a variety of structural features such as logs and boulders that create a variety of habitat. **FEMAT**

Subnivean - Situated or occurring under the snow.

Succession - A series of dynamic changes by which one group of organisms succeeds another through stages leading to potential natural community or climax. An example is the development of series of plant communities (called seral stages) following a major disturbance. **FEMAT**

Succession (plant) - The process of vegetative development whereby an area becomes successively occupied by different plant communities of higher ecological order. Secondary succession refers to this process after some disturbance occurs that moves a plant community to an earlier seral stage.

Sympatrically - Temporal and spatial overlap of the ranges of two or more species.

Timber Management - A general term for the directing, managing or controlling of forest crops and stands of trees.

Timber Production - The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use other than for fuelwood. **FEMAT**

Tractive - the act of being pulled (by water).

Trend (aka "range condition trend") - The direction of change in range condition.

Type Converted - The change from one specific, definable plant community to another on the same ecological site.

Use Pattern Mapping - A process that entails traversing a grazing area (allotment or pasture) to obtain a general concept of the patterns of utilization. These patterns are recorded on suitable maps by 6 different zones - no use, slight, light, moderate, heavy, and severe use.

Utilization ("use" or "grazing use")- The proportion of current year's vegetative production that is consumed or destroyed by grazing animals. May refer either to a single species or to the vegetation as a whole.

Vagility - An organisms capability or tendency to become widely dispersed.

Watershed - The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake. **FEMAT**

Watershed Analysis - A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis provides a basis for ecosystem management planning that is applied to watersheds of approximately 20 to 200 square miles. **FEMAT**

Wet Meadows - Areas where grasses predominate. Normally waterlogged within a few inches of the ground surface for a significant period during the year.

Wetlands - Areas that are inundated by surface water or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that require saturated or seasonally saturated soil conditions for growth and reproduction (Executive Order 11990). Wetlands generally include, but are not limited to, swamps, marshes, bogs, and similar area. **FEMAT**

Wilderness - Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation; include at least 5,000 acres or are of sufficient size to make practical their preservation, enjoyment, and use in unimpaired condition; and may contain features of scientific, education, scenic, or historical value as well as ecologic and geologic interest. **FEMAT**

Wildfire - Any wildland fire that does not meet management objectives, thus requiring a fire suppression response. Once declared a wildfire, the fire can no longer be declared a prescribed fire.

Windthrow - A tree or trees uprooted or felled by the wind. **FEMAT**

Woody Debris - See **Large Woody Debris**.

Underburning - Prescribed burning of the forest floor or understory for botanical or wildlife habitat objectives, hazard reduction, or silvicultural objectives. **FEMAT**

Understory - The trees and other woody species growing under the canopies of larger adjacent trees and other woody growth. **FEMAT**

Xeric - low or deficient in moisture.

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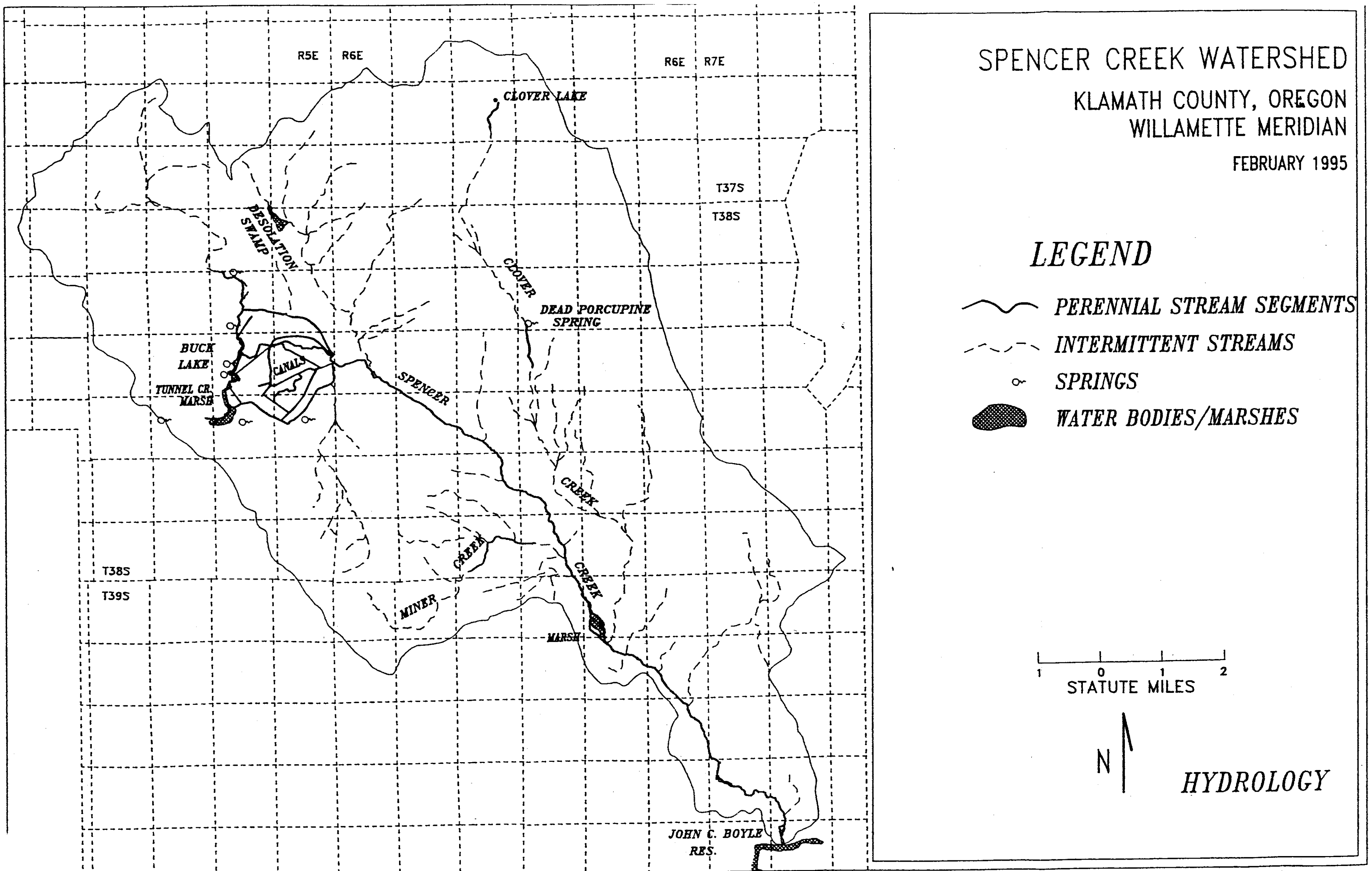
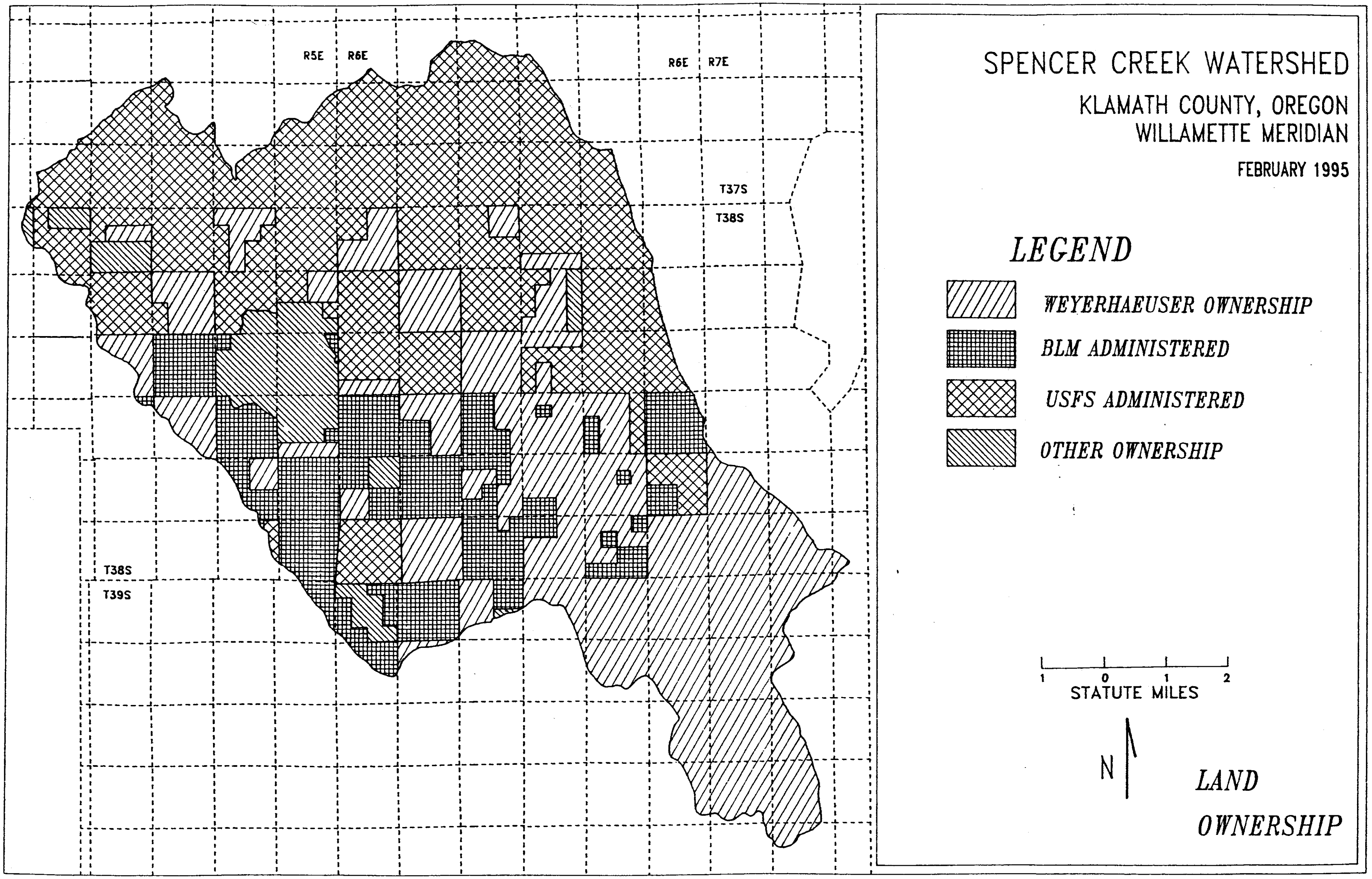
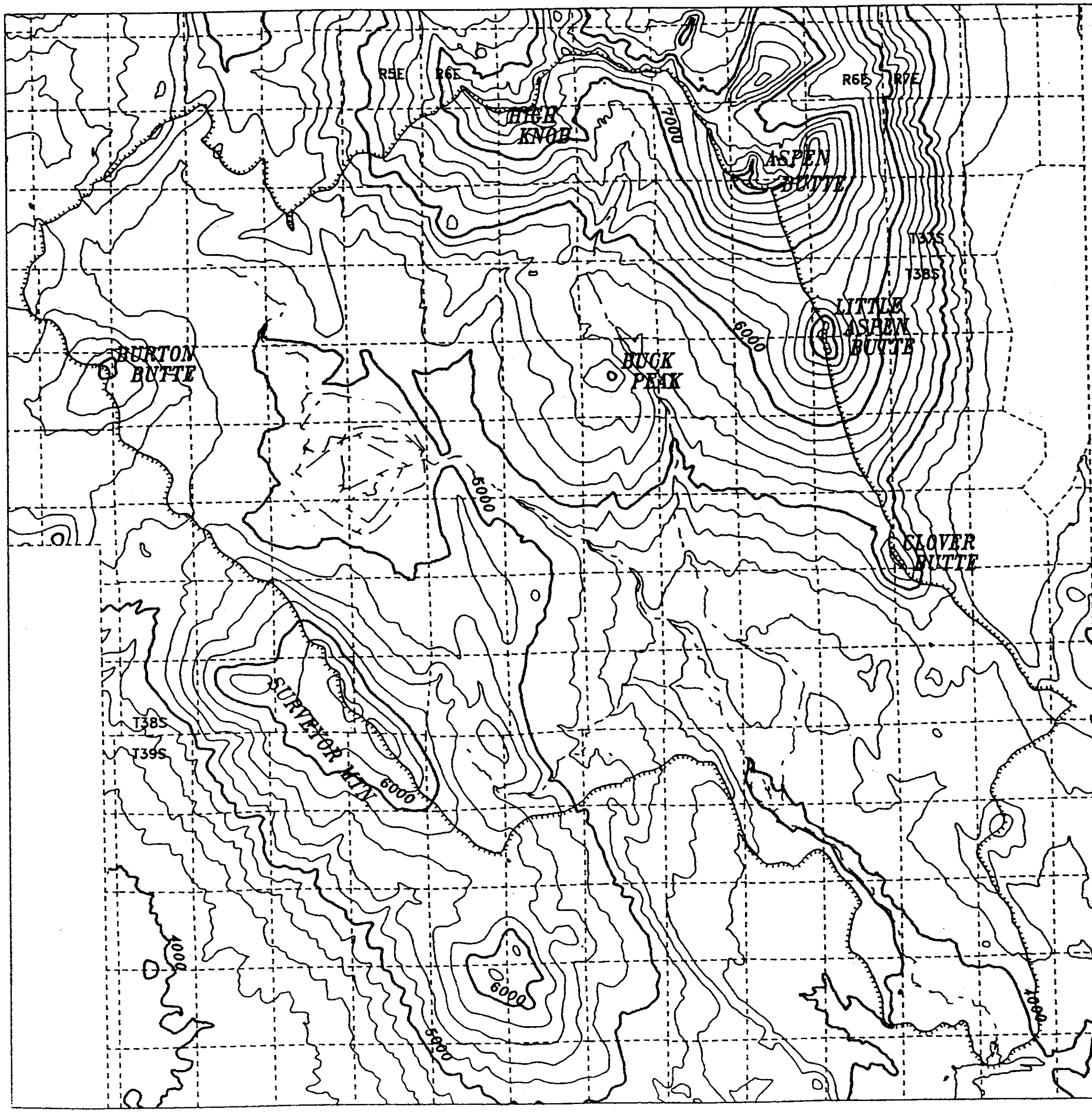

SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
PERENNIAL STREAM SEGMENTS
INTERMITTENT STREAMS
SPRINGS
WATER BODIES/MARSHES
1 0 1 2
STATUTE MILES
N
HYDROLOGY
R5E R6E
R6E R7E
T37S
T38S
T38S
T39S
CLOVER LAKE
DESOLATION SWAMP
CLOVER
DEAD PORCUPINE SPRING
BUCK LAKE
CANALS
TUNNEL CR. MARSH
SPENCER
CREEK
CREEK
MINER
CREEK
MARSH
JOHN C. BOYLE RES.

MAP 2


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
WEYERHAEUSER OWNERSHIP
BLM ADMINISTERED
USFS ADMINISTERED
OTHER OWNERSHIP
1 0 1 2
STATUTE MILES
N
LAND
OWNERSHIP

MAP 3



SPENCER CREEK WATERSHED

KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN

FEBRUARY 1995

LEGEND

WATERSHED BOUNDARY

MAJOR STREAMS

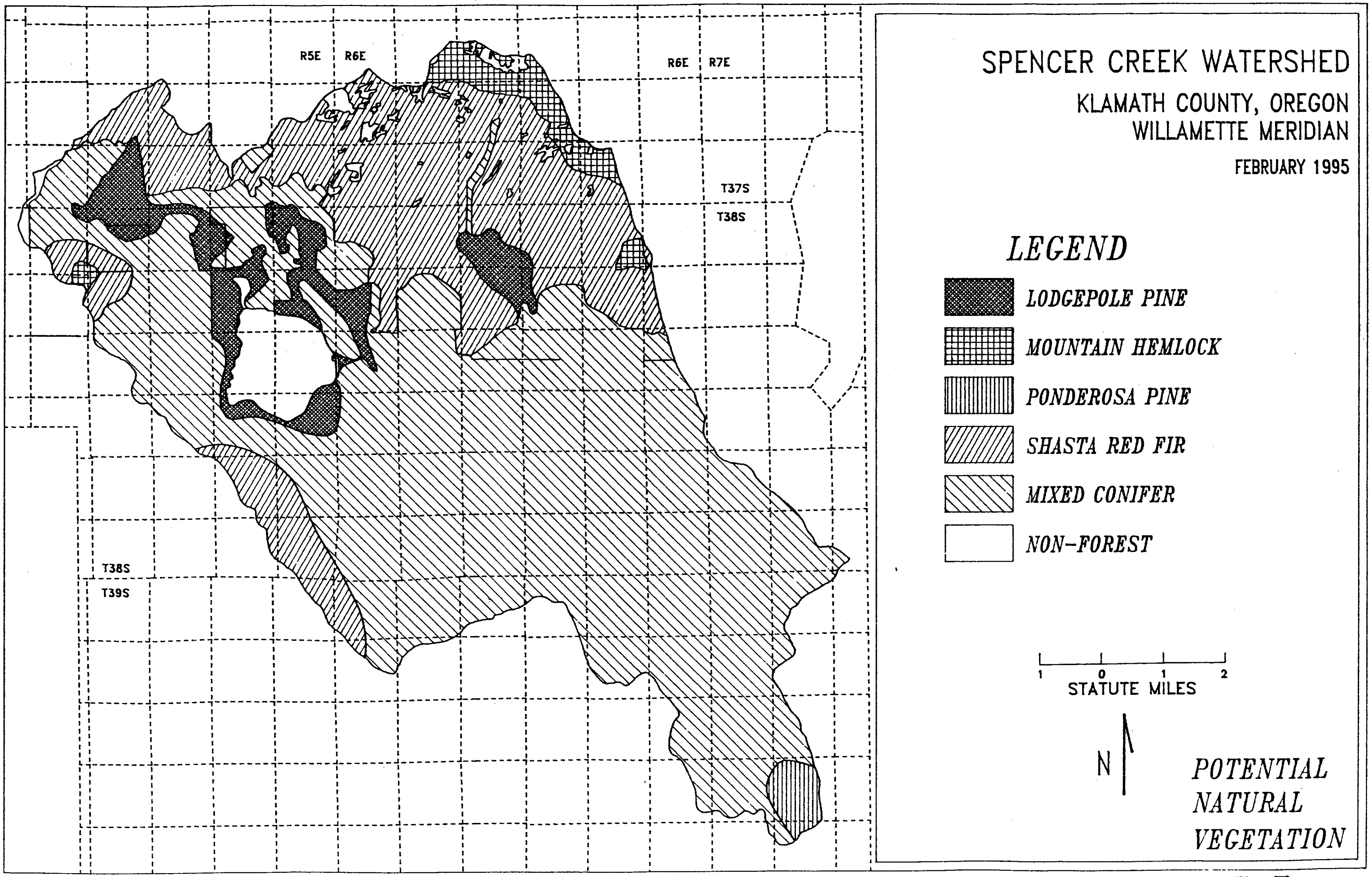
CONTOUR INTERVAL: 200 FT.

1 0 1 2
STATUTE MILES

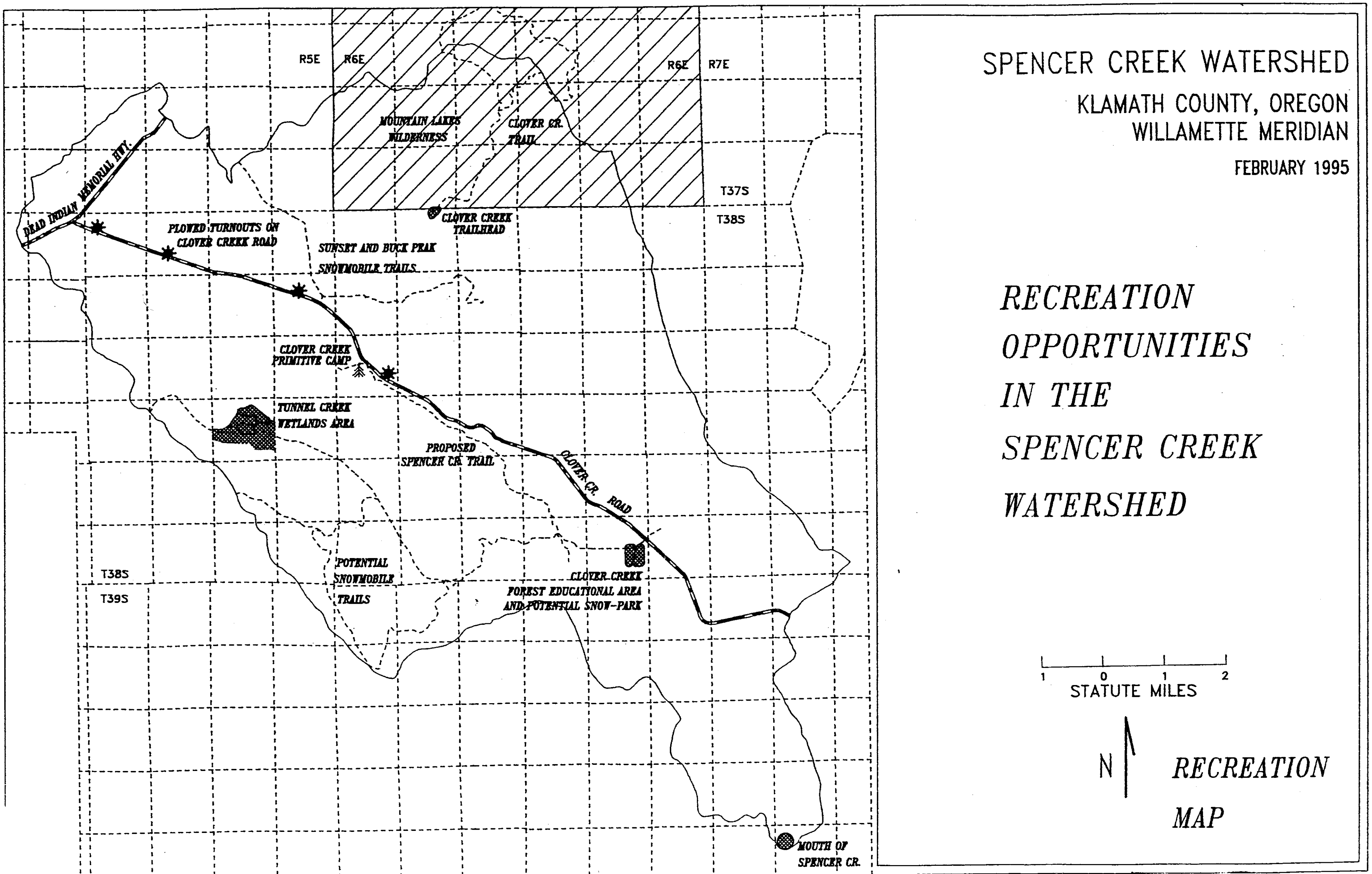
N

TOPOGRAPHY

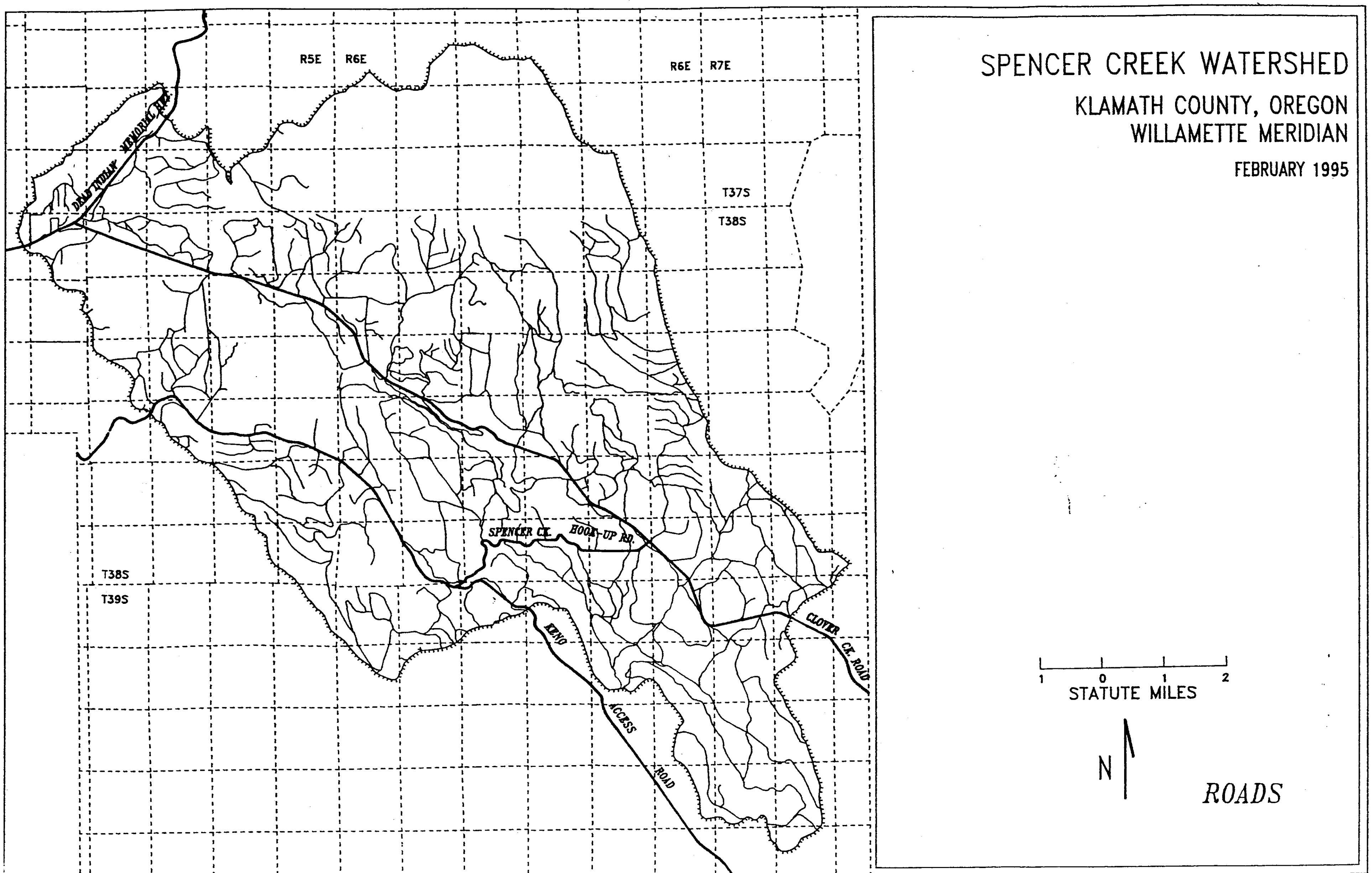
MAP 4


SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
LODGEPOLE PINE
MOUNTAIN HEMLOCK
PONDEROSA PINE
SHASTA RED FIR
MIXED CONIFER
NON-FOREST
1 0 1 2
STATUTE MILES
N
POTENTIAL
NATURAL
VEGETATION
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S

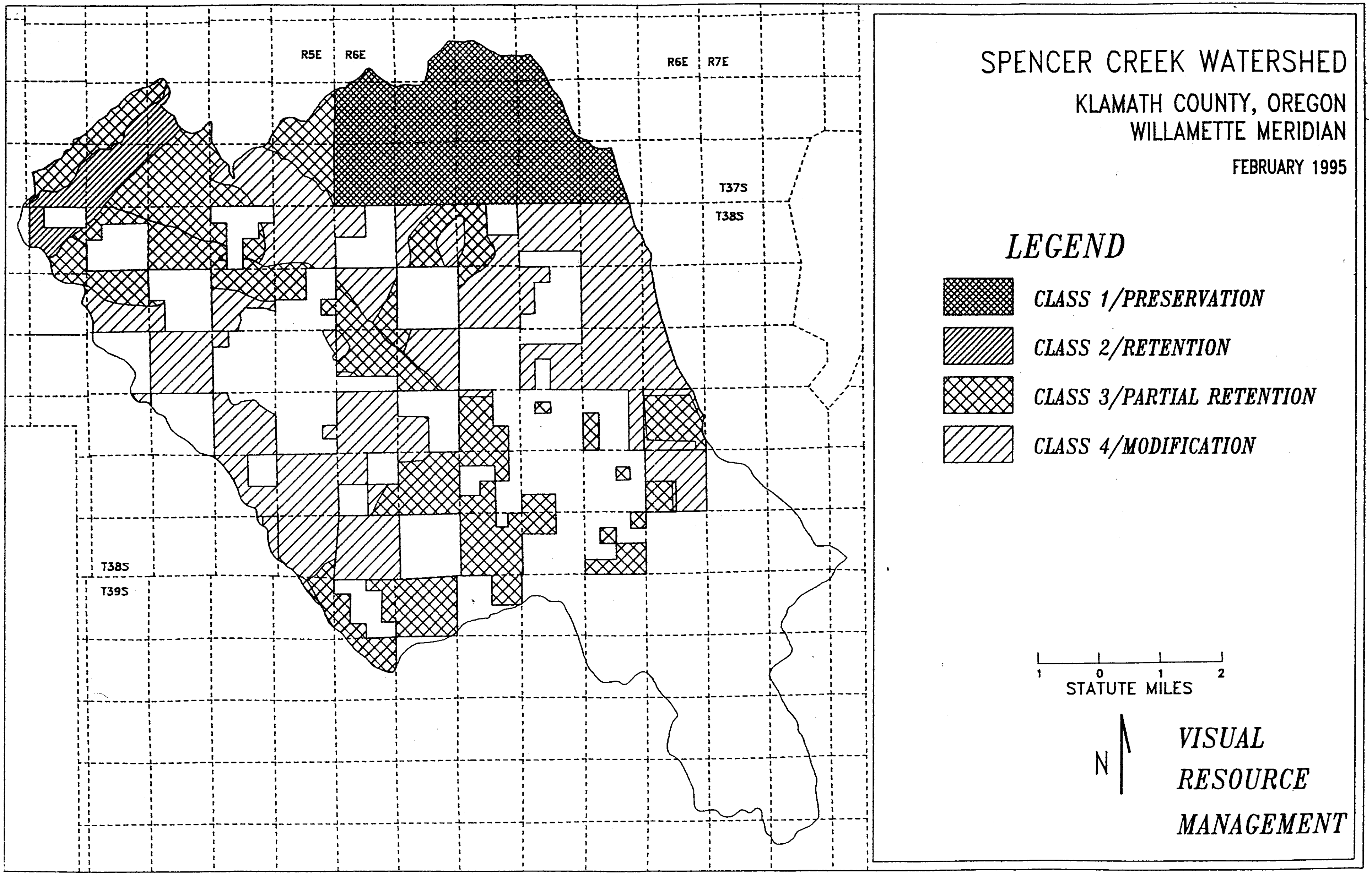
MAP 5


R5E
R6E
R6E
R7E
MOUNTAIN LAKES WILDERNESS
CLOVER CR. TRAIL
T37S
T38S
DEAD INDIAN MEMORIAL HWY.
PLOWED TURNOUTS ON CLOVER CREEK ROAD
CLOVER CREEK TRAILHEAD
SUNSET AND BUCK PEAK SNOWMOBILE TRAILS
CLOVER CREEK PRIMITIVE CAMP
TUNNEL CREEK WETLANDS AREA
PROPOSED SPENCER CR. TRAIL
CLOVER CR. ROAD
POTENTIAL SNOWMOBILE TRAILS
CLOVER CREEK FOREST EDUCATIONAL AREA AND POTENTIAL SNOW-PARK
T38S
T39S
MOUTH OF SPENCER CR.
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
RECREATION OPPORTUNITIES IN THE SPENCER CREEK WATERSHED
1 0 1 2
STATUTE MILES
N
RECREATION MAP

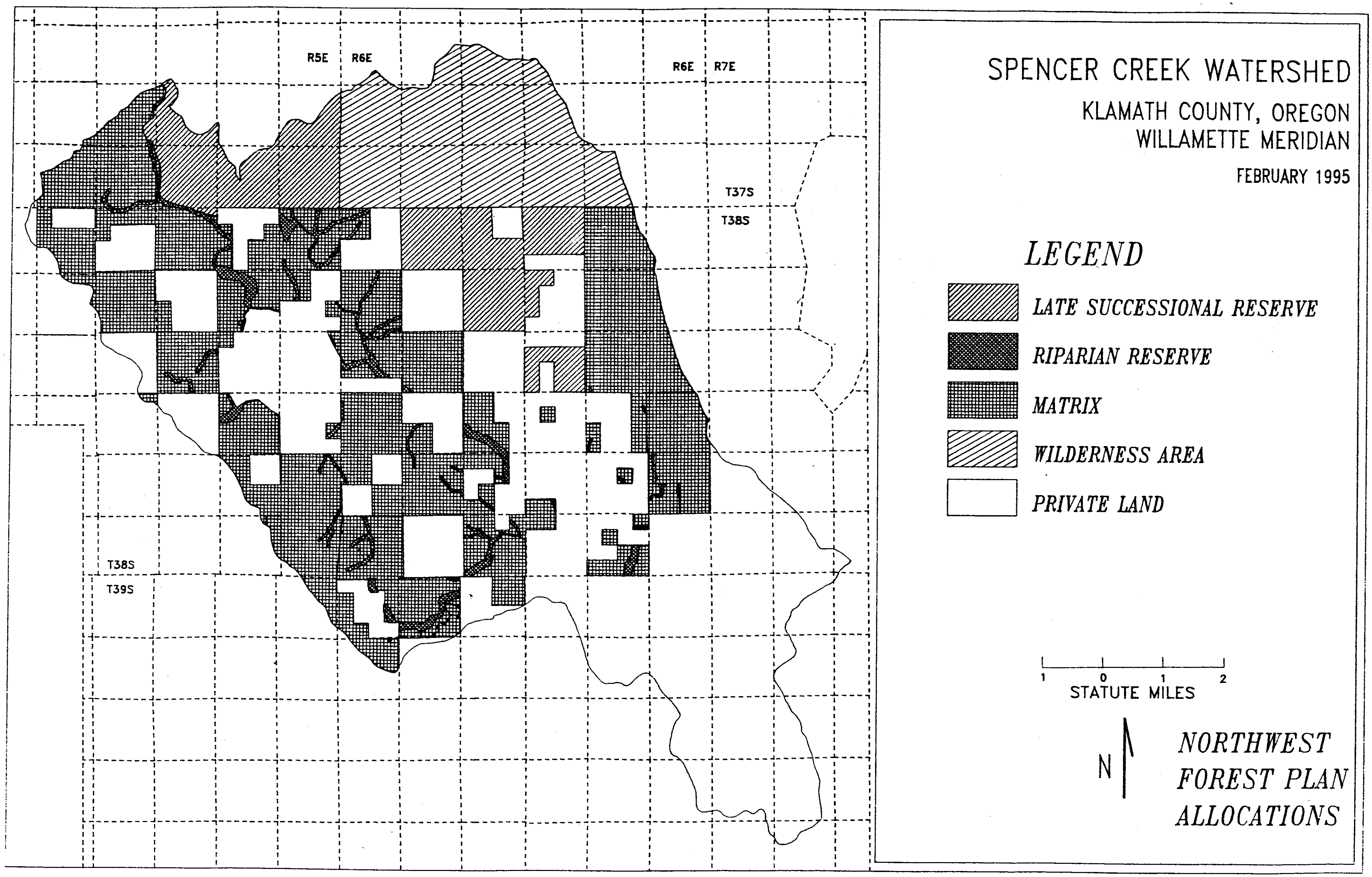
MAP 6


SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
R5E R6E
R6E R7E
T37S
T38S
T38S
T39S
DEAD INDIAN MEMORIAL HWY.
SPENCER CK. HOOK-UP RD.
KENO ACCESS ROAD
CLOVER CK. ROAD
1 0 1 2
STATUTE MILES
N
ROADS

MAP 7

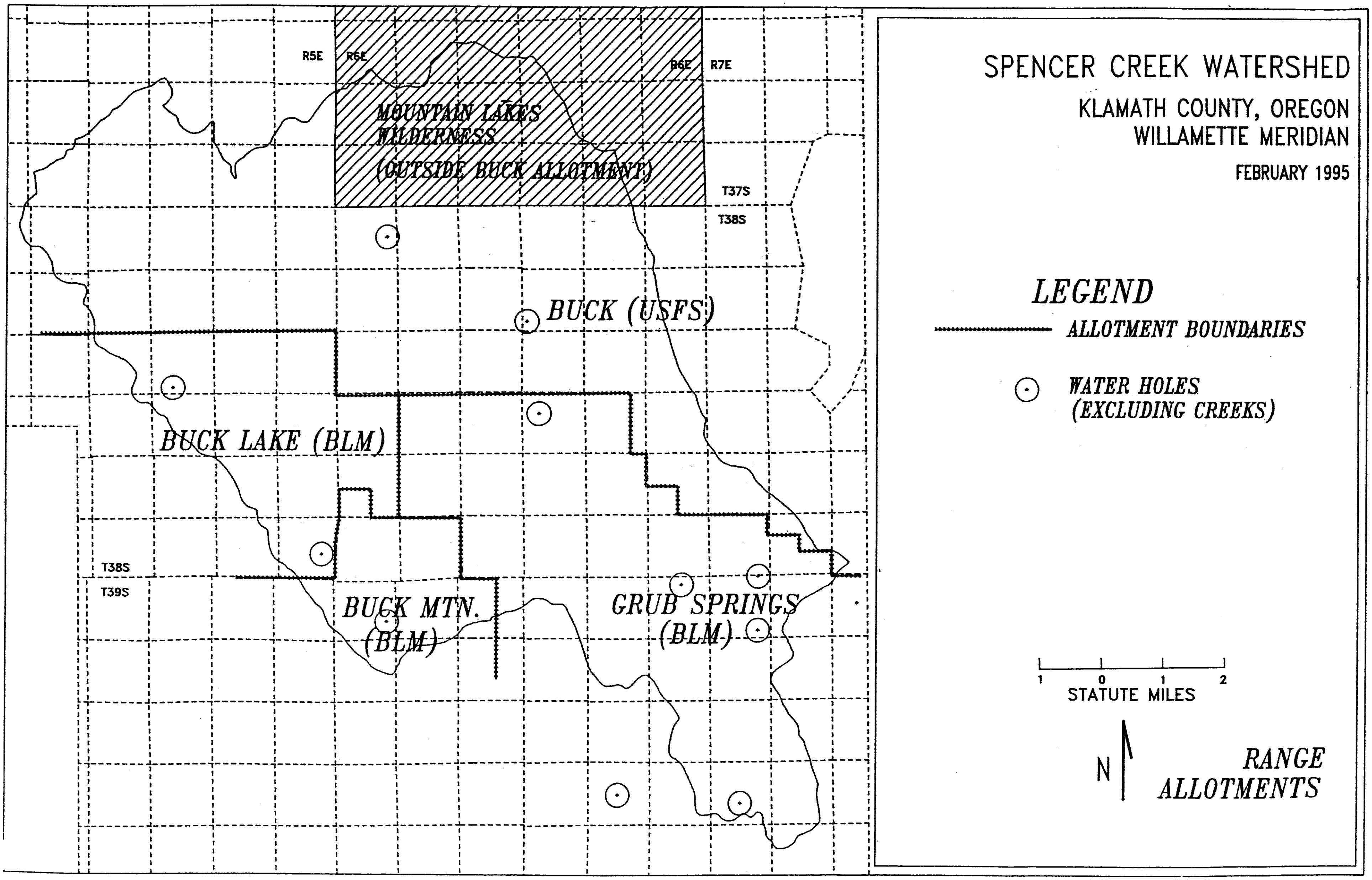

SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
CLASS 1/PRESERVATION
CLASS 2/RETENTION
CLASS 3/PARTIAL RETENTION
CLASS 4/MODIFICATION
1 0 1 2
STATUTE MILES
N
VISUAL
RESOURCE
MANAGEMENT
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S

MAP 8

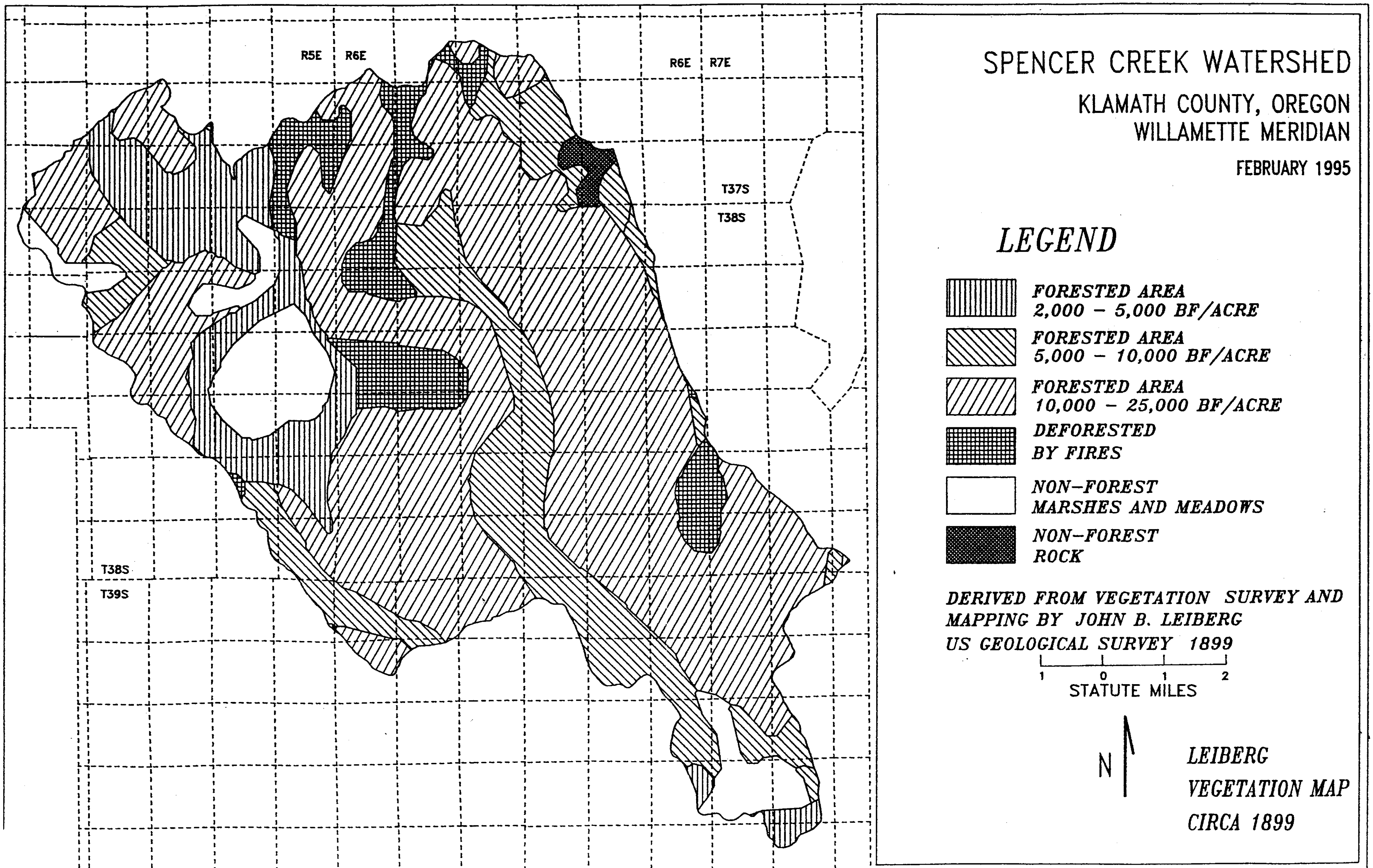


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
LATE SUCCESSIONAL RESERVE
RIPARIAN RESERVE
MATRIX
WILDERNESS AREA
PRIVATE LAND
1 0 1 2
STATUTE MILES
N
NORTHWEST
FOREST PLAN
ALLOCATIONS

MAP 9

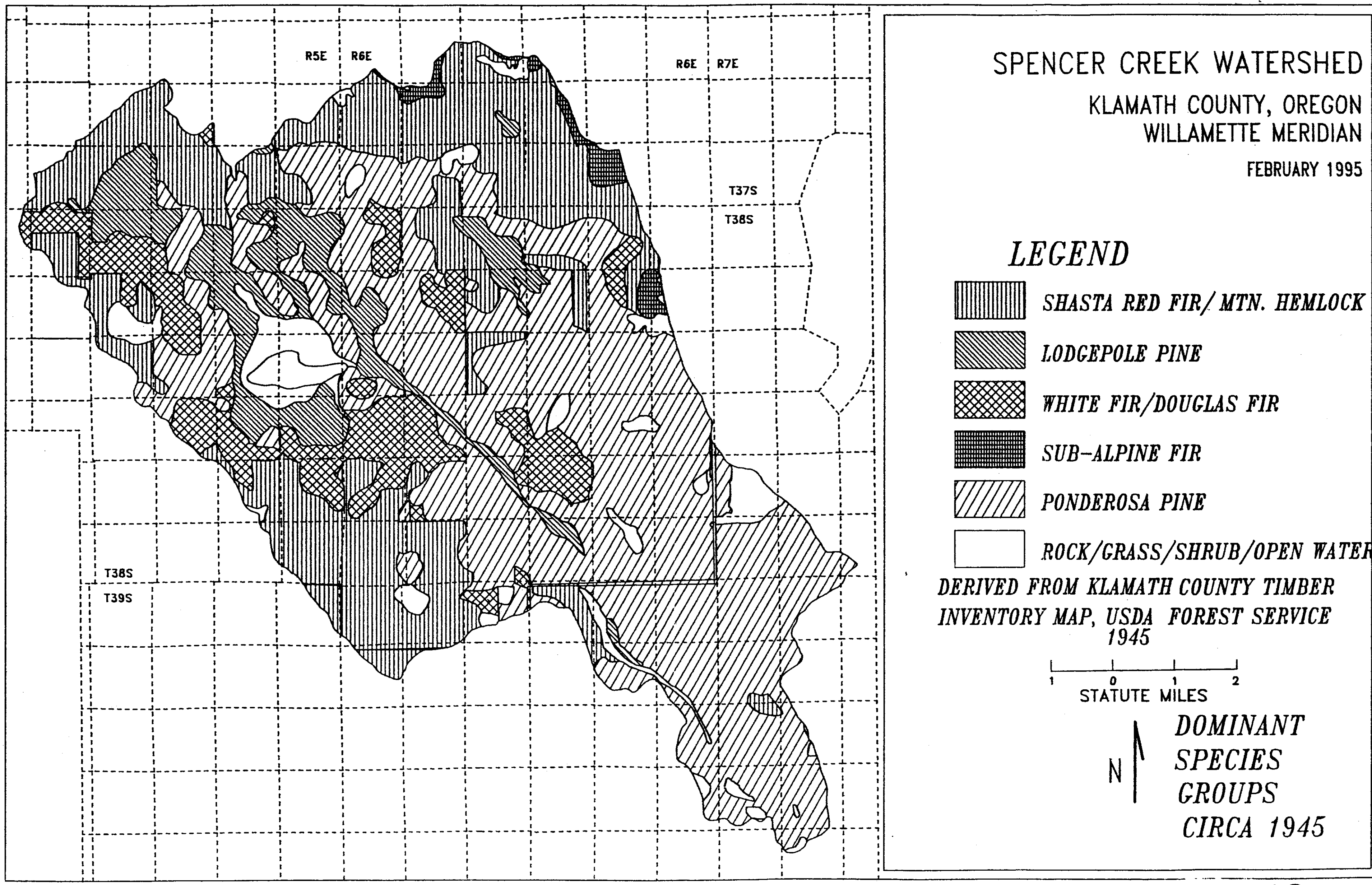

SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
ALLOTMENT BOUNDARIES
WATER HOLES
(EXCLUDING CREEKS)
1 0 1 2
STATUTE MILES
N
RANGE
ALLOTMENTS
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
MOUNTAIN LAKES
WILDERNESS
(OUTSIDE BUCK ALLOTMENT)
BUCK (USFS)
BUCK LAKE (BLM)
BUCK MTN.
(BLM)
GRUB SPRINGS
(BLM)

MAP 10

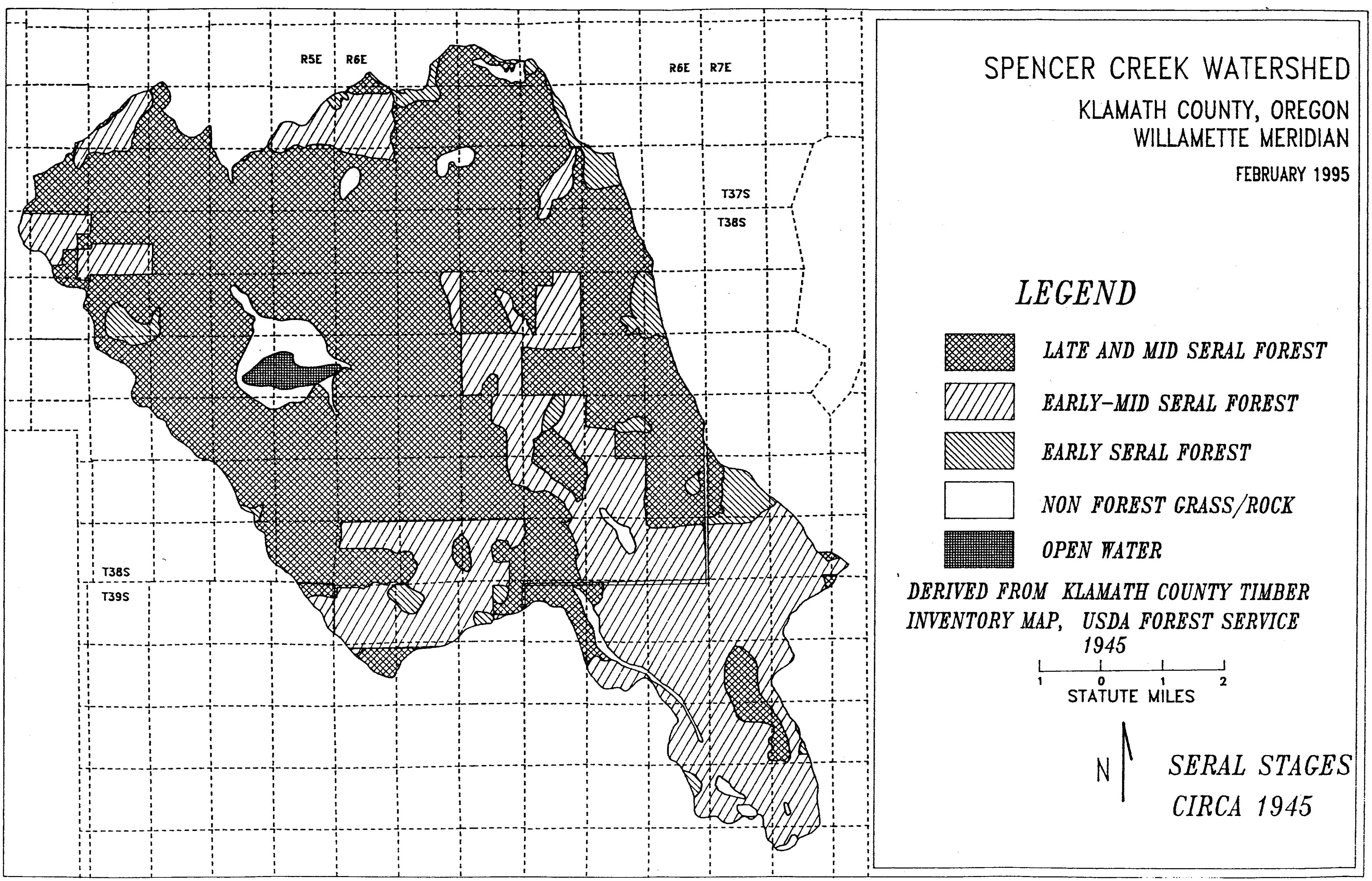


SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
FORESTED AREA 2,000 – 5,000 BF/ACRE
FORESTED AREA 5,000 – 10,000 BF/ACRE
FORESTED AREA 10,000 – 25,000 BF/ACRE
DEFORESTED BY FIRES
NON-FOREST MARSHES AND MEADOWS
NON-FOREST ROCK
DERIVED FROM VEGETATION SURVEY AND
MAPPING BY JOHN B. LEIBERG
US GEOLOGICAL SURVEY 1899
1 0 1 2
STATUTE MILES
N
LEIBERG
VEGETATION MAP
CIRCA 1899
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S

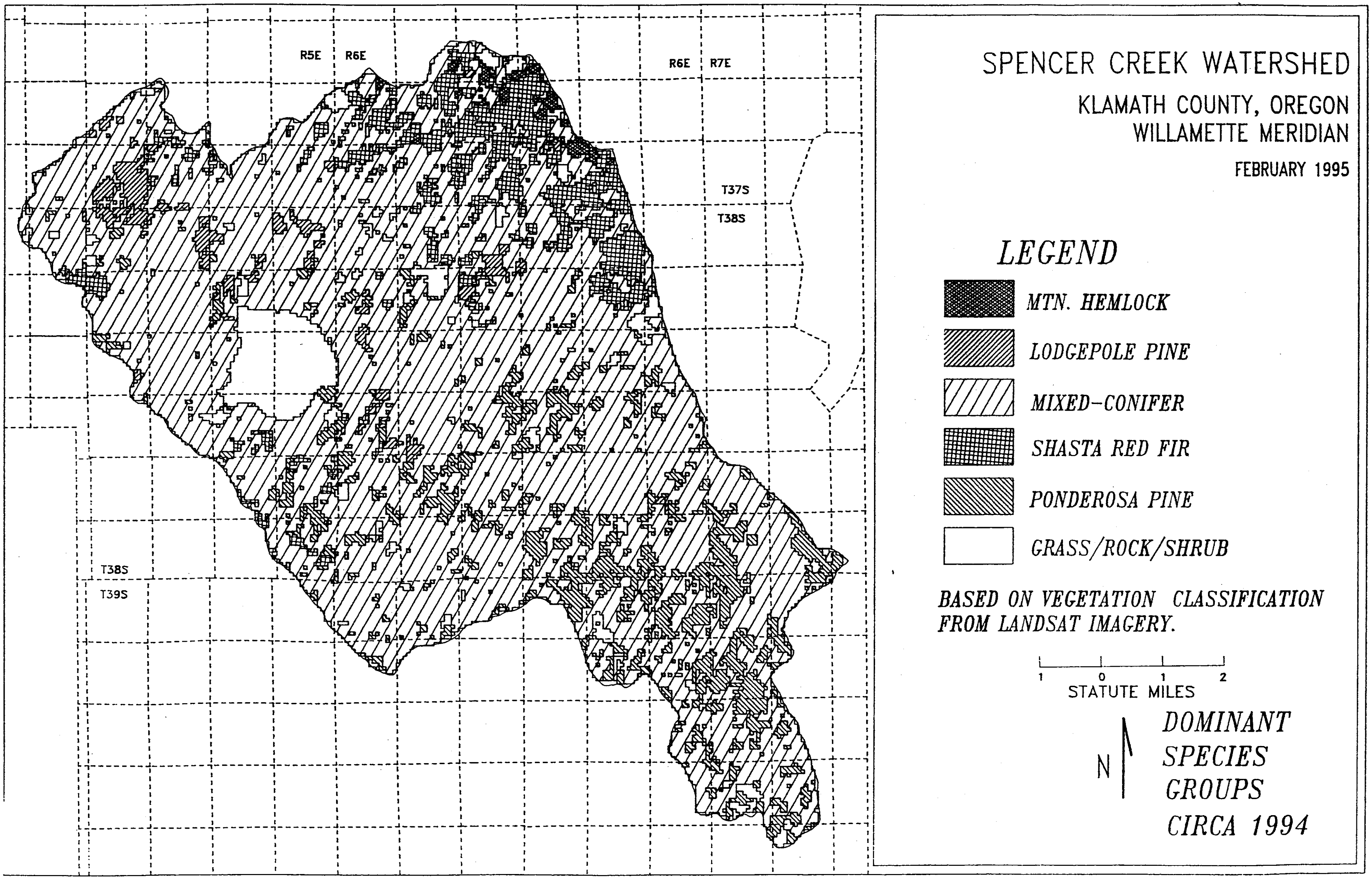
MAP 11


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
SHASTA RED FIR/ MTN. HEMLOCK
LODGEPOLE PINE
WHITE FIR/DOUGLAS FIR
SUB-ALPINE FIR
PONDEROSA PINE
ROCK/GRASS/SHRUB/OPEN WATER
DERIVED FROM KLAMATH COUNTY TIMBER INVENTORY MAP, USDA FOREST SERVICE 1945
1 0 1 2
STATUTE MILES
N
DOMINANT SPECIES GROUPS CIRCA 1945

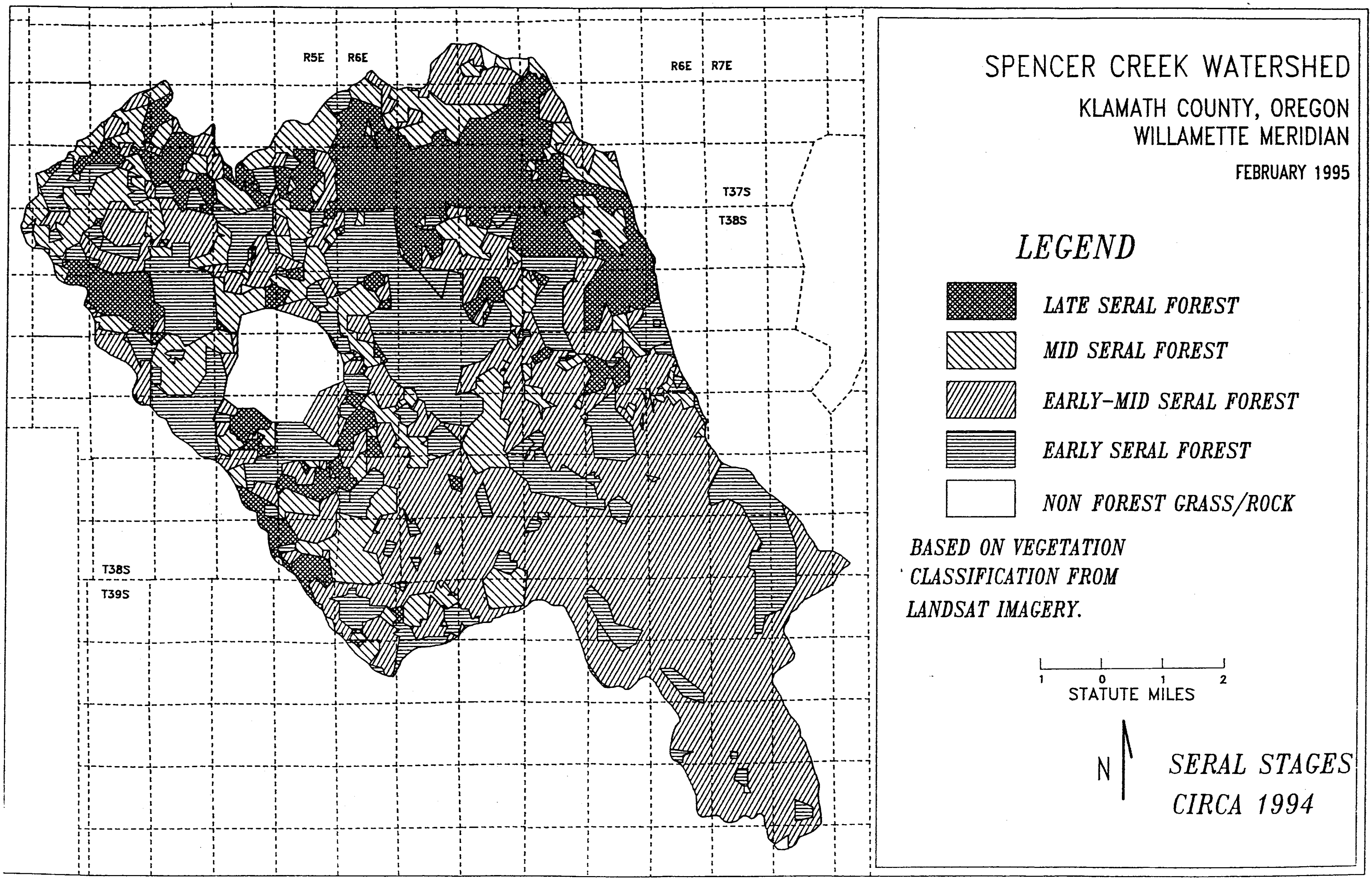
MAP 12


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
LATE AND MID SERAL FOREST
EARLY-MID SERAL FOREST
EARLY SERAL FOREST
NON FOREST GRASS/ROCK
OPEN WATER
DERIVED FROM KLAMATH COUNTY TIMBER INVENTORY MAP, USDA FOREST SERVICE 1945
1 0 1 2
STATUTE MILES
N
SERAL STAGES
CIRCA 1945

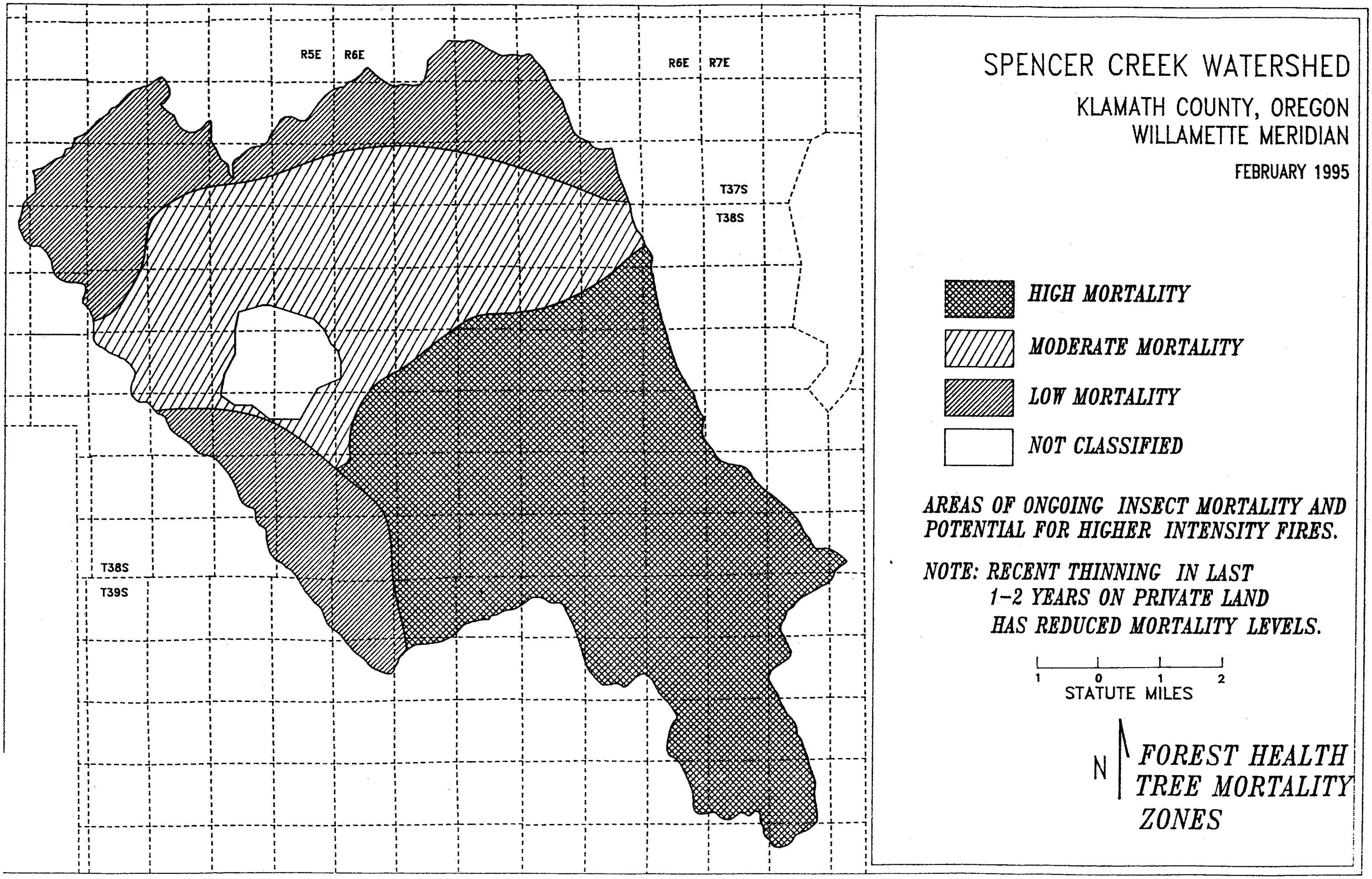
MAP 13


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
MTN. HEMLOCK
LODGEPOLE PINE
MIXED-CONIFER
SHASTA RED FIR
PONDEROSA PINE
GRASS/ROCK/SHRUB
BASED ON VEGETATION CLASSIFICATION FROM LANDSAT IMAGERY.
1 0 1 2
STATUTE MILES
N
DOMINANT SPECIES GROUPS CIRCA 1994

MAP 14

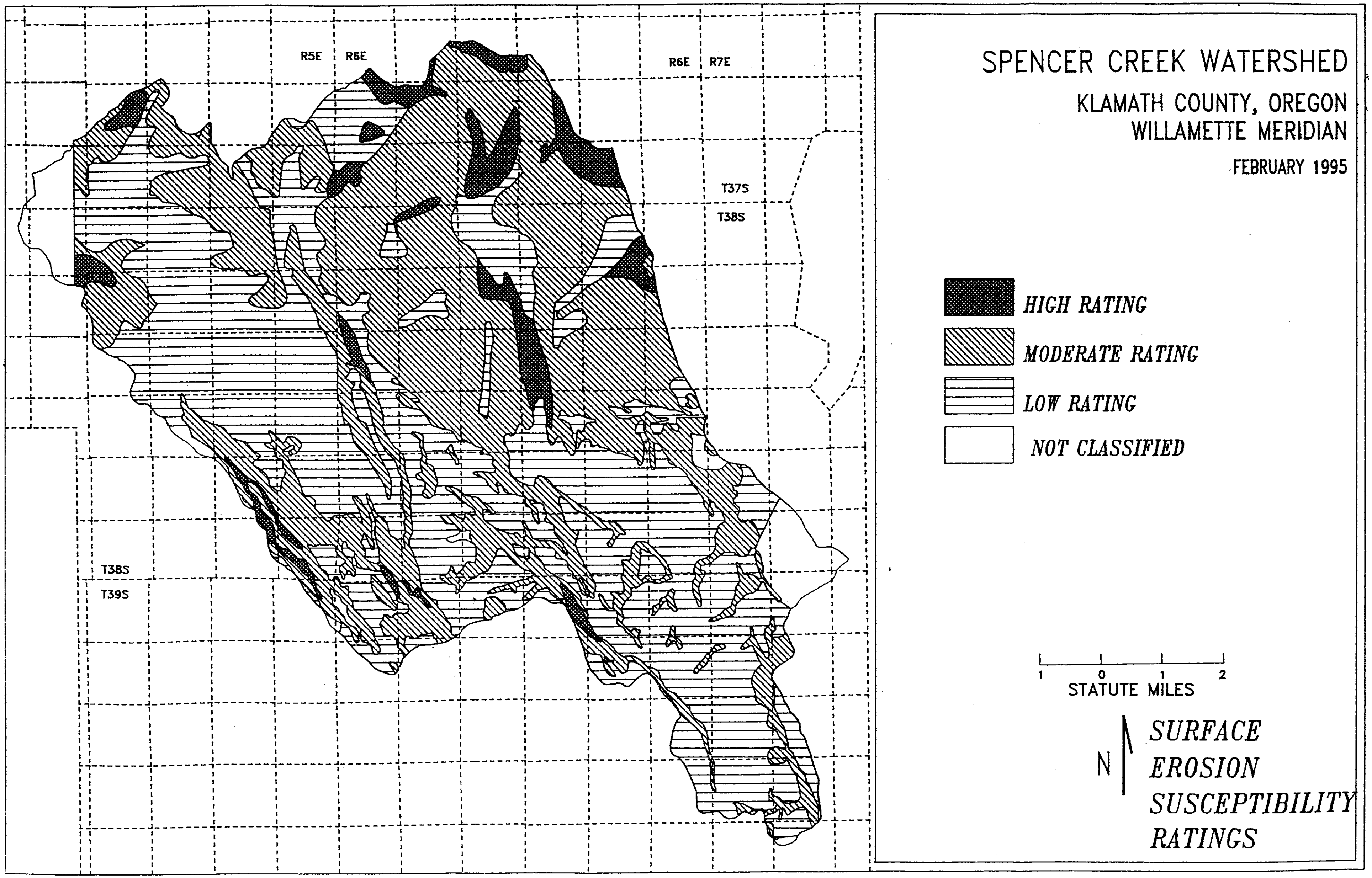

R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
LATE SERAL FOREST
MID SERAL FOREST
EARLY-MID SERAL FOREST
EARLY SERAL FOREST
NON FOREST GRASS/ROCK
BASED ON VEGETATION
CLASSIFICATION FROM
LANDSAT IMAGERY.
1 0 1 2
STATUTE MILES
N
SERAL STAGES
CIRCA 1994

MAP 15



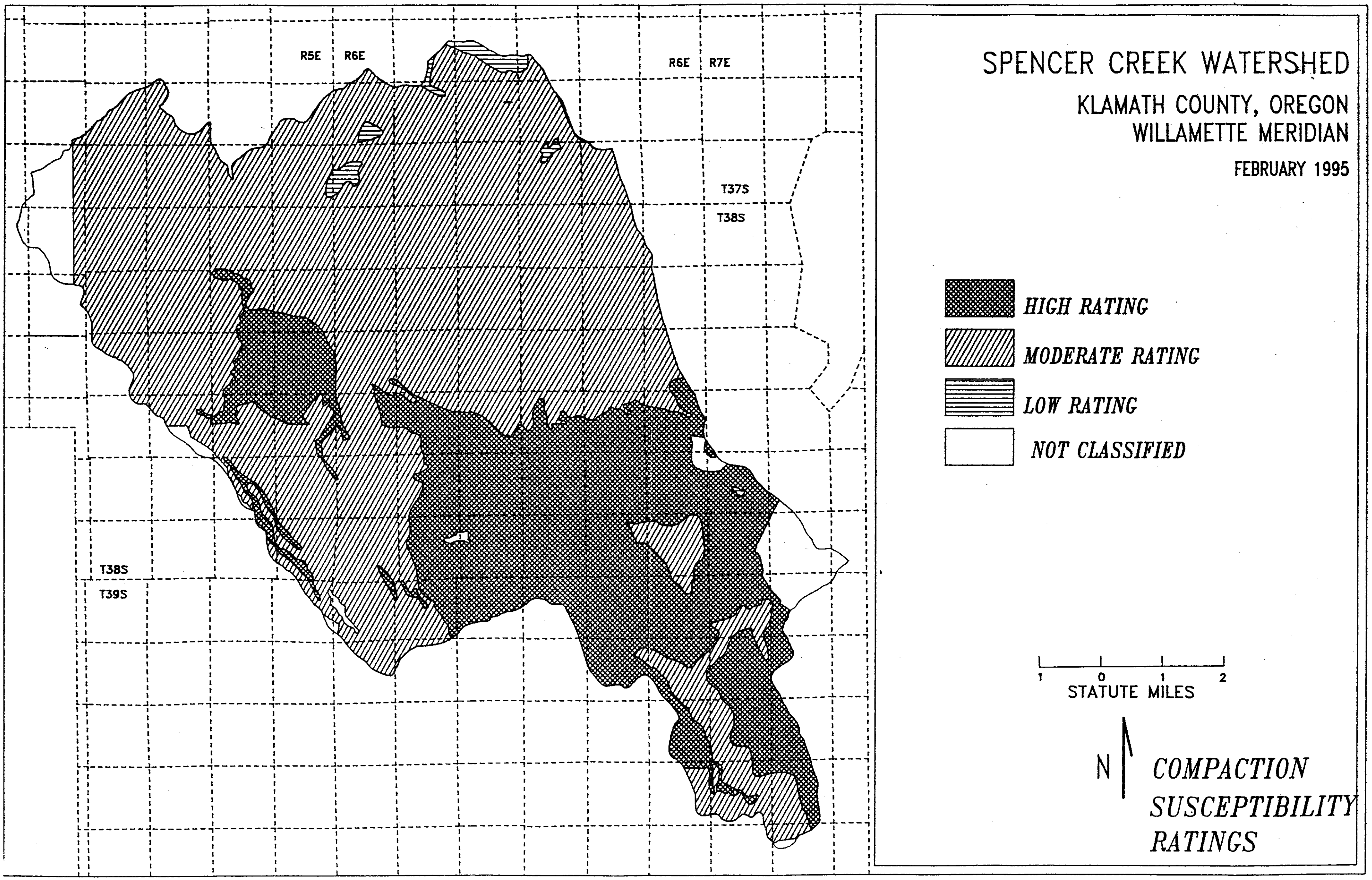
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
HIGH MORTALITY
MODERATE MORTALITY
LOW MORTALITY
NOT CLASSIFIED
AREAS OF ONGOING INSECT MORTALITY AND POTENTIAL FOR HIGHER INTENSITY FIRES.
NOTE: RECENT THINNING IN LAST 1-2 YEARS ON PRIVATE LAND HAS REDUCED MORTALITY LEVELS.
1 0 1 2
STATUTE MILES
N
FOREST HEALTH
TREE MORTALITY
ZONES

MAP 16

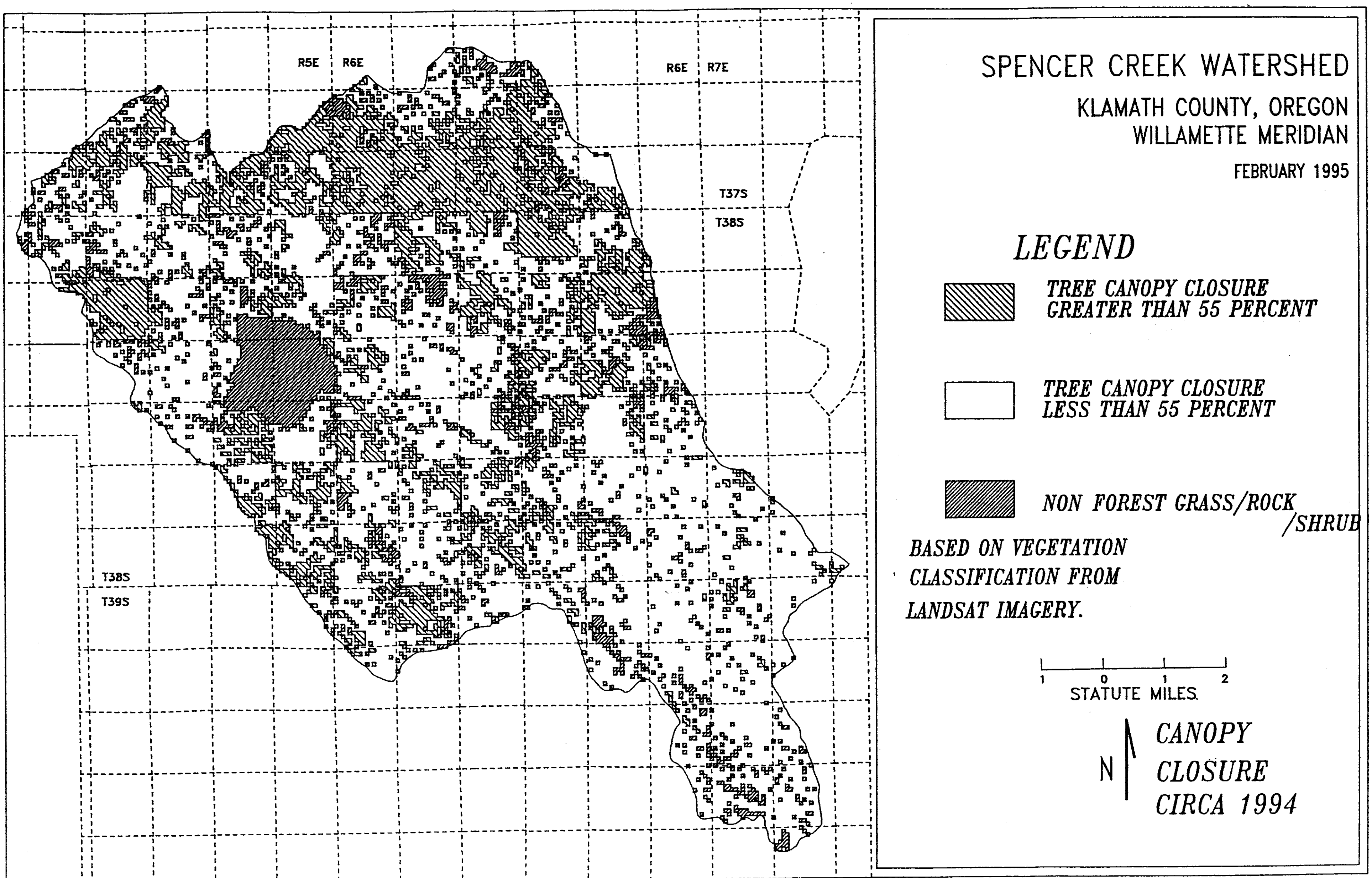


SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
HIGH RATING
MODERATE RATING
LOW RATING
NOT CLASSIFIED
1 0 1 2
STATUTE MILES
N
SURFACE EROSION SUSCEPTIBILITY RATINGS
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S

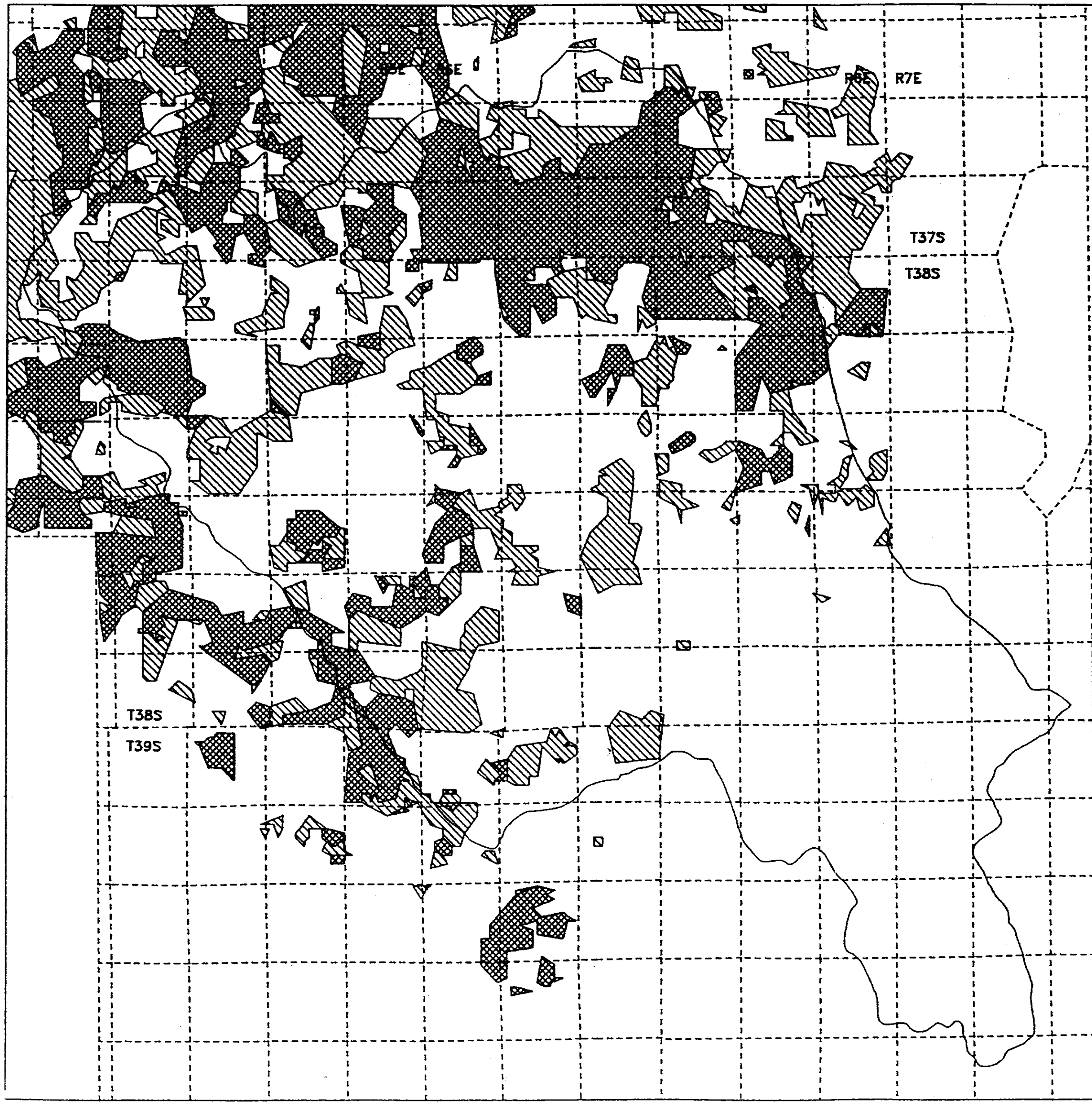
MAP 17


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
HIGH RATING
MODERATE RATING
LOW RATING
NOT CLASSIFIED
1 0 1 2
STATUTE MILES
N
COMPACTION
SUSCEPTIBILITY
RATINGS

MAP 18


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
TREE CANOPY CLOSURE GREATER THAN 55 PERCENT
TREE CANOPY CLOSURE LESS THAN 55 PERCENT
NON FOREST GRASS/ROCK/SHRUB
BASED ON VEGETATION CLASSIFICATION FROM LANDSAT IMAGERY.
1 0 1 2
STATUTE MILES
N
CANOPY CLOSURE CIRCA 1994

MAP 19



SPENCER CREEK WATERSHED

KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN

FEBRUARY 1995

LEGEND

LATE SERAL FOREST

MID SERAL FOREST

MID AND LATE SERAL STAGES IN SPENCER CREEK WATERSHED AND IMMEDIATE VICINITY

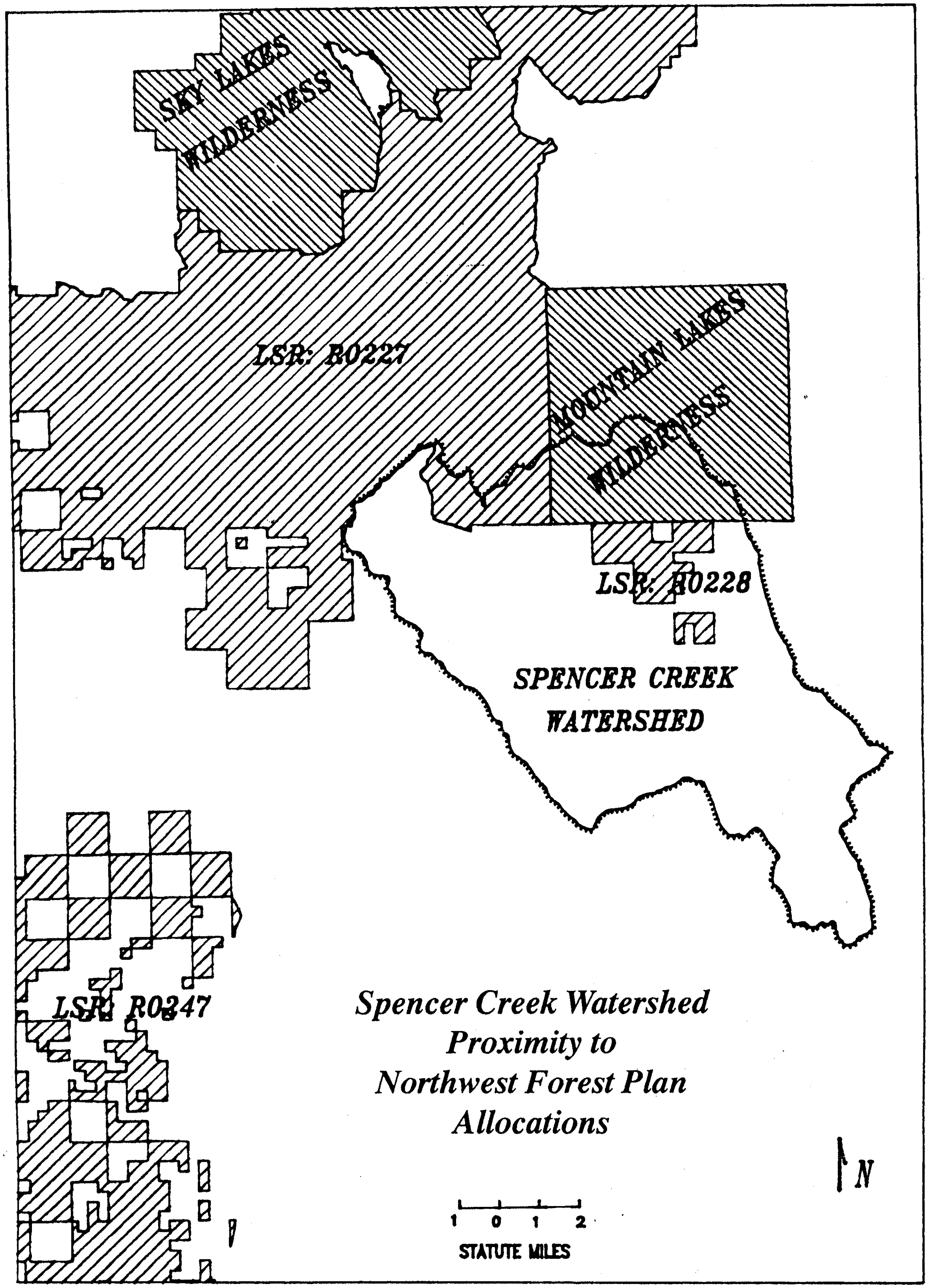
BASED ON VEGETATION CLASSIFICATION FROM LANDSAT IMAGERY.

1 0 1 2
STATUTE MILES

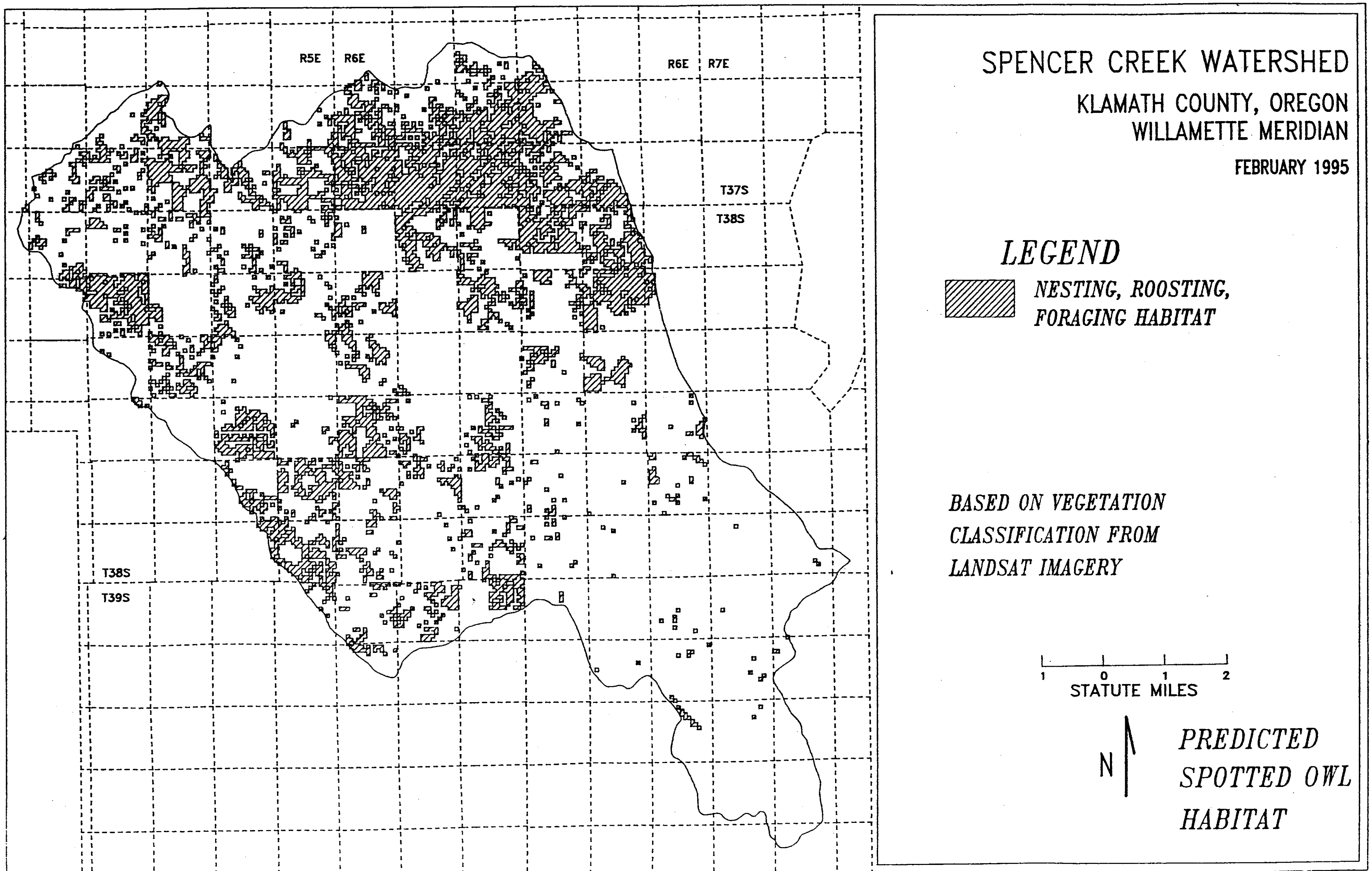
N

MID AND LATE SERAL STAGES CIRCA 1994

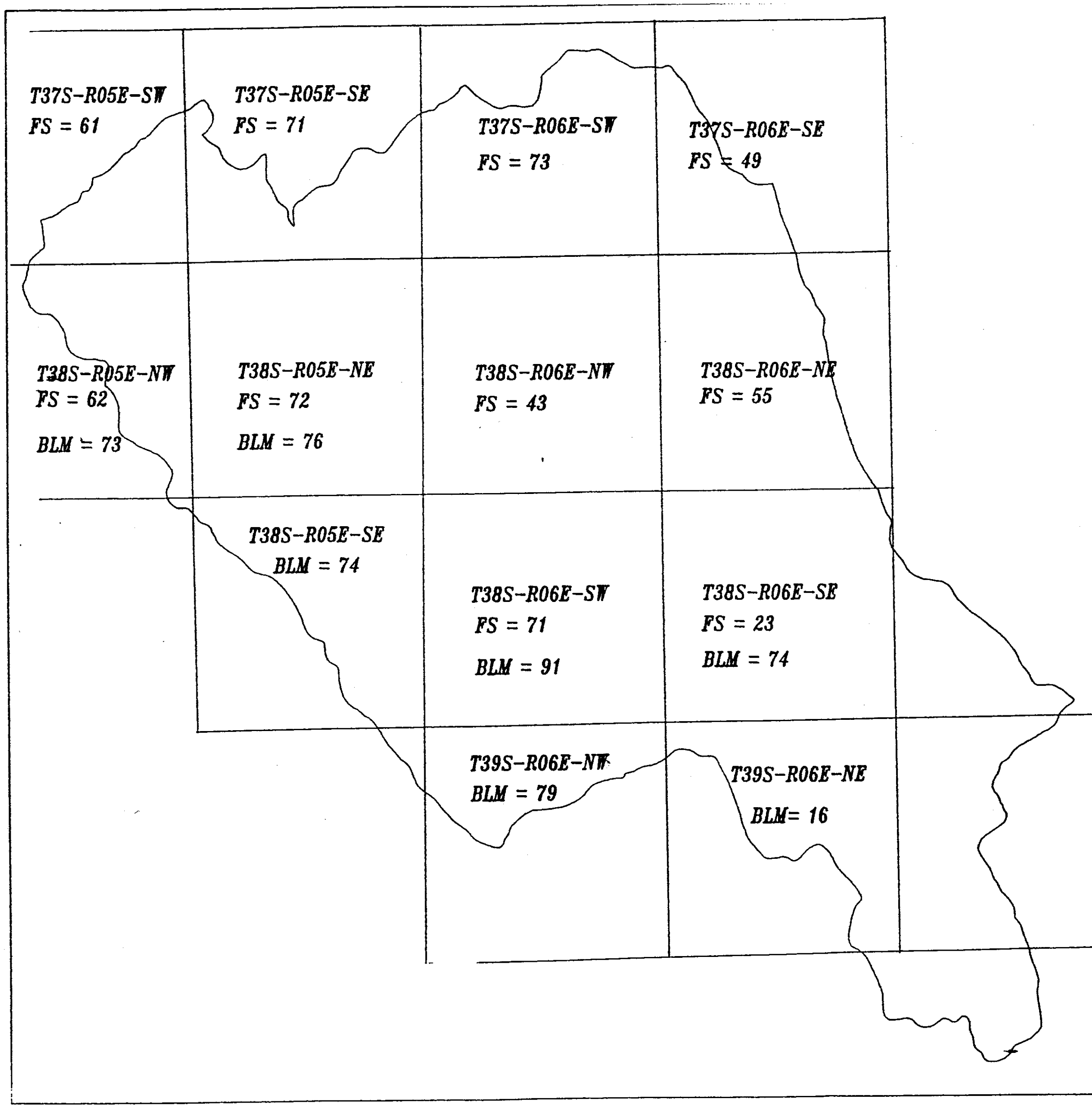
MAP 20


SKY LAKES
WILDERNESS
LSR: R0227
MOUNTAIN LAKES
WILDERNESS
LSR: R0228
SPENCER CREEK
WATERSHED
LSR: R0347
Spencer Creek Watershed
Proximity to
Northwest Forest Plan
Allocations
N
1 0 1 2
STATUTE MILES

MAP 21


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
NESTING, ROOSTING, FORAGING HABITAT
BASED ON VEGETATION CLASSIFICATION FROM LANDSAT IMAGERY
1 0 1 2
STATUTE MILES
N
PREDICTED SPOTTED OWL HABITAT

MAP 22



SPENCER CREEK WATERSHED

KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN

FEBRUARY 1995

PERCENT OF FEDERAL LANDS MEETING NORTHERN SPOTTED OWL DISPERSAL HABITAT REQUIREMENTS BY QUARTER TOWNSHIP

FS = U.S. FOREST SERVICE

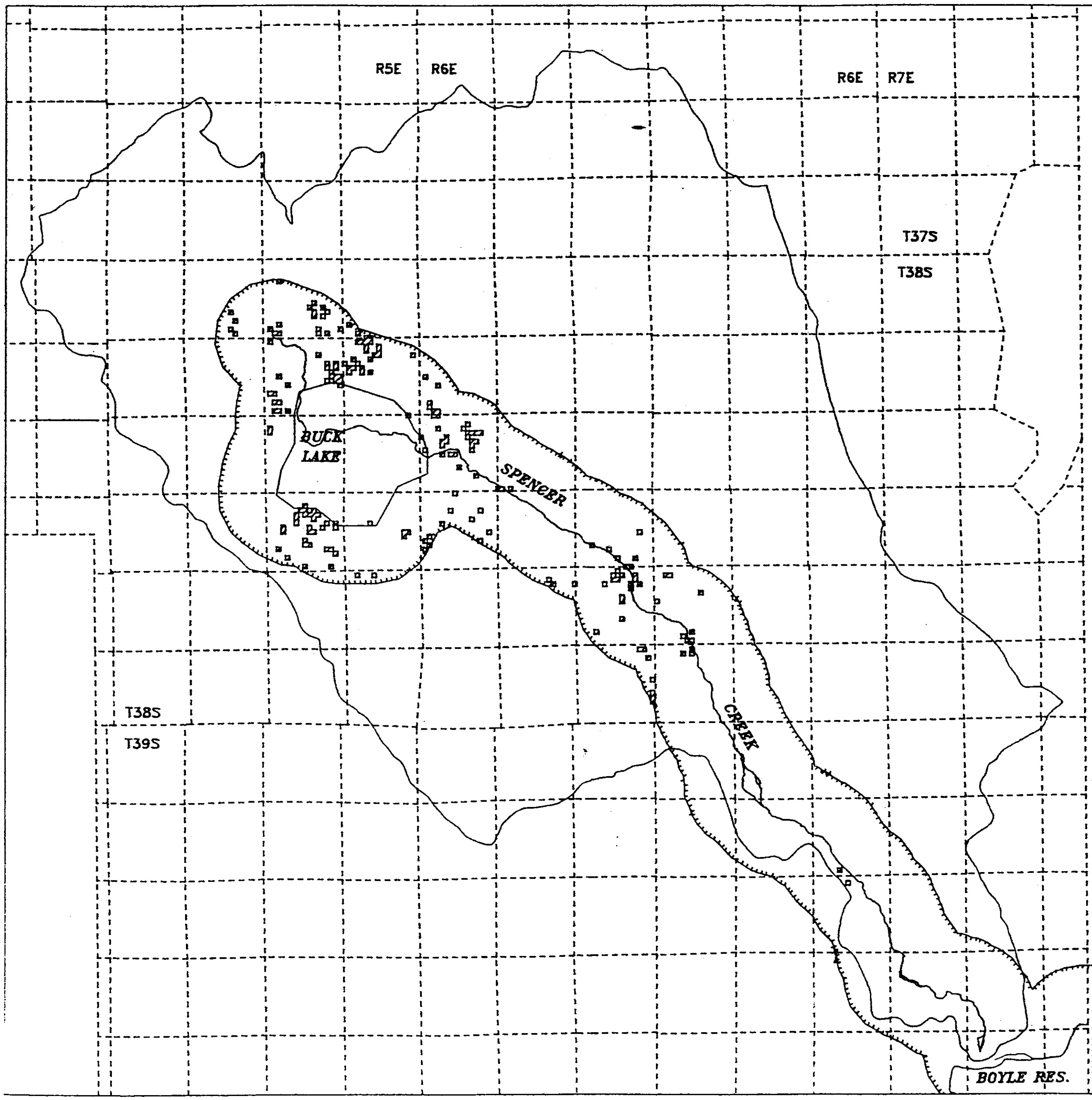
BLM = BUREAU OF LAND MANAGEMENT

1 0 1 2
STATUTE MILES

N

SPOTTED OWL DISPERSAL HABITAT

MAP 23



SPENCER CREEK WATERSHED

KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN

FEBRUARY 1995

LEGEND

SUITABLE NESTING HABITAT

AREA WITHIN .75 MILE OF OPEN WATER

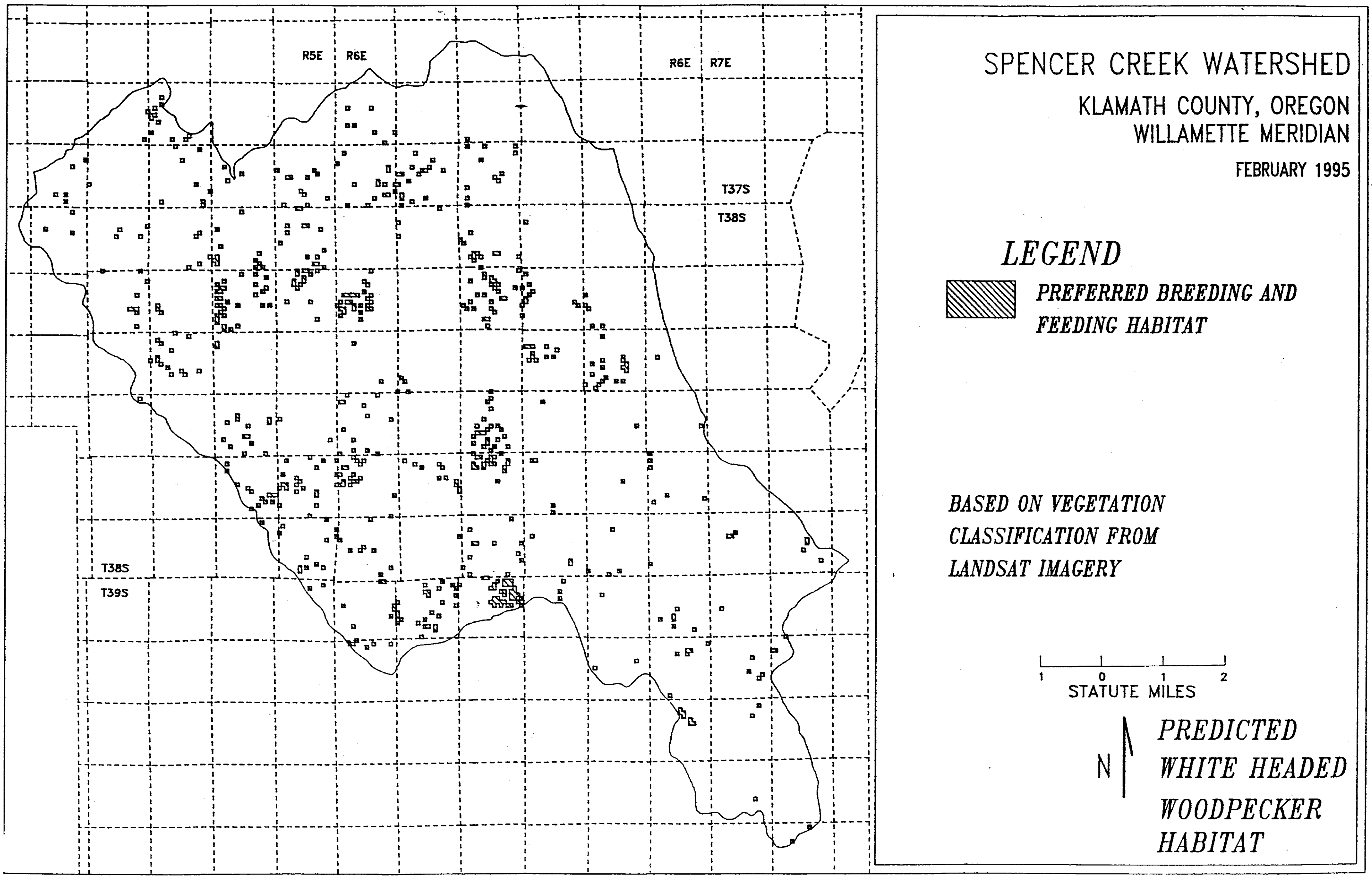
HABITAT MOST LIKELY TO BE USED FOR NESTING IS WITHIN .75 MILES OF THE KLAMATH RIVER, SPENCER CREEK, BUCK LAKE AND BOYLE RESERVOIR.

1 0 1 2
STATUTE MILES

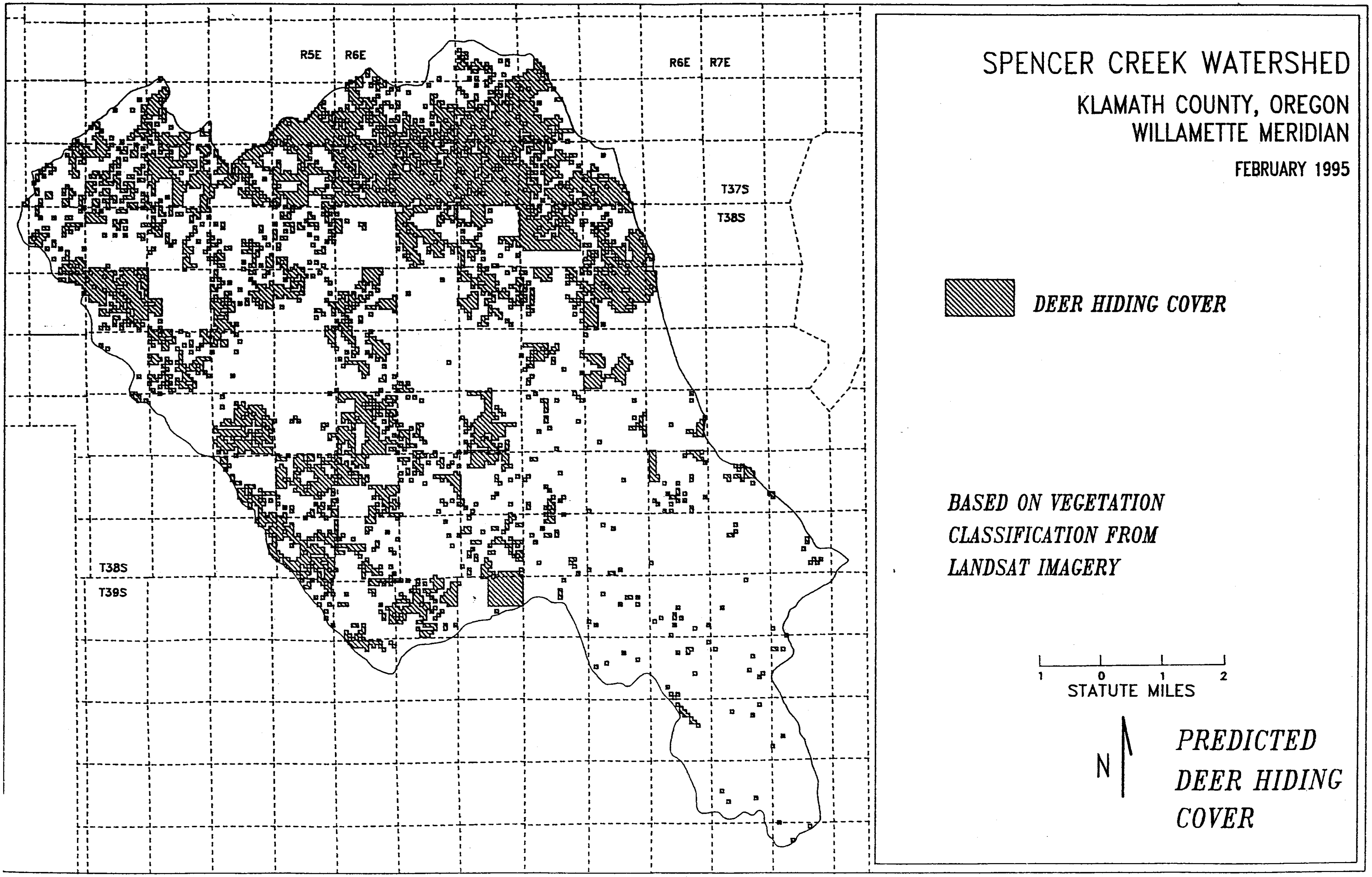
N

PREDICTED BALD EAGLE NESTING HABITAT

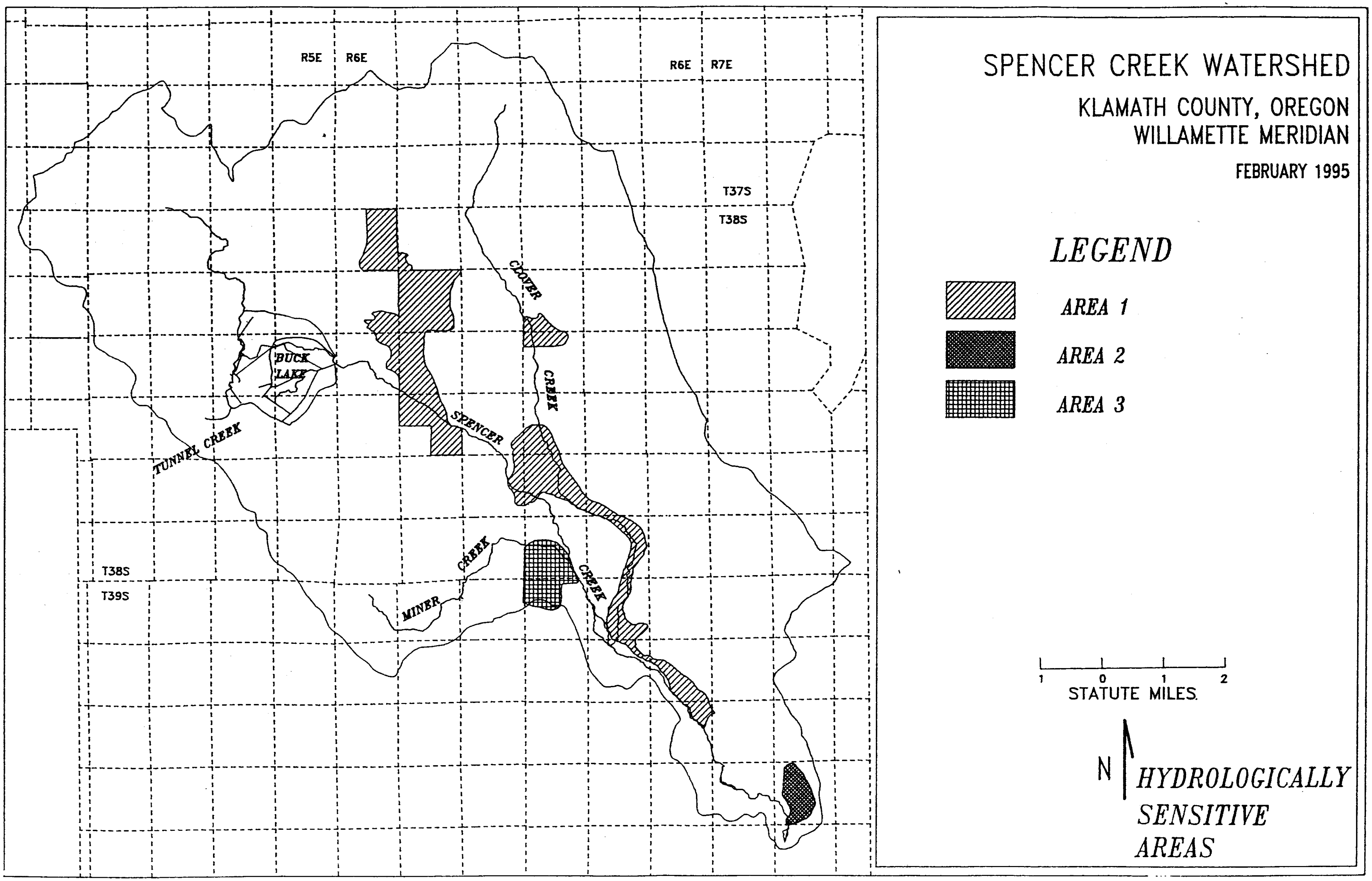
MAP 24


SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
PREFERRED BREEDING AND FEEDING HABITAT
BASED ON VEGETATION CLASSIFICATION FROM LANDSAT IMAGERY
1 0 1 2
STATUTE MILES
N
PREDICTED WHITE HEADED WOODPECKER HABITAT
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S

MAP 25

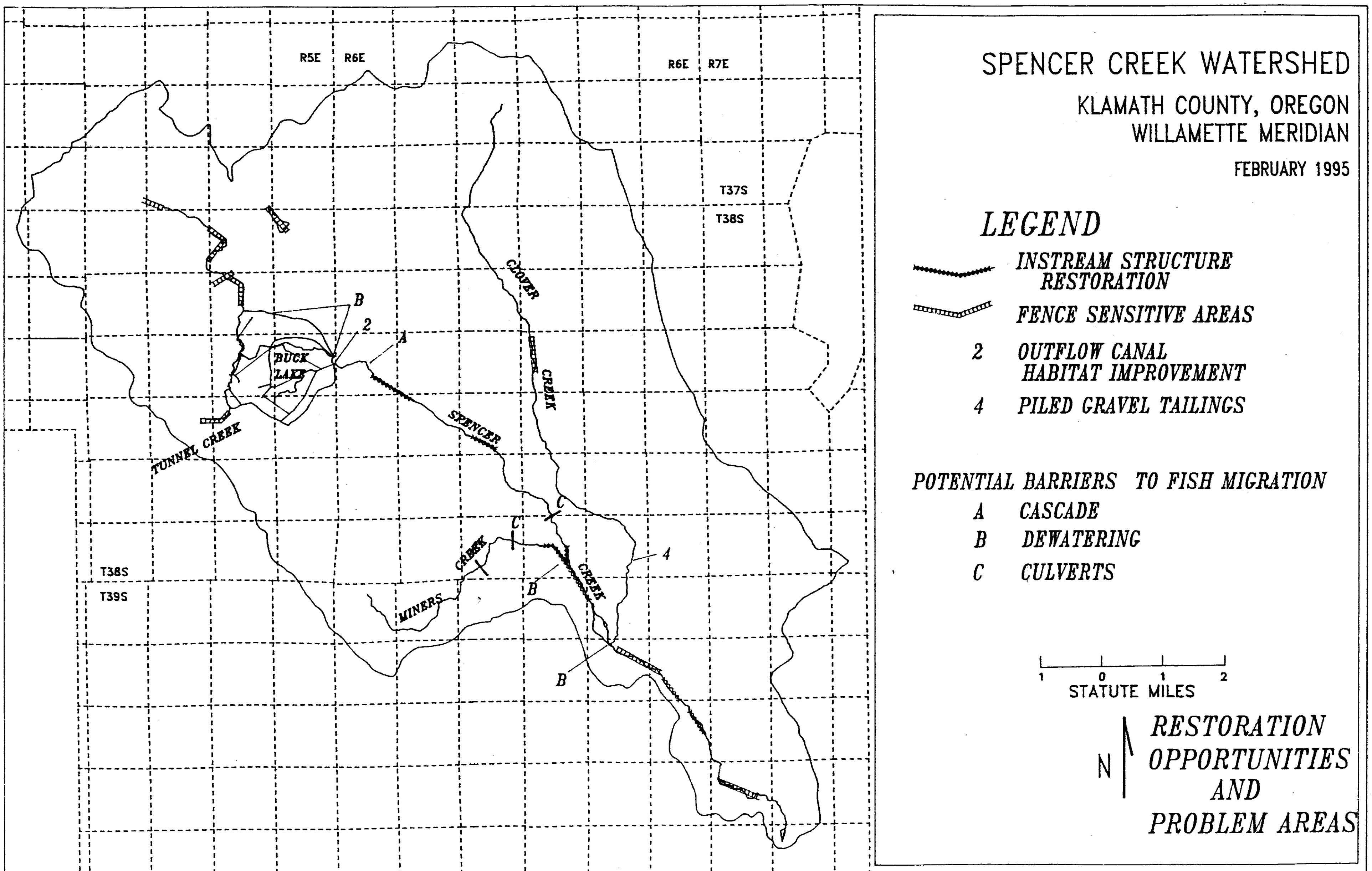

SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
DEER HIDING COVER
BASED ON VEGETATION
CLASSIFICATION FROM
LANDSAT IMAGERY
1 0 1 2
STATUTE MILES
N
PREDICTED
DEER HIDING
COVER
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S

MAP 26

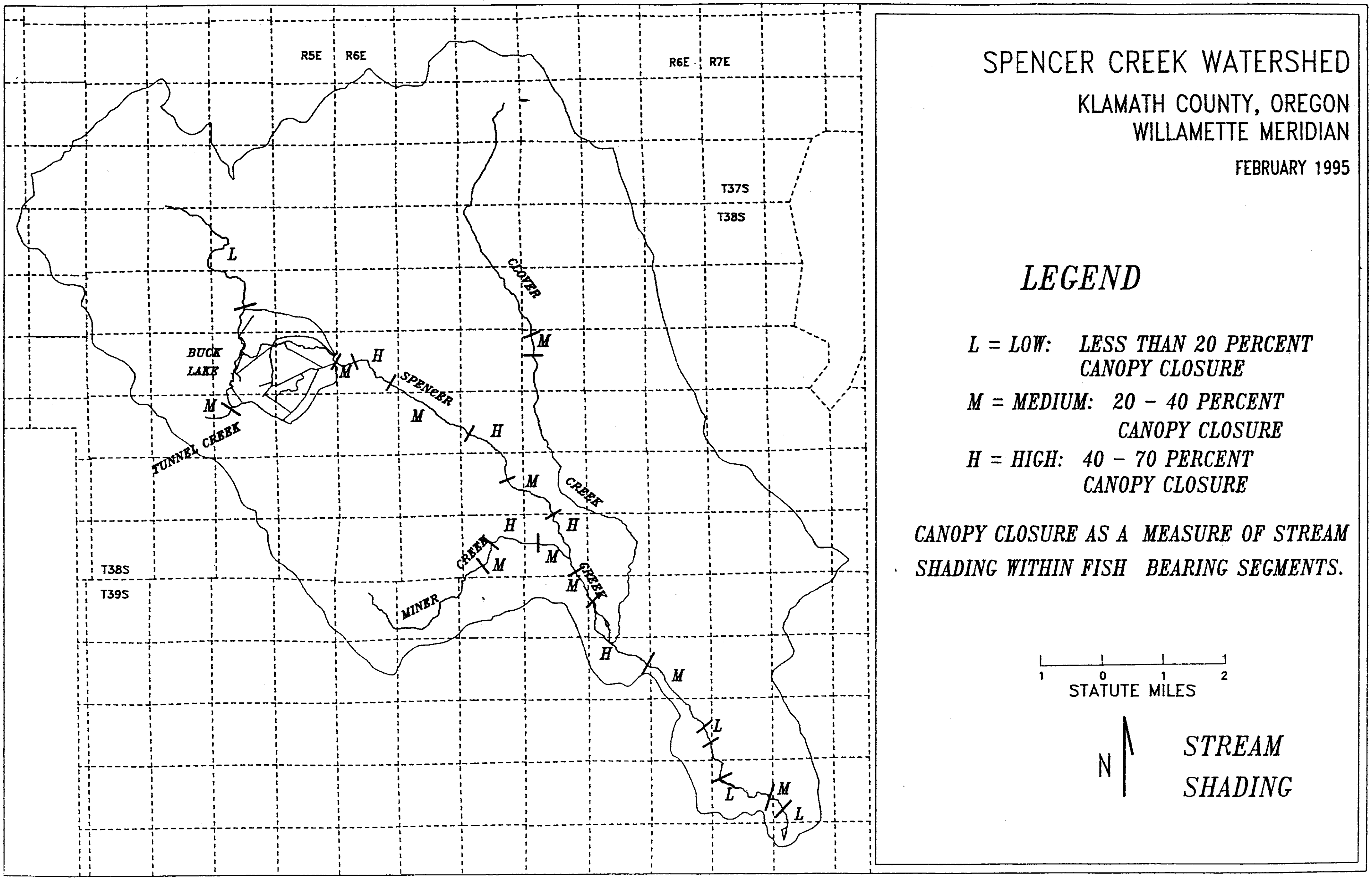


SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
AREA 1
AREA 2
AREA 3
1 0 1 2
STATUTE MILES.
N
HYDROLOGICALLY SENSITIVE AREAS
R5E R6E
R6E R7E
T37S
T38S
T38S
T39S
TUNNEL CREEK
BUCK LAKE
CLOVER CREEK
SPENCER CREEK
MINER CREEK

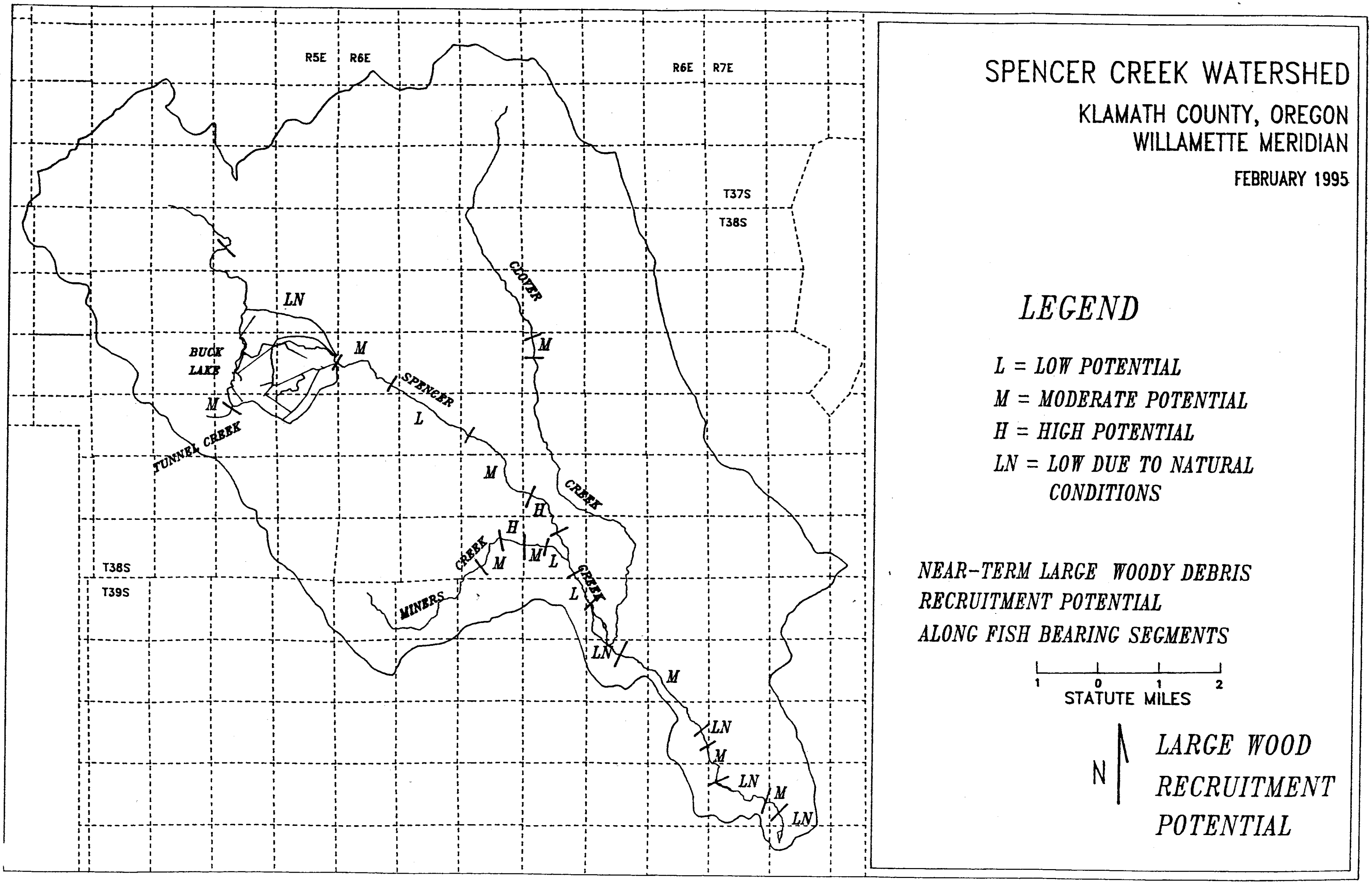
MAP 27

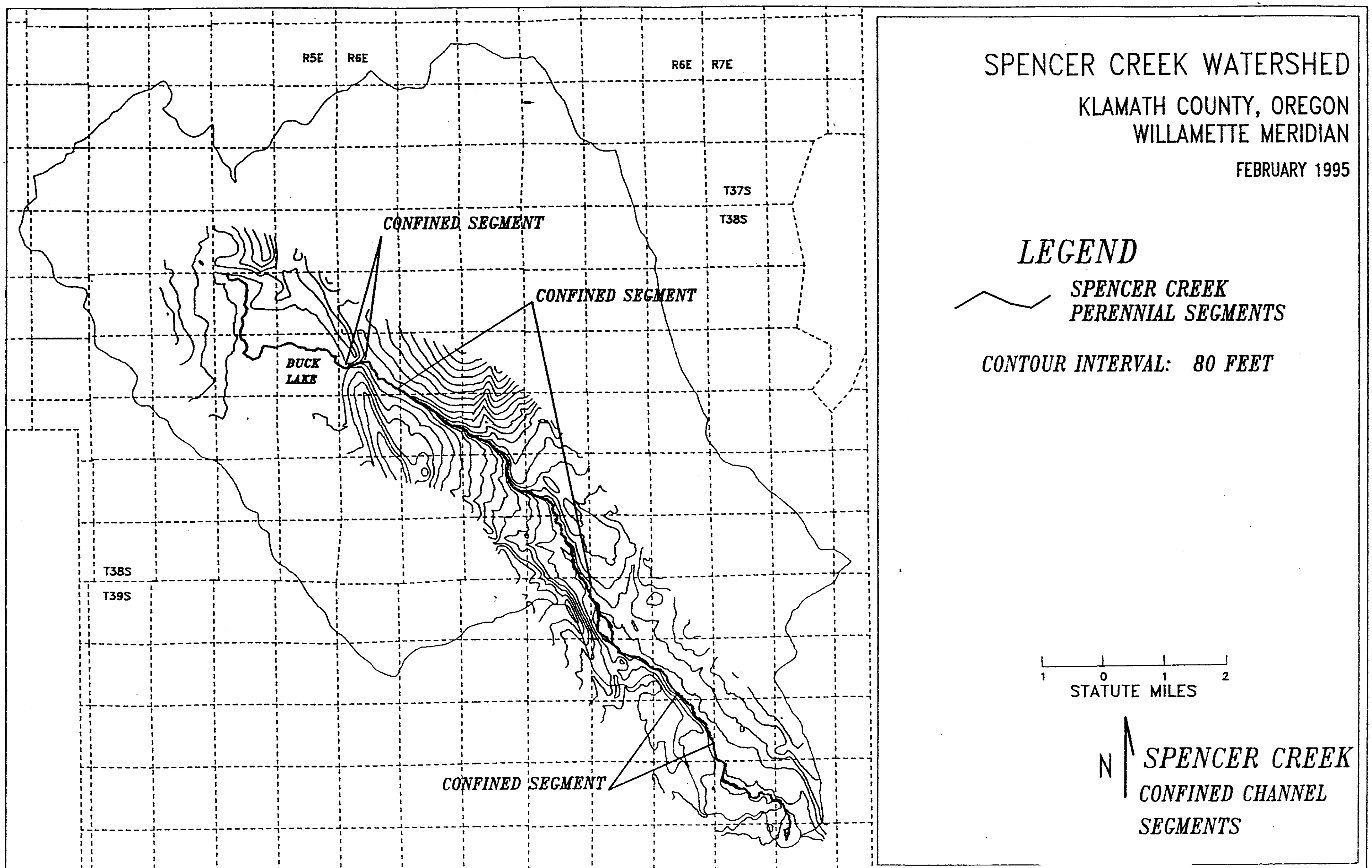

SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
INSTREAM STRUCTURE RESTORATION
FENCE SENSITIVE AREAS
2 OUTFLOW CANAL HABITAT IMPROVEMENT
4 PILED GRAVEL TAILINGS
POTENTIAL BARRIERS TO FISH MIGRATION
A CASCADE
B DEWATERING
C CULVERTS
1 0 1 2
STATUTE MILES
N
RESTORATION OPPORTUNITIES AND PROBLEM AREAS
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
TUNNEL CREEK
BUCK LAKE
SPENCER CREEK
CLOVER CREEK
MINERS CREEK

MAP 28


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
BUCK LAKE
TUNNEL CREEK
SPENCER
CREEK
MINER CREEK
CLOVER
CREEK
L
M
H
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
L = LOW: LESS THAN 20 PERCENT CANOPY CLOSURE
M = MEDIUM: 20 - 40 PERCENT CANOPY CLOSURE
H = HIGH: 40 - 70 PERCENT CANOPY CLOSURE
CANOPY CLOSURE AS A MEASURE OF STREAM SHADING WITHIN FISH BEARING SEGMENTS.
1 0 1 2
STATUTE MILES
N
STREAM SHADING

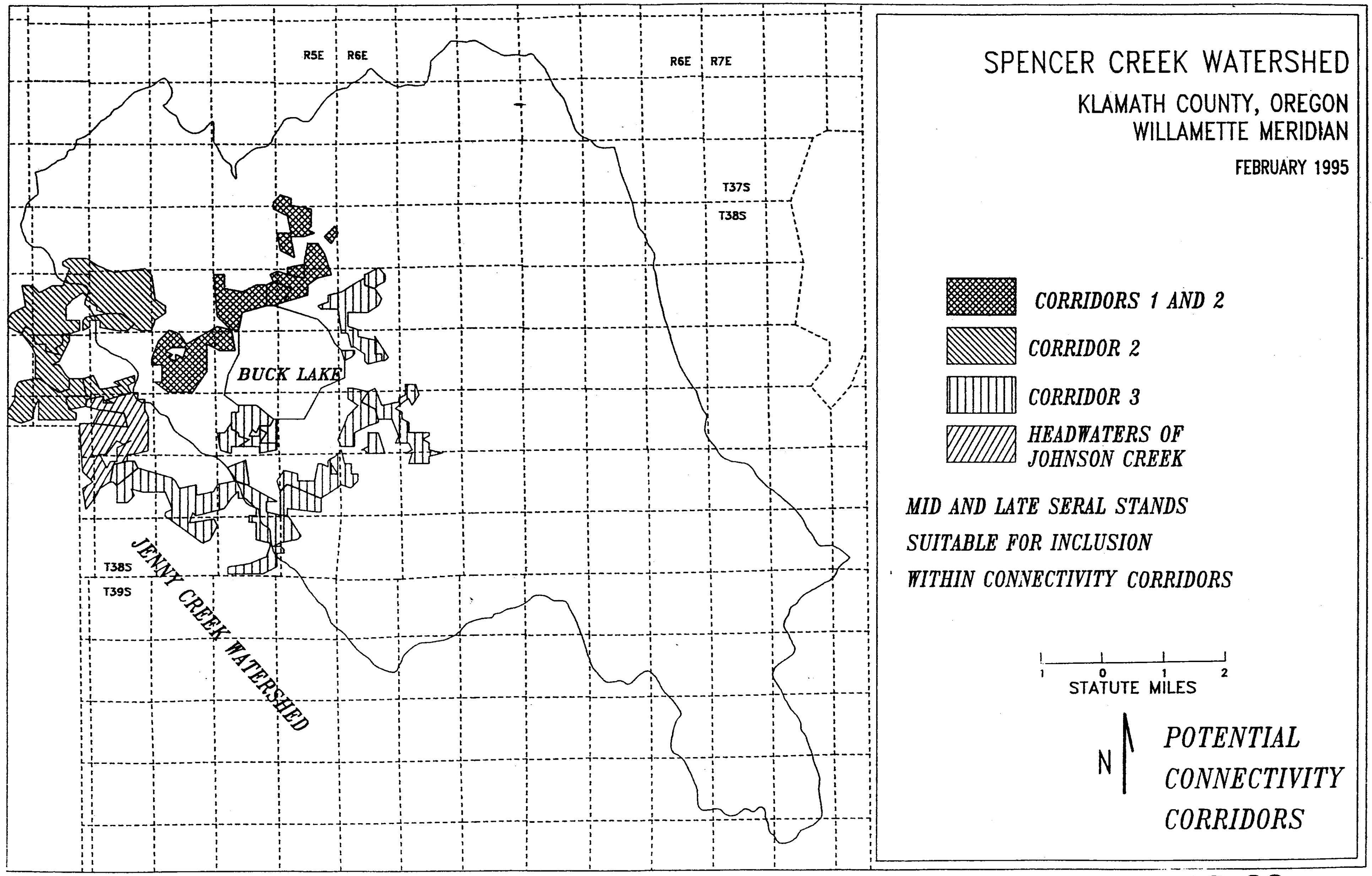
MAP 29


SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
L = LOW POTENTIAL
M = MODERATE POTENTIAL
H = HIGH POTENTIAL
LN = LOW DUE TO NATURAL CONDITIONS
NEAR-TERM LARGE WOODY DEBRIS RECRUITMENT POTENTIAL ALONG FISH BEARING SEGMENTS
1 0 1 2
STATUTE MILES
N
LARGE WOOD RECRUITMENT POTENTIAL
R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
BUCK LAKE
TUNNEL CREEK
SPENCER CREEK
CLOVER CREEK
MINERS CREEK
MAP 30

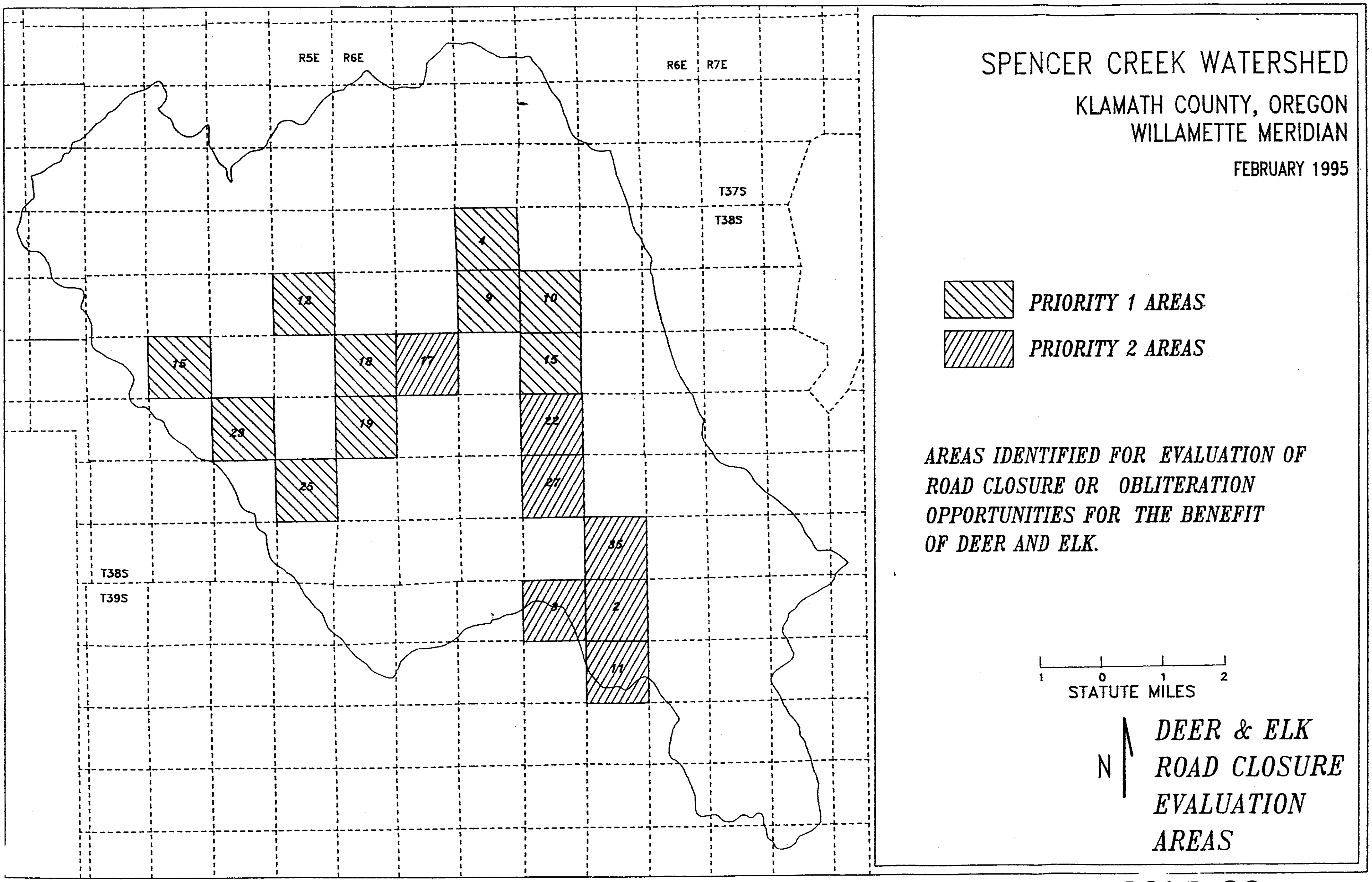


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
CONFINED SEGMENT
CONFINED SEGMENT
CONFINED SEGMENT
BUCK LAKE
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
LEGEND
SPENCER CREEK PERENNIAL SEGMENTS
CONTOUR INTERVAL: 80 FEET
1 0 1 2
STATUTE MILES
N
SPENCER CREEK
CONFINED CHANNEL SEGMENTS

MAP 31


R5E
R6E
R6E
R7E
T37S
T38S
BUCK LAKE
T38S
T39S
JENNY CREEK WATERSHED
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
CORRIDORS 1 AND 2
CORRIDOR 2
CORRIDOR 3
HEADWATERS OF JOHNSON CREEK
MID AND LATE SERAL STANDS
SUITABLE FOR INCLUSION
WITHIN CONNECTIVITY CORRIDORS
1 0 1 2
STATUTE MILES
N
POTENTIAL
CONNECTIVITY
CORRIDORS

MAP 32


R5E
R6E
R6E
R7E
T37S
T38S
T38S
T39S
4
9
10
12
15
18
17
15
23
19
22
25
27
35
3
2
11
SPENCER CREEK WATERSHED
KLAMATH COUNTY, OREGON
WILLAMETTE MERIDIAN
FEBRUARY 1995
PRIORITY 1 AREAS
PRIORITY 2 AREAS
AREAS IDENTIFIED FOR EVALUATION OF ROAD CLOSURE OR OBLITERATION OPPORTUNITIES FOR THE BENEFIT OF DEER AND ELK.
1 0 1 2
STATUTE MILES
N
DEER & ELK
ROAD CLOSURE
EVALUATION
AREAS

MAP 33

Spencer Creek
Pilot
Watershed Analysis

A day of huckleberry picking at Buck Lake around 1905 (photo courtesy of the Anderson family photo collection).

August 1995

Appendix 1
Preparers

Name	Agency	Position
Andrew T. Peavy	USFS Winema National Forest	Forest GIS Coordinator
Andy S. Hamilton	BLM Klamath Falls Resource Area	Aquatic Biologist
Michael W. Bechdolt	BLM Klamath Falls Resource Area	Timber Manager
Patricia R. Buettner	USFS Winema National Forest/ BLM Klamath Falls Resource Area	Wildlife Biologist
Mike Mathews	USFS Winema National Forest	Hydrologist
Kristin M. Bail	BLM Lakeview District	Team Leader
Tom Robertson	U.S. Environmental Protection Agency	Aquatic Ecosystems Coordinator
Robin Bown	U.S. Fish and Wildlife Service	Supervisory Wildlife Biologist
Scott Senter	BLM Klamath Falls Resource Area	Outdoor Recreation Planner
Rob McEnroe	BLM Klamath Falls Resource Area	Timber Sale Planner/GIS
Bill Yehle	BLM Klamath Falls Resource Area	Archaeologist
Bill Lindsey	BLM Klamath Falls Resource Area	Range Conservationist
Lou Whiteaker	BLM Klamath Falls Resource Area	Botanist
Heather Hayden	BLM Klamath Falls Resource Area	Visual Information Specialist
Jim Vienop	BLM Klamath Falls Resource Area	Writer/Editor

Appendix 2
Vegetation

Vegetation-Seral Stage Breakdowns (1899, 1945, and 1994)

1899 Leiberg Data

Leiberg had 4 categories:

1. Nonforest Area: This included burned areas, glades, meadows, marshes, lakes, semiarid tracts, etc.
2. Badly burned areas: We assumed that these were forested lands that had received some type of fire. They were classified as early seral stage.
3. Forested Area: included all forested area that contained trees 4 inches in diameter or greater. We classified all these as either mid or late seral stage.
4. Logged Area (None found within this watershed)

In order to derive numbers for Table 2-1, we averaged the percentage of land in each classification stated above for the 8 townships surrounding and within the Spencer Creek watershed. The numbers were obtained from Leiberg's description.

Note: Later in the analysis process, Leiberg's 1899 vegetation map was digitized just for the watershed boundaries. This later analysis is a better representation of the actual historic breakdown of seral stages in the watershed, but the digitizing was completed so late in the process, that we can only include it in the Appendix. The percentages of the different seral stages is somewhat different that the other method, but they are still reasonably close. Table 2-1 shows the percent of the different seral stages using the two different methods described above.

In summary, it is important to note that historically the watershed contained about 8 to 11 percent nonforest land. In addition, the watershed had been impacted by fires historically. Based upon Leiberg's description, the "Forested Area - 2MBF to 5MBF" was the result of an older burn. It is assumed that about 10 to 20 percent of the watershed was probably in early or early-mid seral stage at any one time due to repeated fires. Based upon a comparison of percentages above, it is assumed that the watershed was probably composed of 65 to 75 percent mid and late seral forests at any one time.

Table 2-1. Comparison of Leiberg's 1899 Data: Comparison between averaging the 8 Townships within and surrounding the watershed and a digitized version of just that area within the watershed.

Seral Stage	Averaging 8 Townships	Legend used in Leiberg's Vegetation Map. Within Watershed only.	Using the Digitized version of Leiberg's map. Within Watershed only.
Non Forest	11.4%	Rock (Nonforest)	1%
		Marshes/Meadows	8%
Non Forest Burned	6.7%	Deforested area as a result of fires	8%
Badly Burned	17%	Forested Area - 2MBF to 5MBF/AC (early-mid?)	11%
		Forested Area 5MBF to 10MBF/AC	18%
Forested	64%	Forested Area 10MBF to 25MBF/AC	56%

1945 Seral Stage Data

Using the 1945 "Legend For County Forest Type Map, Eastern Oregon and Eastern Washington. Prepared by Forest Survey, Pacific Northwest Forest and Experiment Station", forest types were classified into seral stages based upon the limited description of that forest type. Figure 2-2 lists the description given and the subsequent seral stage that it was labeled for this watershed analysis.

Note: Any polygon listed in GIS with a prefix of 34 indicates clear-cut or selectively logged areas now restocking. In Spencer Creek, approximately 15.367 acres (28 percent of the watershed) had been harvested prior to recording this data.

1994 Seral Stage Classification Using PMR (Pacific Meridian Resources)

The PMR classified the forested areas into a combination of sizes and structures. A complete description of the different sizes and structures that PMR classifies the stands into is available in the Winema National Forest PMR Handbook. For this analysis, the size/structure classifications listed in Table 2-2 were found in the watershed and subsequently classified into a seral stage or nonforest category. Note that some areas were treated (harvested) after the time the PMR data was collected. Each area that was treated after 1987 was field checked and assigned a size/structure classification and canopy closure based upon field review. This was done only on federal Lands. On private lands, the data was not updated. However, because most of the private land was already classified as early, early-mid, or mid, we did not feel it was as important to update the private land. The data for private land reported in this analysis is likely more conservative than what is actually there at the present time. Much of the private land has been thinned to treat the ongoing salvage problem. The percentage of early and early-mid is likely somewhat higher on the private land than is reported in this analysis.

Note: For a complete description of what these codes mean, please refer to the PMR handbook available at the Winema National Forest Supervisor's Office or the Klamath Falls BLM office.

The USFS had previously mapped plant associations on their lands within the watershed. In order to be consistent with their plant associations, William Hopkins and Mike Bechdolt, using Hopkins (1979) plant association guide for the South Chiloquin and Klamath Ranger Districts, mapped the plant associations for the remaining portion of the watershed (private and BLM-administered lands). Mapping was done in the field but under a limited time constraint, so there may likely be some corrections to make in the future. Plant associations are shown in Figure 2-1

For the 1945 species group inventory data, the descriptions listed in Figure 2-1 for the different timber types were used to map and determine the amount of acres of a dominant species. There was some discrepancy in the classification they put on a polygon; for example, 21 PONDEROSA PINE - SMALL, and the percentage by species that occurred in that polygon. Sometimes the percentage of white fir in that polygon was higher than the percentage listed for pine, yet they called the polygon a PONDEROSA PINE, SMALL. Therefore, 1945 species group data was somewhat hard to interpret. Table 2-2 is a summary of that query.

For the 1994 species group information, PMR data was used. Some of the PMR species group classifications had to be lumped together for comparison purposes. The 1994 species group PMR data was grouped as outlined in Table 2-3. The data likely has some discrepancies, but does give a general indication of how much of the watershed is likely dominated by a particular species or vegetative type.

PLANT ASSOCIATION	COMMUNITY DESCRIPTION	AREA (ACRES)	PERCENT
CL-S4-13	Lodgepole/huckleberry/forb	3,643	7%
CL-S4-14	Lodgepole grouse huckleberry/ long-stolon sedge	6.0	0.01%
CM-S1-11	Mountain hemlock/grouse huckleberry	1,320	2%
CP	Ponderosa pine	520	0.96%
CR-G1-11	Shasta red fir/long-stolon sedge	903	2%
CR-S1-12	Shasta red fir-mountain hemlock/ pinemat manzanita/long-stolon sedge	1,775	3%
CR-S3-11	Shasta red fir-white fir/ chinquapin -prince's pine/long-stolon sedge	10,445	19%
CW-C2-15	Mixed conifer/snowbrush-bearberry	19,635	36%
CW-H1-12	White fir/chinquapin-boxwood-prince's pine	13,641	25%
CW-M1-11	White fir-alder/shrub meadow	122	0.23%
FW	Forb meadow	58	0.11%
MW	Wet meadow - surface wet/ all growing season	1,466	3%
NR	nonforest rock	512	0.95%
WL	non-moving water	2	0.00%

Figure 2-1. Plant Associations Found in the Spencer Creek Watershed

Fire data records were obtained from the USFS GIS database for USDA Forest Service-administered lands. Records were from 1961 to 1992. The years 1993 and 1994 were not in the USFS database yet. It is important to note that there were quite a few fires in the watershed on USDA Forest Service-administered lands from lightning storms. For private and BLM-administered lands, ODF (Oregon Department of Forestry) records were obtained. Their database contained records from 1979 to 1994 with the year 1991 missing. The ODF records indicate that the minimum fire size reported was 1 acre prior to 1990. After 1990, ODF records show minimum fire size down to 0.1 acres.

Canopy closure for existing stands was obtained using the 5 PMR canopy closure designations (see Table 2-3). Field visits were made and a canopy closure estimate given to all areas treated after 1987. Canopy closure for historic stands (1945) was speculated from available aerial photographs of the area.

Table 2-2. Summary of Seral Stage Classifications

SERAL STAGE CLASSIFICATION GIVEN	SIZE/STRUCTURE-DESCRIPTION
Nonforest	Grass, Water, Rock
Early	Decadent Brush, Vigorous Brush, Seedling, Seedling/Sapling, Seedling Sapling, Pole, Large/MSLD, Medium/Seed/Sapling, Large/Seed/Sapling, Large Seed/Sapling/Pole.
Early-Mid	Pole/Small, Pole/MSLD, Pole, Pole/Small.
Mid	Small/MSLD, Small/Medium, Small/MS-, Pole/MS+, Small, Medium/MSLD, Small/MS+ (less than 55% crown closure).
Late	Medium/MS-, Medium/MS+, Medium/Large, Large/MS-, Large /MS+, Small/MS++, Medium, Small/MS+ (greater than 55% crown closure).

SERAL STAGE CLASSIFICATION GIVEN	1945 DESCRIPTION OF TIMBERLAND TYPE
Nonforest-	NONCOMMERICAL ROCK AREAS
Early-	DOUGLAS-FIR SEEDLINGS AND SAPLINGS, forest of over 60% Douglas-fir, 0-6" DBH. -NONRESTOCKED CUT-OVERS, nonrestocked logged areas having a residual stand of less than 1 M board feet per acre. 35A, cut after 1920, 35B, before 1920. -DEFORESTED BURNS, Any nonrestocked burn, not cut over, 37A, drought killed, 37B, insect killed, 37C, wind throw.
Early-mid-	PONDEROSA PINE, SEEDLINGS, SAPLINGS, AND POLES - forest of over 50% ponderosa pine, 0-12" DBH. -BALSAM FIRS-MOUNTAIN HEMLOCK, SMALL - forest of over 50% of either noble, pacific sliver, alpine, or shasta fir and/or mountain hemlock, under 12" DBH. -LODGEPOLE PINE, SMALL - forest of over 50% lodgepole pine, 6-12" DBH. -PINE MIXTURE, SMALL - mixed forest of from 20-50% ponderosa pine, 0-12" DBH. -UPPER SLOPE MIXTURE SMALL - mixed forest of larch, white fir, alpine fir, Douglas-fir, englemann spruce, lodgepole pine, or whtie fir, 0-12" DBH.
Mid-	-DOUGLAS-FIR, LARGE POLES - forest of over 60% Douglas-fir, 12-20" DBH. -DOUGLAS-FIR, SMALL POLES - forest of over 60% Douglas-fir, 6-12" DBH. -PONDEROSA PINE, SMALL - forest of over 50% ponderosa pine, either selectively cut stands or immature stands, 12-22" DBH. -BALSAM FIRS-MOUNTAIN HEMLOCK, LARGE - forest of over 50% of either noble, pacific silver, alpine or shasta fir and/or mountain hemlock, over 12" DBH. -LODGEPOLE PINE, LARGE - forest of over 50% lodgepole pine over 12" DBH. -LODGEPOLE PINE, MEDIUM - forest of over 50% lodgepole pine 6-12" DBH. -PINE MIXTURE, LARGE - mixed forest of from 20-50% ponderosa pine, over 12" DBH. -UPPER SLOPE MIXTURE SMALL - mixed forest of larch, white fir, alpine fir, Douglas-fir, englemann spruce, lodgepole pine, or whtie fir, over 12" DBH. -WHITE FIR, LARGE - forest of over 50% white fir, over 12" DBH. -WHITE FIR, SMALL - forest of over 50% white fir, under 12" DBH. -SUBALPINE - forest at the upper limits of tree growth, usually unmerchantable.
Late-	DOUGLAS-FIR LARGE OLD GROWTH - forest of over 60% Douglas-fir, over 40" DBH. -DOUGLAS-FIR, SMALL OLD GROWTH - forest of over 60% Douglas-fir, 20-40" DBH. -DOUGLAS-FIR, LARGE SECOND GROWTH - forest of over 60% Douglas-fir, 20-40"DBH. -PONDEROSA PINE, LARGE - forest of 50-60% ponderosa pine, over 22" DBH. -PURE PONDEROSA PINE, LARGE - forest of over 80% ponderosa pine, over 22" DBH. -PONDEROSA-SUGAR PINE MIXTURE, LARGE - forest of over 50% ponderosa pine and 20% or more of sugar pine, over 22"DBH. -SUGAR PINE MIXTURE, LARGE - forest of 20% or more of sugar pine and less than 50% ponderosa pine, over 22" DBH.

Figure 2-2. 1945 Description of Timberland Type

Table 2-3. PMR - Classifications

	What Categories Were Combined
Rock	Rock (no combining)
Grass	Grass (no combining)
Water	Water (no combining)
Shrubs	Areas dominated by brush (no combining)
Mountain Hemlock	Mountain Hemlock and Whitebark Pine Communities
Shasta Red Fir	Shasta red fir and Shasta red fir/Mixed Conifers
Mixed Conifer	Less than 25% any species
Mixed-Various conifer species	
White fir/ Mixed-Various conifers	
White fir	
White fir/Douglas-fir/Ponderosa	
Lodgepole pine	Lodgepole pine
Lodgepole pine/ponderosa pine	
Ponderosa pine	Ponderosa pine (no combining)

Appendix 3
Cultural Resources

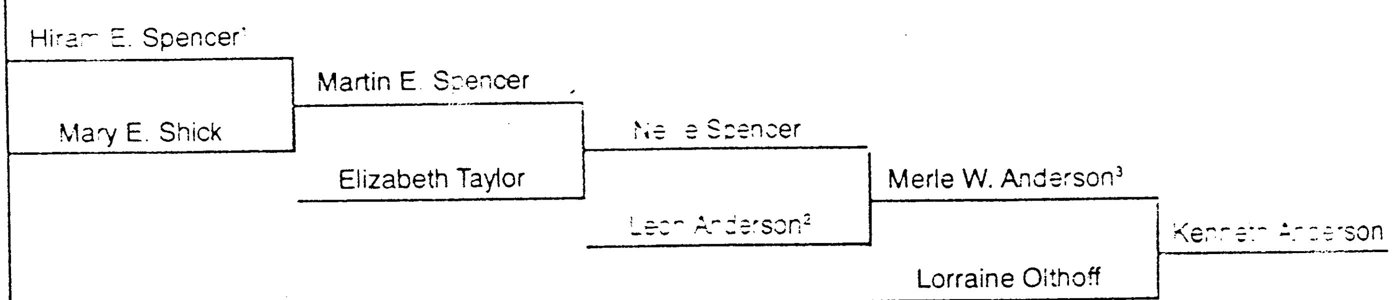
Introduction

This appendix consists of five major parts. The first major section of this appendix describes the historiography (methodology of historic study) of the area, particularly as it relates to the Spencer Creek watershed. The second section is an autobiography of Fred L. Spencer. The third part is a biography of Alice Isobell (Spencer) High. Part four is a transcript of an oral history with Merle Anderson. The fifth part is an oral history interview with Hugh Charley.

To put the following sections into persective, a summarized tree of the Spencer family is provided. This family tree is provided to show the relationship of the individuals (Fred Spencer and Merle Anderson) described in the autobiography and oral history of this appendix. Hugh Charley and his family (both predecessors and descendants) are not related to the Spencer family, but have also been long time land owners in the watershed. Hugh's oral history is also included in this appendix.

Several reproductions of photographs are included in this appendix to help relate the text to the visual conditions present when the photos were taken. Many thanks to the Anderson family for the use of their historic photographs.

Note: There are many other descendants of the people in this summarized tree who are not shown here. This tree was produced to help the reader keep track of those people for whom we have oral histories and/or biographies in this appendix. More complete information is available at the BLM office.



[1] Early settler in the Spencer Creek area. Both Fred L. Spencer and Alice Isobell are children of Hiram and Mary and their biography's are reproduced in this appendix.

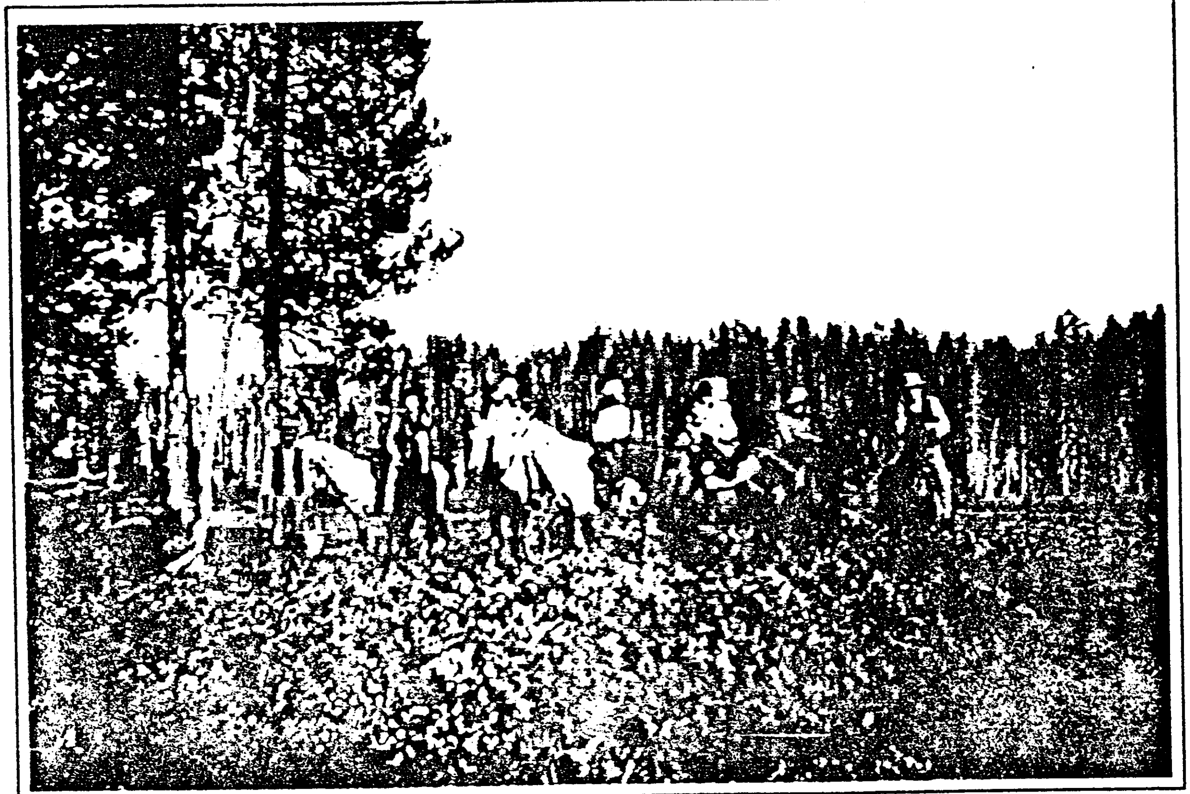
[2] See Leon's photo below.

[3] See Merle's oral history interview.

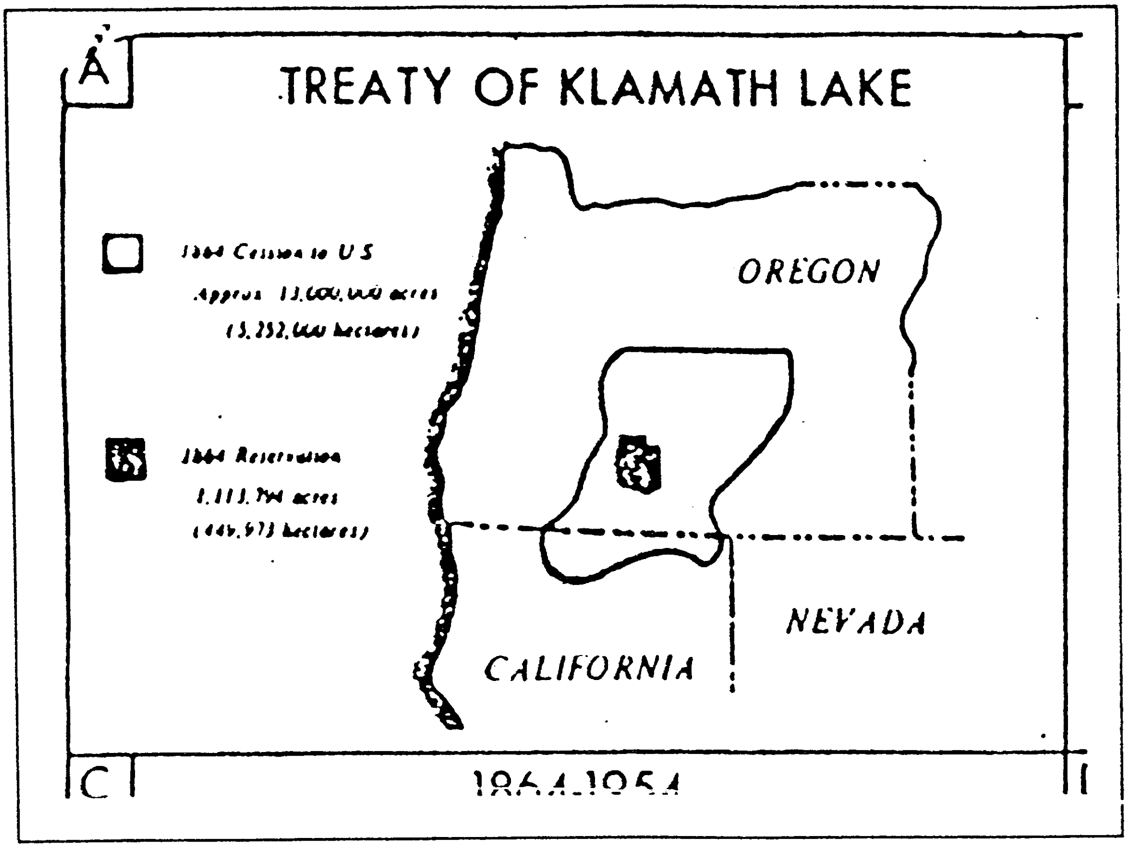
Figure 3-1 Summarized family tree

Chinook Salmon caught at the confluence of Spencer Creek and the Klamath River prior to 1917 by Charles A. Sprague - Governor of Oregon from 1939 to 1943 (photo courtesy of the Anderson family photo collection).

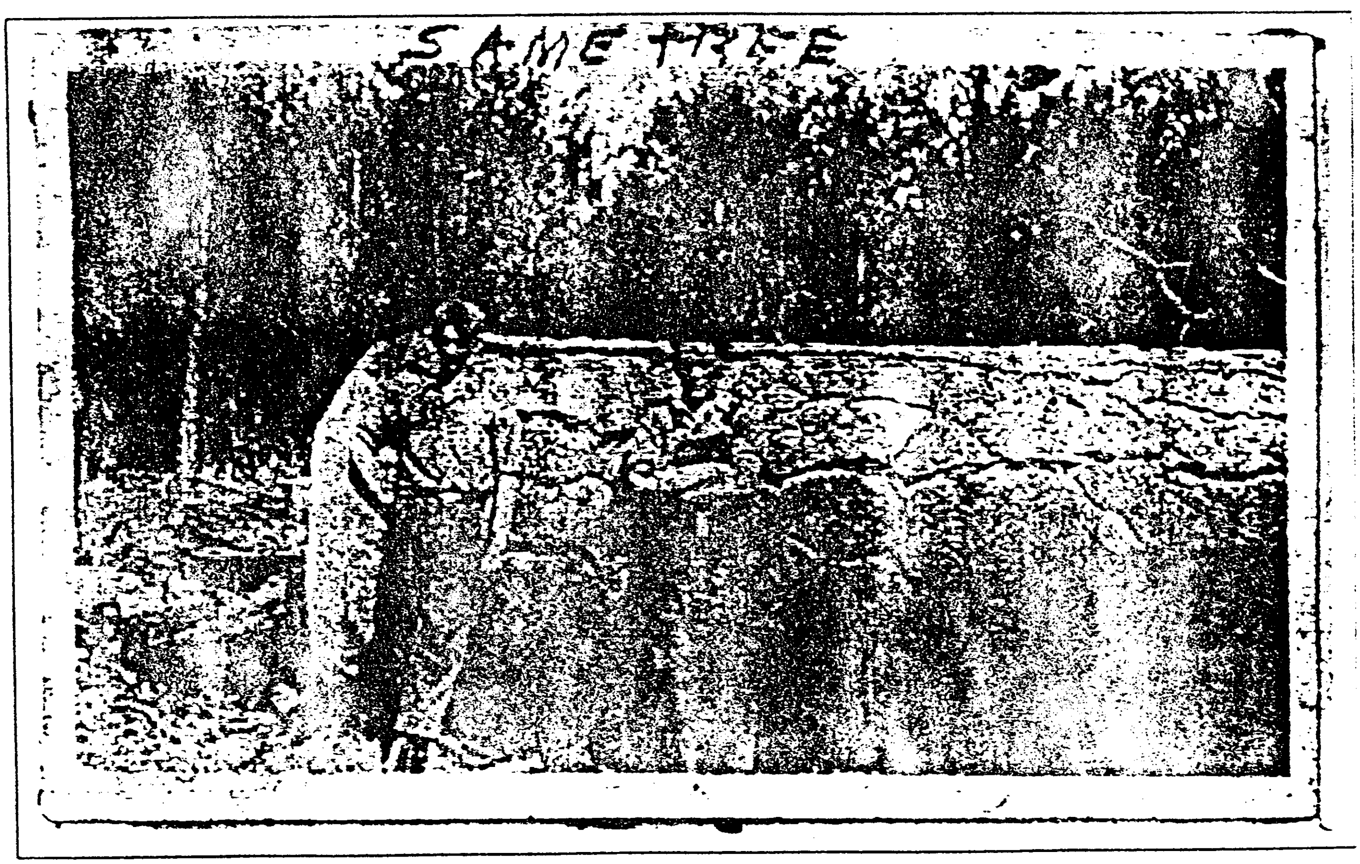
Fishing for steelhead on Spencer Creek, Charles Sprague (R) and Leon Anderson (L) around 1900 (photo courtesy of the Anderson family photo collection).



A day of huckleberry picking at Buck Lake around 1905 (photo courtesy of the Anderson family photo collection).



Treaty map of 1864



Ponderosa pine fell in the Spencer Creek watershed by the Anderson family.

Deed, from State of Oregon to O. J. Brown)

In consideration of Six hundred and forty three $\frac{80}{100}$ ($643\frac{80}{100}$) Dollars paid to the Board of Commissioners for the Sale of School Lands the State of Oregon doth grant, bargain sell and convey unto O. J. Brown his heirs and Assigns the following described premises to wit: the North West quarter of the North west quarter and Lots one and Eight (1 & 8) of Section twenty nine (29) and Lots one (1) two (2) three (3) four (4) and six (6) and the North west quarter of the North East quarter and the South East quarter of the North West quarter of Section thirty (30) Township thirty nine (39) South of Range seven (7) East Willamette Meridian containing three hundred and twenty one $\frac{90}{100}$ ($321\frac{90}{100}$) acres of State Land situated in the County of Jackson and State of Oregon. To have and to hold the said premises with their appurtenances unto the said O. J. Brown his heirs and Assigns forever and that the State will warrant and defend the same from all lawful claims whatsoever.

Witness the seal of the State affixed this 15 day of February 187[illegible]

{Seal}

L. F. Grover Governor
S. F. Chadwick Secretary
L. Fleischner Treasurer

Record of deeds [illegible]
Recorded August the 10th 1875
(Jackson County Record of deeds Vol. 1 page 84)

Warranty Deed from O. J. Brown and wife to Mary Elizabeth Spencer)

This Indenture witnesseth: That O. J. Brown and Roxannah E. Brown his wife for the consideration of the sum of $3000 dollars lawful money to them paid have bargained and sold and by these presents do bargain sell and convey unto Mary Elizabeth Spencer the following described premises to wit: The North West quarter of the North West quarter and Lots one (1) and eight (8) of Section twenty nine (29 and Lots one (1) two (2) three (3) four (4) and Six (6) and the North west quarter of the North East quarter and the South East quarter of the North west quarter of Section thirty 30) Township thirty nine (39) South of Range seven (7) East Willamette Meridian Oregon containing three hundred and twenty one $\frac{90}{100}$ ($321\frac{90}{100}$) acres of bargain sell and convey unto Mary Elizabeth Spencer the following described premises towit: The North West quarter of the North West quarter and Lots one (1) and eight (8) of section twenty nine (29) and lots one (1) two (2) three (3) four and six (6) and the north west quarter of the North East quarter and the South East quarter of the North west quarter of Section thirty (30) Township thirty nine (39) South of Range [illegible] (7) East Willamette Meridian Oregon Containing three hundred and twenty one 90/100 (321 90/100) acres of land situated in Jackson County Oregon.

To have and to hold the said premises with their appurtenances unto the said Mary Elizabeth Spencer her heirs and assigns forever and the said O.T. Brown and Roxannah Brown his wife do hereby covenant to and with the said Mary Elizabeth Spencer her heirs and assigns that they are the owners in fee simple of the said premises that they are free from all incumbrances, and that they will warrant and defend the same from all lawful claims whatsoever.

In witness whereof we have hereunto set our hands and seals this 1st day of January 1875

Done in presence of
A.T. Pee
A.H. Miller

O.T. Brown (L.S.)
Roxannah E. Brown (L.S.)

Warranty Deed from O.T. Brown and wife to Mary Elizabeth Spencer for Spencer Station

Historiography

A Brief History of the Spencer Creek Watershed
by
William D. Yehle, M.A.

The Prehistoric Period

Evidence of the first humans in the Klamath Basin is tied to the find of two Clovis projectile points along the Lost River. The time line for Clovis points is the earliest projectile point horizon in North America, marking the beginning of the Paleo Indian period approximately 11,000 years ago. These early explorers were big game hunters who concentrated on large mammals, often Mammoth or Mastodon. There is then a significant gap in our knowledge of prehistory until the Middle Archaic period (7000 to 2000 years ago). This period is best illustrated by the sites found at Nightfire Island located at the lower end of Lower Klamath Lake in California. After this time (2000 years ago), there is a record of continuous occupation by humans, but not necessarily the same culture.

The Ethnohistoric Period

History begins with written records. The ethnographic (see glossary) present is that period of time between the Late Archaic into the Historic period, in this case, approximately 1,000 AD to about 1850. To understand the time just prior to the historical period, archaeologists try to extend the ethnographic present back into time based upon the information we have in the ethnohistoric record, which is observed behavior and culture. Fagan (1993) states the early ethnographic period appears to reflect late prehistoric trends which can be seen in the archaeological record.

At the time of Euroamerican contact with the Native American people in the Klamath Basin, distinct tribal boundaries were in a state of flux. Four distinct tribes vied for territory, the Klamath, Modoc, Shasta and Takelma. Spencer Creek appears to have been within a transitional area between the Klamath and Shasta, but clearly utilized by the Modoc. The Klamath were strongly entrenched to the north while the Shasta had a firm foothold in the Klamath Canyon. The Takelma were up on the divide of the Cascades, and apparently in conflict to some extent with the Klamath. The Modoc appear to have had peaceful relations with the Klamath at this time, and shared resources within the Spencer Creek watershed. There is a historic record of a combined Modoc/Klamath presence in the watershed during the early historic period. The Shasta lived primarily in northern California, but extended their territory north into the Rogue River Valley, and east up the Klamath Canyon. The Takelma held the middle and upper Rogue River Valley and the Bear Creek Valley as their lands. The Klamath held the territory in the Klamath Basin north of the Klamath River, and the Modoc lived south of the Klamath River and along the Lost River into the Tule Lake areas of northern California (Fagan et al. 1993 pgs 3-4 and 5).

Human Impacts on Spencer Creek

The prehistoric impact appears to be a seasonal use of the land for hunting and gathering purposes, perhaps centered out of a seasonal village near the confluence of Spencer Creek and the Klamath River. Burial grounds are reported in the general vicinity, a logical cultural resource because we can always be sure that with human occupation people certainly did two things, procreate and die.

Native American use of the area appears to have ended abruptly at the end of the Modoc War. Prior to this time, during the early historic period several contacts are reported with Native American people, both Klamath and Modoc. The Modoc Band led by Captain Jack is reported to be in the area on a semi-annual basis, and to have specifically visited at Spencer Station. Captain Jack, Schonchin John, Hooker Jim, Scarface Charley, Shacknasty Jim and Queen Mary (Captain Jack's sister) often stopped by during their seasonal round when the men hunted and the women gathered epaws[1], wocus, berries and fished. It is said that Captain Jack often ate at the Spencer's during these visits.[2] In the Lost River Area, the Modoc warriors had a habit of walking into a homesteader's kitchen, sitting down and expecting to be fed. This may have been the case in Spencer Creek (Anderson, 1994). However, Fred Loland Spencer in his memoirs tells of sitting on Captain Jack's lap at dinner and of playing with his children when they visited Spencer Station. Fred Spencer further states that Captain Jack asked for him to be the interpreter at Lava Beds during the Modoc War, because he trusted the nine year old boy. In his autobiography, Spencer cites this as the reason the Army took him along (at the age of nine years, with parental consent). In his memoirs, (see the autobiography) Fred Loland Spencer relates:

> Captain Jack and his tribesmen were familiar figures to me during the two years after we moved to Spencer Creek. They were in and around our place twice a year on their semi-annual pass from the reservation for their supplies of Venison, Huckleberries, fish, epaws and Wocus or Indian flour. Epaws were roots they dug, and were small like peanuts with a rich nut-like flavor, but crisp in your teeth like water chestnuts. It was not unusual for my father to trade a sack of flour, when we could spare it, to them for a sack of dried huckleberries or epaws.
>
> When they came to fish, they camped on Spencer flat. Hooker Jim, Scarface Charley, Shacknasty Jim, Sconchin John and many others mentioned prominently in the annals of the Modoc War, I knew as a small boy. Queen Mary, as Captain Jack's sister was called, was around with them. Nowadays they would call her a golddigger. During their periodic visits, the Modoc Chieftain frequently ate dinner with us. I used to sit on his lap. He had a boy about my age, who, with Ali Whittle [whose mother was a Modoc] taught me to speak the jargon.

The last reported contact with Captain Jack at Spencer Creek is reported by Alice Isobell Spencer High after the murders of General Canby and Reverend Thomas at Lava Beds by the Modocs. In her memoirs she reports seeing Captain Jack and Scarface Charley, as they were attempting to cross the river near Spencer Station, in their final flight from the United States Army. There were U.S. Calvary troops at Spencer Station at that time. The footprints of six horses were found at the location Isabelle pointed out to the authorities.

Merle Anderson, the oldest living Spencer descendant, was born in the Spencer Creek watershed, near the site of Spencer Station in 1913. Mr. Anderson tells us he cannot ever remember any Native American use for hunting, fishing or gathering in the Spencer Creek Watershed during his lifetime (see oral history). Hugh Charley ranches on land purchased by his great grandfather in 1932. Their range runs from Lake of the woods on the north to below Buck Lake on the south and from the west side of Buck Lake into Clover Creek on the east. Hugh, in his oral history interview, reports he has never seen a Native American engaged in hunting, fishing or gathering activities on his range, nor does he recall his father or grandparents reporting such use.

The Historic Period

Spencer Creek and its major contributor Clover Creek drain an area of roughly 54,500 acres, entering the Klamath River at a point on the north side of John Boyle Reservoir near the upper end of the flood pool. It is at a point very near the confluence with the Klamath River, where the Applegate Trail crossed Spencer Creek.

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[1] It seems farfetched that epaws would be gathered in the Spencer Creek Watershed as they prefer rocky, well drained soil, which is not the norm for Spencer Creek. The reference to epaws is from a Native American ethnographic reference. O.A. Sterns in his memoirs, refers to root digging but not to epaws. Camas would be a higher probability root crop. Fred Spencer refers to his father trading for epaws. This is possible as they could have been brought in by the tribesmen.

[2] See appendix this chapter for memoirs of Alice Isobell High nee Spencer. Mrs. High states her father bought the mill because the family physician advised him to get her to a forest non-city climate for her health.

The wagon ruts from the trail are visible at that point. Less than a mile further east the Applegate Trail forded the Klamath River at a point below a prominent falls that was first exploited as a fishing station by Native American people who occupied the area as a part of their seasonal round (Woods 1994). The pool below the falls was later exploited by Euroamerican commercial salmon fishermen until those runs were halted by construction of COPCO Dam, which has no fish ladder (Anderson 1994).

The first Euroamerican settlement on Spencer creek occurred during the summer and fall of 1860 when Company L, 3rd Artillery, commanded by 1st Lieutenant Alexander Piper, with sixty-six men established Camp Day about one mile upstream from the confluence with the Klamath River (Oregon Historic Quarterly 1968). Second in command was 2nd Lieutenant Lorenzo Lorain. Camp Day was named in honor of Lieutenant Edward Henry Day, 3rd Artillery, who died at Fort Umpqua on January 2, 1860, (Klamath Echos 1964). Although there are no records available, it is though that Camp[Day was headquarters of an expeditionary force in search of a location for a permanent Fort (Klamath Echos 1964). Fort Klamath was subsequently established seven years later at its present site near the Wood River and Agency Lake. At that time, or shortly thereafter, the stream was called Elk Creek. Spencer Creek had several names prior to it's present day name. It was first known as Clear Creek, then Elk Creek, then Wet Ass Creek[3], and finally Spencer Creek (Fagan et al. 1994).

On August 12, 1860, Lt. Piper met with an assemblage of Klamath Chiefs and warriors, including Chiefs George and Kumtucky. Also among the Native American dignitaries was The Modoc Chief, Schonchin. A photographic record of the event was made by Lt. Lorain who among his duties, served as the photographer. Camp Day also served the purpose of exhibiting a military force to the Klamaths and Modocs. With the advent of the American Civil War, military activity in the Klamath Basin was for the most part, at a stand-still, as these resources were badly needed in the eastern United States.

The town of Linkville was established in 1867, ten years after trapper trader Martin Frain established his trading post. In that same year (1867), the first Euroamerican settler, O.T. Brown homesteaded on Spencer Creek (Klamath Echos 1964). Mrs. Brown was the first white woman settler to arrive and settle in Klamath County (Klamath Echos No. 10). Hiram and Mary Spencer crossed the plains in 1860 from Iowa. They settled in Ashland, Oregon, and in 1870 bought a sawmill on Spencer Creek from Melvin Taylor[3]. Later, they purchased the Brown Station and 320 acres around the confluence of Spencer Creek and the Klamath River from O.T. Brown. Spencer had traded his home in Ashland and 160 acres to John Walker for 46 head of horses. Cash was rare in Oregon Territory in those days, and barter was often the system used in business transactions. Some of these horses provided down-payment on the land bought from O.T. Brown (see Warranty Deed O.T. Brown to Mary Elizabeth Spencer, 1875). The balance of the herd was sold for $759. The Modoc war had broken out and the horses were paid for in script, to be redeemed after the war (see autobiography section).

Spencer Station was a stage stop between Linkville (Klamath Falls) and Ashland. It is not known if the 40 by 60 foot, two story log structure was built by the Government or by O.T. Brown. The first floor had a kitchen and barroom (for men), however it was a barroom in name only, because no liquor was ever reported as having been sod there. There was a parlor for the ladies and bedrooms for the family. The second floor was a fifteen bed dormitory. It is said that Mrs. Spencer kept the bare floors shining. Lighting was from tallow candles and grease pots. Meals, usually venison, duck, and goose were served three times a day, along with wild plum jam, gooseberry, huckleberry, and blackberry pies.

[3] There is some indication the origin of this name is Modoc WeTas which does not translate well. In Klamath language Way-tas would mean Day Creek. However this has no known associations with the name of Camp Day (Bettles, Personal Communication, 1994)

The winter of 1890 was extremely bad, cold and deep snow plagued the pioneers. It was during this time, Mrs. Spencer heard a loud noise, ran for the door, as the roof of the station collapsed. She was blown off the porch by the force of the collapse. There was so much snow and ice, the Spencers had to place her body in the home-made coffin, and then wait until spring before they could reach Spencer Cemetery which was about one mile away.

Unfortunately, Spencer cemetery has been badly vandalized. At least one grave has been dug into by looters, and several of the Spencer family headstones are missing and presumed stolen. The Spencers had eight children. Francis Ellen, Aden, Incinda, John, Hiram, Eugene, Fred Loland, and Alice Isobell. See the "Spencer Cemetery" notes below.

Spencer Station closed as a stage stop after the route change was made in the Applegate Trail. A bridge was built across the Klamath River and eliminated the need to use the river ford just north of Spencer Station. The Spencer family went on to other enterprises, but did maintain a presence in the watershed.

Klamath Basin General Society 1555 Hope Street, Klamath Falls, OR 97603

Spencer Cemetery

From a very old cemetery on Spencer Creek and Klamath River. On hill, south of the mouth of Spencer Creek, on the bank of Klamath River, Klamath County, Oregon. 10 gravesites visible in 1967 whom read by DAR.

Additional material from Gwen Campbell, 1962, who visited with Esther Simmers, daughter of Nellie Anderson who was a Spencer.

DECKER ______________
DECKER W.y., age 73 years, 10 mo. 17 da.
SPENCER Olive I., 1857-1871.
John O., 1855-1880.
Hiram E., 1817-1905.
Mary E., 1827-1890 wife of Hiram.
woman who died in childbirth.

ANDERSON Infant son of L.W. & N.L. Anderson, died Aug. 27, 1913.
Marion R., age 22. Son of Marcus - kicked by a mule who left shoe print in side.
Marcus R., age 74, born 1840; died 1910. (grandfather to Esther Simmers)
Ashberry, age 68 (brother to Marcus)
CONNOLLY Mother
Daughter and infant - died in childbirth.
SPENCER Daniel T., died June 26, 1897, age 10 yrs. 4 mo. 3 da.
("inflamatory rheumatism" -bro. to Mrs. Anderson.
GRUBB ______________
Frances, E., wife of W.E. Grubb, died June 11, 1902, age 52 yrs. 9 mo. 8 da. (Mrs. Anderson's aunt and Esther's great aunt.)

Notes: Marcus R. Anderson married Eva and they lived in Ashland and had Leon, Marcus Ray, and Walter Jay - twins, George, Zora, and Bertha, and Marion. Eva got pregnant again and when it came time to deliver, Leon - Esther's father rode to town after the doctor but the baby was born before they got back. Later Eva died. Marcus R. and his brother Ashberry packed up the eight kids (baby named Chester) and moved to Keno where they homesteaded the place owned by Esther Simmers in 1962. They came to Klamath County in 1894.

Down on the other side of the cemetery is where the Spencer's and Grubb's homesteaded. Hiram Eugene Spencer married Mary Elizabeth and in 1890 the winter was very severe and the roof caved in and killed Mary Elizabeth. Their son, Eugene Spencer married Elizabeth Taylor (buried in Ashland - both of them) and Daniel T. Spencer and Nellie Spencer were two of their children. Nellie Spencer married Leon Anderson. Esther was born in 1902. Eleven years later Nellie had another baby and wouldn't go to town but gave birth at home. Two or three days later she had a terrible fever and delivered the twin of Merele which is the infant son buried in the cemetery. Nitch's mother put hot irons on her heart and feet and revived he, but in the process she was burned terribly and has great scars on her arm and feet and wasn't able to walk for a long time.

According to History of Klamath County: in part Leon Wilford Anderson born Feb 24, 1877 at Hamilton, Oregon. He drove a stage and also freighted between Parker Mtn and Klamath Falls, His father, Marcus born 1840 and come to Klamath County in 1894; died 1910. Leon was 17 when he came here. Married Nellie February 13, 1901.
Nellie born on Spencer Creek November 19, 1882.
Martin E. Spencer born April 15, 1860 in Iowa and came to Klamath County in 1872 when 12 (Father Hiram Eugene). Owned and operated Spencer Station, a stage stop over offering accommodations for freighters and stages. Died May 22, 1936 (buried in Ashland). Nellie's mother (Elizabeth Taylor) was born in 1860 in Jackson County and married December 20, 1881.

NOTE: Gwen Campbell - material undocumented - use for what it is worth. In Jan of 1984 both Esther Simmers and her mother, Nellie Anderson, were both dead.

At the turn of the century, the USGS published its twenty-first Annual Report. Part V is a report by John R. Leiberg titled Cascade Range and Ashland Forest Reserves and Adjacent Areas. For Details of Leiberg's report see: Forest & Range Ecosystem Health, in this report. Apparently the total effect of the Spencer (Taylor) Mill on the forested area of the Spencer Creek Watershed, around 1900, after several years of production, was not enough to be noted in Leiberg's assessment of the area. However, we know the mill did not operate full time over the thirty year period, and that it eventually was sold, dismantled and moved. Also, we do know it was a low production, water power, operation. In an oral history interview with Merle Anderson, Great Grandson of the Spencers, he states, due to the water-flow in Spencer Creek, the mill pond had to be refilled during the day to power the mill wheel. Mr. Anderson also states the production was "about 1,200 feet a day"(Anderson 1994). Other water powered, small saw mills are reported to have been started on Spencer Creek however there does not appear to be any trace left of them today. Leiberg reports 23,400 acres burned in a forest fire. Making the assumption that the fire was from natural causes, human impact on the watershed ca1900 from logging activities was negligible (Lieberg 1899).

The Weyerhaeuser Company began operation in the area in 1923, and built Camp 7 on Spencer Creek. Camp 7 was a frame tent camp, rather than a permanent structure. The Weyerhaeuser Railroad was extended into the Spencer Creek drainage. With the advent of more powerful tractors, skidders and loaders, the railroad was gradually replaced by converting the existing grades into roadways for logging trucks (Sokol 1994). There is extensive human impact on the land, due to the logging activities of Weyerhaeuser Company on lands they own.

In 1942, Bill Vanderhelen bought the ranch at Buck lake from COPCO. His original intent was to raise muskrats for their fur. To this end, he built a series of dikes in the lake to enhance the muskrat habitat. At the end of World War II, Mr Vandernelen abandoned this plan and went to full time cattle ranching.

At one point in time, John Boyle headed a scheme to divert the water of Buck Lake through Tunnel Creek into the Rogue River Drainage to increase the supply of irrigation water in the Rogue Valley. (See Hugh Charley oral history). There are historic photographs of Buck lake which show a large expanse of open water. The lake was formed by a natural dam, and served as a catch basin for runoff from the surrounding hills which form the basin of Buck Lake. In addition there is a large spring system that feeds the lake. Today, the natural dam has been cut, and much of the spring water is used to irrigate the pasture that has been built in the old wetland/lake bed.

Other homesteads in the Buck Lake area of the watershed were acquired by the Forest Service, canceled or if patented, sold. There appears to have been a thriving real estate speculation market in the watershed. As part of this study we tracked 169 transactions of various types. The land ownership, administration pattern is dominated by the USDA Forest Service and Weyerhaeuser Company with roughly equal holdings of more than 20,000 acres. BLM is the third major land administrator with over 8,000 acres returned to public ownership from O & C Railroad lands. Private sector ownership is less than 4,000 acres.

Little is known historically regarding the lands in the Clover and Miners Creek tributaries. There was some homesteading activity near the headwaters of Clover Creek by the Whitcomb family. There are fish in Clover Creek that do not appear to be native, but there is no known evidence of anadromous fish migrating into the drainage. That is not to say that during prehistoric times Clover creek was not flowing at a greater rate. It is simply unknown due to lack of research.

Historic Impact

The historic impact begins with cattle and sheep ranching and minor logging and sawmill activity during the 19th Century. There are two primary and one secondary source statements of fishing and fish processing activity. Alice Isobell High (see her biography) states that there were fall runs of salmon up Spencer Creek. Merle Anderson (see his oral history) tells us his father fished for salmon and smoked them at the ranch. Les Hinton who grazes cattle in Spencer Creek today, relates a story told to him by rancher Loyd Howard (deceased): Mr. Howard stated that his father would drive a wagon to the crossing (where the Applegate Trail crosses Spencer Creek), and using a pitchfork, load it with salmon. The wagon would be so full, the salmon would flop out going up the hill (Hinton pers. comm. 1995). Klamath Tribe elders also talk of catching fish (not specifically salmon) at Spencer Creek. This activity was ended with the construction of COPCO dam which had no fish ladder and stopped the anadromous fish runs.

Merle Anderson tells us of the fish hatchery on Spencer Creek, and how his father scraped out the old Spencer Mill pond for the main hatchery pond. Water was then piped to rearing ponds below the main catch pond which stored the creek water. He states "the pipes kept plugging with moss and other growth due to the high manure levels in the water", and finally the ponds had to be abandoned due to the clogged pipe system. In his oral history interview (appended) he states that the Spencer Creek Hatchery trout were in demand because of their robust size and action. One might speculate on whether or not these were trout, feral salmon, or steelhead, landlocked by construction of Irongate Dam.

Autobiography by Fred Loland Spencer

This document given to William D. Yehle, Archaeologist, Bureau of Land Management, Klamath Falls Resource Area, by Mr. Merle Anderson, December 1994

I, Fred Loland Spencer, was born April 4, 1864, on the old Judge Tolman place, three miles south of Ashland, Oregon. My parents, Hiram Edwin and Mary Elizabeth Spencer, crossed the plains in 1860, and settled on Emigrant Creek about a year.

Someone asked me what I recall about my early days in Ashland. There are three things which stand out in my mind. The first is the Thanksgiving that I was four years old, sitting silently with my parents around a bare table. My mother said rather sadly "The Lord will provide." The conversation was interrupted by a whir of wings and a grouse flew in the door, chased in by a hawk. My mother caught it and roasted it for dinner. The other members of the family dele— (sp ?) it was the best tasting grouse they had eaten. I do not recall being hungry. That Thanksgiving day has always been in my mind. I have always trusted in the Lord for everything.

The second most important event in my life was the building of a barn on the family property in Ashland by my brother-in-law, Ash McCord. It is still standing in Ashland with its square nails, wooden pegs, and handhewn sills.

At six, I wasn't so young but what I could remember and admire a tomboy playmate, Rachel Applegate, who had a pet peacock that screamed. She outdid it. No one ever suffered from boredom in her neighborhood. She was a very pretty and clever girl, who later married Mose Alford.

In 1870 the folks bought a sawmill on Spencer Creek from Melvin Nailer. Later my father purchased the Brown station and 320 acres around the junction of Spencer Creek and the Klamath River from the O. T. Brown family on credit. About all my father had at this time was a yoke of oxen and a two year old colt. He had traded his home and 160 acres in Ashland to John Walker for 46 head of horses, mostly wild. They ranged over on Roxy Ann, Grizzly Butte, and Emigrant Creek Mountain. Some of the horses provided a down payment on the land bought from Brown. After the others were sold for about $759.00. When the Modoc War broke out in 1872, the horses were paid for in script to be redeemed after the war.

The station — I never knew whether it was built by the government or by Brown — was a two story log structure, 40 ft. by 60 ft. The first floor had a kitchen, a barroom for the men (The barroom was a complimentary title, as no liquor was ever served there) and a parlor for the ladies. The second story consisted of one large room, dormitory style with approximately fifteen beds. The floors were bare but shining due to my mother's untiring efforts. Tallow candles and grease pots served as lights—meals three times a day, days without end consisted of venison, wild ducks and fish, fried potatoes and sometimes boiled potatoes and hot biscuits. Often there would be wild plum preserves, huckleberry and blueberry pies.

I can see my mother, yet, short and heavy. Father was a large man, a six footer. He wore white shirts, unbleached muslin at all times. He never condescended to wear suspenders, preferring to depend on a roll of shirt and trousers.

Captain Jack and his tribesmen were familiar figures to me during the two years after we moved to Spencer Creek. They were in and around our place twice a year on their semi-annual pass from the reservation for their supplies of Venison, Huckleberries, fish, epaws and Wocus or Indian flour. Epaws were roots they dug, and were small like peanuts with a rich nut-like flavor, but crisp in your teeth like water chestnuts. It was not unusual for my father to trade a sack of flour when we could spare it to them for a sack of dried huckleberries or epaws.

When they came to fish, they camped on Spencer flat. Hooker Jim, Scarface Charley, Shacknasty Jim, Sconchin John and many others mentioned prominently in the annals of the Modoc War, I knew as a small boy. Queen Mary, as Captain Jack's sister was called, was around with them. Nowadays they would call her a golddigger. During their periodic visits, the Modoc Chieftain frequently ate dinner with us. I used to sit on his lap. He had a boy about my age, who, with All Whittle whose mother was a Modoc, taught me to speak the jargon. Captain Jack was a fine looking Indian very straight, thin and all muscle. In describing him I am reminded of the amusing comment given by an old pioneer of the fifties, who acquired a small fortune and was persuaded to visit Europe for a bit of culture. He took one look at the statue of a Creek God in Italy and exclaimed, "My God, a Mohawk!".

In the history books Captain Jack is pictured as wearing a shirt. I never saw him with one. When he came to our station he wore moccasins, a breech clout, a head-dress and a quiver of arrows slung over his left shoulder. Usually he carried a spencer rifle along with his bow. His squaws were mostly in calico. They usually wore more than one dress and didn't bother to remove the first dress—merely donned another and then another. The last time I saw the Modoc Chieftain, until after the was, was in the fall of 1872. He came in for dinner as was his habit, and my father who had been hearing rumors, asked to see his pass. After a perusal of it, my father said, "Cap, you'd better get back to the agency." You've been out three weeks too long." Calmly Captain Jack said, "Ho no go back." "You get in trouble", advised by father. "I no care", shrugged the warrior. After a brief stay, the Modocs moved to Lost River to finish their supply of Millet. There three settlers notified the agency of the undesirable-visitors.

Captain Jack had twenty-seven warriors, not counting the young lads of sixteen and upwards. Histories list the renegade chief's force at fifty and sixty braves. Perhaps the army didn't wish to publish their embarassment over the hide and seek game in the Lava Beds, or perhaps they did not count the young boys.

By the time the soldiers arrived to return Captain Jack and his people to the reservation, the women and children were safely in the Modoc stronghold. Collie Stowe, the cook for the soldiers, personally gave me his version of the encounter. As the children from Fort Klamath approached the wickiup and gave the order to surrender, warriors were disquised as squaws carelessly walked out and into the Tule Marsh where their horses were secreted. (Editor's note: the word children is definitely wrong, it must be that the word should be soldiers.) Scarface Charley, the last one out, turned and fired into the ranks of the soldiers, and when the latter charged the wickiup, they found it as bare as mother Hubbard's cupboard.

The indians then made their way to the Lava Beds, taking time out, however, for the Brotherton and Boddy murders. The first of the next year 1873, Captain Joseph H. Hyzer and his soldiers of Jacksonville were stationed at out place. Hyzer had a Cavalry unit. It was his business to prevent the indians from reaching the Rogue River Valley. By this time, runners from Port Klamath had arrived to tell my father to move his family out. This my father declined to do. He was not afraid. One evening Captain Hyzer received word by runner that the indians were out of the Lava Beds and coming to Ashland. His orders were to cross the river and to head them off. When he was ready to leave he discovered that someone had cut the ferry loose. The boat floated down the river and had lodged a mile below the emigrant ford on some rocks. It was rumored that Bill Kinney cut the cable, at least that was the opinion among the Cavalry. That night Hyzer came to my father and asked if I a nine year old boy, might act as his guide to the Lava Beds. People have asked me why my father didn't volunteer as a guide. My father was a busy man. He operated a sawmill and supplied hay for the string of teams that came through. I had played around camp—was a sort of mascot for the soldiers. I had my own pony. I rode as easily as I breathed and was thoroughly familiar with the country.

With something akin to a thrill I heard my father saying, "sure, take him along, if he's any good to you". At midnight by the aid of a grease pot light, I saddled my pony. He was white with black ears and black eyes. He resembled Captain Jack's except that the latter had no black on him whatsoever. It was a beautiful moonlight night in February and the stars shone coldly overhead. We threaded our way up the little hill past the chalk banks and over the big eddy. Captain Hyser and I were in the lead with our horses. As we rounded the bend, I couldn't help but wonder if the turtles, some of them only about the size of a dollar, weren't out on the rocks enlivening the scene with occasional silver spills in the water. Of course, a small boy couldn't say anything like that to a Cavalry Captain. His mind would be certain to be on better things.

Our journey led us across the emigrant ford and over black mountain. Ase we took a turn in the trail on the mountain in the bright moonlight I was aware of a stinging sensation in left leg and realized I had an arrow in it.

"I'm shot," I half whispered to the Captain. I may have screamed it out, but I could barely hear my own voice. They haulted long enough to fix me up. They haulted long enough to fix me up. The doctor cut the quill end of the arrow, pulled out the rest of it and ran a sterilized rang through the hold in my leg. It was a flint tipped poisoned arrow. I do not consider that it was from Modoc hands. I am of the opinion that it came from the double-crossing Klamath Indians who secretly sneaked guns to the Modocs while they pretended friendship with the government.

We arrived at the Lava Beds at half-past one the next day. Perhaps I would have been sent home, had it not been for the wound, which swelled the entire leg. I was laid up in camp for about a week. The injury was about ten inches long and livid in appearance. Today the scar is the size of a poker chip.

As soon as my leg healed, I was out scouting on my pony. The extensive lava country was a mass of crevices: the indicans could run for cover in any direction. They could and did snip the soldiers off at will.

The company's tailor said to me, "If youre going to be a soldier you might as well dress like one." He cut out a suit and an overcoat to fit me. I kept this little uniform and wore it until it was in shreds. The soldiers at camp armed-in fact they fixed me up sassy—as my grandchildren might say. They hung a 44 colt in a holster on my saddle, and laid a sawed-off needle gun with a bayonet in front of me, when I was mounted.

A few weeks after General Canby's death, at the hands of Captain Jack, while I was out on my pony I sighted Scarface Charley and Hooker Jim trying to get roots and fish. I rode around and came in behind them. I was close enough to note "quivers" of arrows on their backs and the bows beside them on the bank. I gave them the customary greeting in Modoc and called. "You're getting something to Eat."

Hooker Jim grunted and Scarface who recognized me but had no knowledge that I was with the soldiers, merely said, "You no tellum pale face." I answered in the negative and returned to camp six miles away Here I gave the information to Captain Hyzer, who sent George Doney and Henry Roberts out to bring them in.

It was in the late spring of 1873, and shortly after this the Modoc War was over. The Tomahawk taken from Captain Jack when he was captured was given to me. I treasured this along with a gold dollar, a gift from General Canby on his visit to our station. I treasured this with a lot of English relics which were stolen from me in 1865.

I think that was about the twenty-second of May in 1873. In about four days just after the taps were blown, we saw an indian coming with a white flag. He stopped about a hundred yards away. Capt. Hyzer asked me if I knew that Indian and I said "Yes, that is Shacknasty Jim, one of Captain Jack's worst warriors." The Captain and three or four men went out to meet him, and he told the captain, "You bring Spencer Pappoose, me tell him."

One of his men camp after me. I talked to him in Modoc. He said Jack would not surrender to the regular Captain. He would not surrender to the Warm Springs Indians, but he would surrender to the Siya Killipie Jacksonville Captain—That would be Captain Hyzer. I told the Captain and we made arrangements for the Captai, Jack, to come in at nine o'clock the next morning. He did. After they were locked up, we started out to bring the rest and the ponies. They were all ready when we got there I asked the Captain if I could put my rope on Captain Jack's pony and he said "sure." I did, and the next morning Captain Jack asked for me. I went to see him. He said. "Your iskum nika couston", meaning "did you get my pony"?. I told him I did, in Modoc, and he said, "Nioka Pot Latch Nika couston", meaning "I give you my pony". I thanked him in Modoc. I had the pony for four months and when the officers came from Jacksonville to get what stuff that was left at our station, such as guns and ammunition, clothing and hardtack, they took the pony. They almost broke my heart..

I can't help but think what a great day the twenty-sixth of May in 1873 was for me. The soldiers took turns about picking me up and carrying me around, yelling bravo and hero, and they called me captain, colonel, major and general—everything they could think of.

In 1927 I ran across George Doney. He asked me if I was getting my pension. I told him what would I get a pension for. He said he was getting $75.00 a month and I deserved it too, so he made out an affidavit for me, but I was turned down. I was not on the payroll and had no discharge. Thatis the way it goes with the old pioneers who fought for their country.

After the war was over I wanted to go through the lava beds. So four of us started to go in. One of them was a girl whose father and two brothers had been killed the beginning of the war. This is where the indians had the best of the soldiers as they could run in every direction. The bottom of this was an appalling trench was very uneven and dotted with puddles of stagnant ill smelling water. A pool larger than the rest was alive with large green and block dotted frogs and repulsive lizards. Countless redhaired mink were running everywhere. We came to a high ridge of smooth lava resembling the back of an enormous prehistoric animal. We continued through a narrow passage, a mere slit between towering lava walls, which let us into an open circular space all of two acres in area. This was surrounded by solid walls of dull red lava more than a hundred feet high. In its very center stood a pillar-like lava all of three hundred feet high. It resembled a shaft of an immense chimney—and it all but smoked. Near its southern base was a large water hole which was much visited by bears, mountain lions, wolves and the wildcat, as evidenced by the many prints on the damp ground. Nearby this strange forbiding hollow is today known as the first stronghold of the Modoc Indians.

(To be continued in the winter issue.)

(TITLE NOT READABLE)..........

It was into this Lava Crater that Capt. Jack, the Modoc Chief, led his 27 warriors and their squaws and children—onehundred seventy five souls, in all, and hiding when troops of the first Cavalry, second and twenty-first infantry began to round the hostile modocs into the Lost River Valley. It was in this kettle-hole that the Modocs succeeded into lowering by means of horsehair ropes a number of their poinies for a future food supply. Here for seven long months they maintained their stand against the military forces of the U.S. As we went through we rode into a dim trail which led downward and seemingly into a very bowels of the earth. Presently, we reached a tunnel-like passage through which we crawled for about a quarter of a mile.

Suddenly we came into the open—arena—like expanse—and I gazed upon a chaotic lava vastness, of mother earth's greatest volcanic upheavals. In profound admiration our eyes rested upon what I justly may term a monstrous volcano. This giant stump of black lava forms no oval at its base and towers into a pointed top nearly a thousand feet into the blue california sky. On the northern slope this monstrous mound is roughly terraced into three distinct stories with many xx vaves openings and holes. We stood on familiar ground. I had been there before.

We pointed out cave-like retreats from which the Modocs fought our troops. These xx caves and holes are the lairs of wild beasts, and strong odors revealed the presence of bear, wildcat and the bat. We could see a scraggly cedar that stood upon a level plateau perhaps a half mile away. Under this tree stood the tent in which General Canby and his officers held a peace talk with the Modocs on that memorable day of April the 11th, Good Friday, in the year 1873.

It was a gray day, a drizzle of rain dampened the ground. This is what took place in that tent which stood under the scraggly cedar on Good Friday, April 11, 1873. At noon, General Canby in command of the Military Forces against the Modocs accompanied by two of his staff officers and the Indian Commissioner, Mencham, walked into the tent which had been erected for a peace talk with the Modocs. At the same house the Modoc Chief, Captain Jack, with nine of his warriors climbed a narrow mountain goat trail into the plateau to meet General Canby. As they met, the General shook hands with the Modoc Chief and all stooped into the tent and seated themselves on bare ground. In less than five minutes the tent seemed to blow up and we all started to run for the tent. The indians saw us coming and broke and ran for their stronghold. When we got there General Canby was dead and they had started to scalp Mencham who was unconscious, but came to in a few minutes.

Some claim that Scarface Charley and Hooker Jim were never hung but I know they were as My father was there. Captain Jack, Hooker Him and Scarface Charley and Boston Charley were all hung for their Dirty Deeds.

Chapter III
Part II

At the request of my grandchildren, I am recording some of the outstanding experiences in my life after the Modoc War. I have already written an account of my experience during the Modoc War.

Silas Kilgore was the first man to carry the Mail from Ashland to Linkville. One day when he came to our house we took him in and he was very ill and asked my father to get someone to take the mail to Ashland for him. My father said "that young man can do it", and pointed to me. So Mr. Kilgore gave me an order to the Postmaster and I started out over the old immigrant trail through the wilderness. I was nine years old. I had a fine pony and made the trip in seven hours. The mail in those days was carried in saddle bags hung over the saddle. I stayed over one day in Ashland to visit old friends there then I made the trip back to Spencer Creek in seven and one-half hours.

I helped in every way I could on the ranch until I was 13 years of age when I commenced riding wild horses. I got ten dollars a head for these horses. In 1882 some men stole two horses from the Gore ranch and two saddles from Hohn Walker. The sheriff made up a posse to go after them and I was one of the party. We followed them up on the Siskiyou Mountains and lost them. When the sheriff turned back, Bill Webb and I went over the Greenspring Mountain to Spencer Creek and swept the road for them. They passed through the night. We went to Linkville and told the sheriff and he sent us after them. We followed them to Fort Klamath over the Sand Creek Mountain and came upon them jst as the sun was coming up. We got behind a tree that had falled down and called to them to surrender. They got up and commenced shooting at us. One of them shot right and the other left handed. I shot the one on the right as I was trying to silence his gun, when I stepped down about five steps, I could see his hand very well, took good aim and shot his finger off. This silenced his gun. The other one jumped out and said, "come out and fight right", then one of us shot him in the cheek but he was not badly hurt. We took them to Linkville and turned them over to the sheriff. The sheriff started with them to Lakeview and when they got as far as the Sprague River the one who was shot in the cheek jumped out and got away. He was never heard from again. I was on that job for about five days and never got a penny out of it.

In 1885 I had another interesting experience. Lindsey Applegate came to me and wanted me to go out and work for the boys in the Hay. The first night I saw I was up against a group that was plenty tough. I said, "I came out here to work, but I am bound to live the life my mother wanted me to. I think a lot of my mother and sister but I will tell you one thing, I can ride, rope and shoot with any of you." I could see a change in the foreman, Selden Olges. The next day he came to me and said, "Sis, You know you got under my hide. I am so homesick I can't stand it any longer." In about a week he came to me and said he was going home and that the boys all wanted me to be their foreman. I got along fine with them. We got ready for the round-up in the fall.

The folowing is an account of my riding the Man Killer, which was written up by one of my granddaughters:

George Stevenson, who owned the livery stable, wrote to Oliver O. C. Applegate at Swan Lake to make a bet that Sis could ride the man killer. He was a big 1200 pound strawberry roan horse, with white stocken feet and one eye was white (they called it a glass eye). Non one had ever rode this killer. He was raised on Roxie Ann, had the range of Roxie Ann, Jersie Butte and Imperial Creek Mountain.

Oliver was a good man but couldn't turn down a sure bet as that one-even if he knew his own mother was riding. That was the life of the cattleman. Sis, had heard of the killer, but he had never been thrown from a horse since he was ten years old. After making the statement that he could ride any horse, Sis couldn't see any reason why he should turn down this ride, and there was that nick-name, Sis, that he had to think of. the men had learned to love and plenty of respect for Sis, and Sis was the kind of man that couldn't let anyone down.

They set the date for the ride-July 3, 1883. It was to be at Ashland in the square. It was quite a place to hold a thing like that. And the next day being the fourth of July, everyone could stay over for the fireworks and spend their money from the winnings.

Sis and the boys, about thirty of them, saddled their horses the afternoon of the second and rode into Ashland. There was a lot of talk about the ride on the way over. Clay Rambo (The father White the mother Indian) raised .... and Jim W. Whiller (Roller Skating expert) stuck close to Sis. They didn't ..... much about it, for against the ride. But there was that feeling between the three of them that was close and warm, and they didn't have to talk as they knew silence sometimes brought more strength to the one on the spot.

The men got to Ashland the next morning. Sis went up to see his mother, Mary Alisibeth. She was so proud and happy to see him. She fixed him breakfast while they talked. Nothing was said about the ride, but Mary knew. You couldn't live in Ashland and not know about it for it was the talk of the town for days. Mary had that kind of silence that gave Sis the confidence he needed. He knew his mother was a woman who kept close to God.

It was about 5:30 when Sis went down to the square. There was a big crowd and everyone was so interested in the excitement that they couldn't take time to ask Sis how he felt. the just told him to be sure and ride the killer as they had their money on him.

The big moment came and there was a big silence when Sis went out to the Killer. When he hit the saddle, he reached over and pulled off the leather blindfold. The Killer started bucking. He went to the right and then to the left, and then he jigged a little. Sis was still on and he stayed there. The killer went through all the bucking tricks any horse ever tried. Clay and Jim stood there with their lips ... and that deep silence that you could almost feel the warmth and paid that they felt for Sis after twenty minutes of that kind of riding. Sis's nose was bleeding, he had that sort of dazed look in his eyes that made you feel he would stick to the killer until it was over for the two of them. Sis set his jaw and jammed his right spur under the cinch; then he jammed his left spur under the cinch. Just then the killer raised his 1200 pounds up on his hind feet, put his front feet together, bowed his neck as if to say this is the end of him, (Sis). He came down on his front feet so hard that he tore he legs off the shoulders. The killer lay there. Sis knew that the killer had stopped, but he couldn't rouse himself enough to pull himself off. It was only a second when Clay and Jim were at his side loosening the cinch so they could take Sis off. They laid him on the ground. A layd had a bottle of corn squeezings and they poured it down Sis's throat. By that time the druggist was there with his remedies. After about twenty minutes Sis came too enough to realize that he had been the first man to ride the Killer, and to prove that he was not a sissy.

George Stevenson gave him three hundred dollars. The boys took Sis and had his picture taken. they were so proud of Sis—they wanted to do everything for him. They all insisted that he take some of their winnings. Sis went up and gave his mother most of his money before he started back to Swan Lake.

One of the boys had been over to Sprague River and his horse went lame on him and he left it there. We got word that some horse thieves stole some horses and his horse was in the bunch. I got up the next morning and went out on the range and saw them coming down coyote canyon. I rode and told the boys to go across Badger Flat and get them as they came out of Wild Cat Canyon and take all their horses and send them on their way on foot. But when he saw them on his horse he began shooting and he got both of them. He hung them up on a juniper tree and put a tag on their back stating that if anyone took them down before they rotted down they would get the same. The next Sunday morning I got up early and went up the ridge. I saw a lot of turkey buzzards flying around and discovered that they had eaten oen of the men. I went back and told the boys to go over and bury them.

In the fall the former foreman returned and I wanted to go home. As I ..... through Linkville, I heard of an indian boy who got out of jail and there was a twenty dollar reward offered for him so I went to Spencer Creek. My brother-in-law, W.B. Grubb, was then running the station. The next morning while we were at breakfast the indian boy came in for breakfast. After he had been gone a while I said, "I believe that is the indian boy for whom there is a twenty dollar reward". I took two of my horses and went after him. I overtook him and yelled at him to surrender. He ran his hand in his pocket and said, "I'll shoot". I threw my rope over him and started down the road, he soon yelled. I took him back to the house and Bing Grubb took him to Lakeview and got the twenty dollars.

We now learned that the railroad was coming here and I worked on the railroad that winter. When the railroad got to Ashland, I worked in the roundhouse, but when they put me on the switch engine I got scared and quit the job. Things now began to boom in Ashland, so my father sold out and went back to Spencer Creek. I had forty head of nice heifers, four mares, and three saddle horses. My brother and I ran a saw mill that summer. One day I dot on my horse and went to look after my heifers and as I got close to them I heard one of them bawl like she was hurt. I put spurs to my horse and grabbed my gun and I thought it was a cougar or a bear, but it was three indians. One had her by the head and one by the tail, the other one was going to cut her throat. She was down when I got there, I had shoved my gun in my fork of my saddle. I told them they had to pay me for the heifer. The one that was holding the heifer grabbed my horse and said "Iskum", that means "get him", I grabbed my gun and got them before you could say 1-2-3. I threw them in a beaver dam and went home. When I got home my mother said "what is the matter with you?" "Your as white as a sheet." I told her all and she said "O My God", and walked off.

I believe I know as much about the Rogue River as anyone. My father knew all of the settlers that came out here in 1849-50- and 1852 from Illinois. He came out in 1860 and ran into his old friends. They told him all that had happened and helped him all they could. In 1869 Cap Duskin, A.J. Walls and Sam Colver came to our place and wanted my father to go down to Table Rock and put a fence around the place where the peace pipe and tomahawk were buried, the 10th of September 1953.

This is just a few of the things I have done when not riding wild horses or driving stage. At one time I knew everyone from Roseburg to Lakeview.

One of the hardships I experienced in Oregon was on the 23rd of January 1889-90. We ran out of hay. I bought two stacks of hay from R. A. Emmitt. My father and brother moved our stock to Keno the next day over a hard packed road of about 4 feet of snow. That same day it commenced snowing and about three feet of new snow fell. The wind blew so hard it blew the snow all over the north side of a two story house that my mother was in. About twelve o'clock the house commenced to crack and mother ran out in the snow and screamed. I heard her and ran over to her and there she was in three feet of new snow with nothing on but her nightgown. I carried her over to our house. The next morning she wanted to go over and pack some things. She said if the house commenced to fall she would run out the back door and she told me to go and break the road as far as I could so my father could come home. I broke the road and when I got back the house was still standing. I packed in some wood for my wife and when I went out the house was down. It had broken off at the top floor. I ran over there but my mother had run out the front door and the house buried her under the snow and timber. I went back home and told my wife I would have to go for help. I started out with a seven foot pole at 9:00 A.M. the snow had drifted so you could hardly see the road. I had to break the road 7 miles but I got to Keno about — P.M. My brother-in-law, —— Grubb, got his team and some men and we started back about 4 p.m. We got back to Spencer Creek about 12:30 at night. we got my mother out about 2:30 and made a rough box. About 8:30 A.M. we all started for Keno and we got within two miles of Keno and our horses gave out, so we had to leave the sled with my mother's body in the box. However, we had a big newfouling dog and a water spaniel that t stayed with the sled all night and when we got back the next morning the coyotes had a trail beat around the sled but the dogs had kept them off. This was the fate of a brave mother that drove an ox team over the xx plains in 1860.

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In September 1882, I came to Ashland and the stage driver that drove to Grants Pass was kicked by a horse. He wanted me to drive the stage to Grants Pass. I could come back on the next stage but when I got there that man was drunk. So I had to go to Cow Creek. When I arrived at Cow Creek that driver was also drunk and I had to take the stage to Roseburg. I had eleven women in the stage nine inside and two on the seat. As I started up the hill a man stepped out from behind a tree and said "This is a stick-up-throw out the box." I reached down in the boot and got a king bolt. I said she is a heavy one you will have to help me get it out. As he came up I hit him above the ear with the king bolt and knocked him out. I tied his hands and feet and put him in the back boot. When we arrived in Roseburg he had come to. I never heard what they did with him. The women all took my address and I got a log of nice presents from all of them. I vowed I would never take that trip again and I never did.

In February 1883, a man underbid Bob Gafett on the stage route from Ashland to Linkville. He lived in the east and he sent his boy out here to run the route for him.

They had a lot of the best horses, and stages I ever saw. But he was a Drunkard and a mean man. When he got here all his men quit him and someone told him about me. I had heard about him and told him I did not want the job. He said he would give me twenty dollars if I would make one trip for him. That was when the big flood was back in 1883. I made it over the first two crossing of immigrant creek, but when I got to the upper ford I told him I could not make it but he said the mail had to go. I had two girls on the front seat with me. I unpacked the apron and told one of the girls to take hold of her sister. And when I told them to jump to really jump. When the horses hit the water, it happened. The lead horse jackknifed and the lead bars slipped over the goose neck and we jumped. I grabbed an alder limb. The water swung us around and I grabbed another limb. I got out and helped the two girls out and when we left the stage it turned around and lodged against an elder tree. The man was on top of the stage and walked off. If we had stayed on the stage we would not have gotten wet. The horses were all drowned. We went down to Doziers and they gave the girls some dry clothing. We went up to the Soda Springs. In about two hours the creek had gone down.

I took the four horses that I had driven from Ashland and started for Linkville. The man went back to Ashland. As I cam back I met Bob Garett with Mike. He said the man gave him two thousand dollars to take the job off his hands. Let him use his horses till he could get his horeses back on the line and when they did he wanted me to take his horses and the stages to Redding. So I did. We had to take the tongue out of one stage and put a short tongue in it. I hitched up six horses and tied one horse on the side of the six, that made twelve horses in the string, and I tied the rest behind the stage. I had to go in the night then so I would not meet anyone. With that long string it took four nights to make it.

An Oral History Merle Andrson

Interview By
William D. Yehle, M.A.
At
Brookings Oregon
December 20, 1994

Bill Yehle, Lakeview District, Klamath Falls Resource Area

Oral History Review With Mr. Merle Anderson in Brookings Oregon, 12/20/94.

Merle Anderson is a direct descendent of Hiram and Mary Spencer. Hiram and Mary Spencer crossed the plains in 1860 coming from Iowa, They bought a sawmill on Spencer Creek from Melvin Taylor. Later they purchased the Brown Station and three hundred twenty acres around the confluence of Spencer Creek and the Klamath River from O.T. Brown. Spencer had traded his home in Ashland and one hundred and sixty acres to John Walker for forty-six head of horses. Some of these horses provided the down payment on the land he bought from O. T. Brown. The balance of the herd was sold for $759.00 during the Modoc Indian War. The horses, we believe were purchased by the Army, and were paid for in script to be redeemed after the war.

Actual Interview With Merle Anderson:

Can you tell me anything about the things you were told when you were a child, about your family?

Ans: It seems like things like that never came up.

Did anyone ever tell you about your great grandparents, or your grandparents?
Ans: That was in later years, when I got to inquiring.

What kinds of things did they say, what did you ask about?

Ans: Well, I was interested in when my granddad Spencer came across the plains. Found out that my great granddad had a sawmill on Spencer Creek, that it was water powered. Later my grand daughter got a hold of papers on the Spencers, and that cleared a lot of things up that we were wondering about. They came across the plains in 1860, and my great granddad walked the whole distance driving cattle.

They went to Ashland?

Ans: Evidently settled in Ashland and then one of his daughters wasn't in very good health and the Doctor said to get her out in the timber and get a better climate than Ashland. He thought she would do better. Get her out where she would have some horses, cattle and dogs and stuff to play with, she would forget her troubles and get well. He got to looking around and ended up at Spencer Creek buying that sawmill. He didn't have any money to but it with so all he did was trade. They moved to Spencer Creek in 1871. The house they lived in was the top part of the sawmill, the sawmill was the lower floor so they didn't have much living space. After a few years he traded someone out of a house and some land. It was a big two story house and they lived in it until his wife was killed. It was a heavy snowstorm that winter and the top of house fell in and crushed her. I have papers that were written by one of the Spencers that explains the whole thing. He lived about 15 more years (I think) and ran the sawmill. He really didn't run it all the time, he taught his boys to run it and he did the hauling of the lumber around the area, some of it to Klamath Falls. He traded for a team of oxen, and hauled lumber from Spencer Creek to Ashland. Which would probably take two or three day each way, I think, because that was nothing but a trail you might say. A real glutton for punishment!

It was a hard life wasn't it?

Ans: That was the good old days.

Did your grand parents or their brothers or sisters continue to run the mill? Ans: No, he sold it and whomever he sold it to ran it for a short time, then they discontinued it. It was a very slow mill, one reason is that they didn't have enough water power, they only cut about 1200 feet a day. They shut the water off after each log so it (water) would build up in the pond, and then they would have a good head of water to run it a while. It took quite a while to change each log because they had to do it all by hand. It was so ridiculous because they owned a good part of Ashland. When they first settled in Ashland they got a hold of 360 acres, he had to trade off a little bit of the land at a time for food, etc. He would swap land, for something to live on for a while. When he got hard up he would just swap more land. So, he was finally down to practically nothing when he when to Spencer Creek. He traded what land he had left for horses and traded the horses for the sawmill. The sawmill was valued at $1800.00. He paid the rest of the sawmill off with the lumber he had cut.

There wasn't money around in those days?!
Ans: No, just trading and swapping.

When they bought Spencer Station, it was Brown Station and they bought it from O. T. Brown, and there was 320 acres that came with the station, where your great grandmother was killed. Did they ever rebuild that and keep it going as a station?

Ans: No

That was the end of it, when the roof collapsed?

Ans: I don't know that was the end of it, it just kind of fizzled out. The stages quit coming that way and break wagons, etc. They changed the course of the trials from time to time and got better roads elsewhere. Sometime they would go on one side of the river and sometimes on the other side. After they would get to the Klamath River they would go on the southside until they got to Keno, that was after the Keno bridge was put in, that was in the late 1900s. They started going that way rather than past our old place on Spencer Creek. It was a little better road and cut the miles shorter to go on the southside rather than the northside.

You were ranching in Spencer Creek, have you been there ranching all your life, or were you raised somewhere else first?

Ans: They had a little school down below where the bridge was on Spencer Creek, and there was a mill on the opposite side of the river, several families lived there to run the mill so they had a school there for three years. Then they discontinued the school when I was in the third grade. My mother, sister and I moved to the ranch up at Keno so we could go to school. My sister was 12 year older than I and had gone through all the schooling she was going to take. This is a picture of the log house that was down where the eddy is. Was to the northwest about half a mile from the cemetery on the hillside. Due West of the cemetery, they have the area all fenced now. It was originally five forties, two hundred acres, it was the forty isolated from the rest (that was sold). Sold one forty at Spencer Creek because we were afraid the hippies would start fires and burn everything up. This was the one by the cemetery. Had an awful lot of timber.

Did you remember anything about any big fish (salmon or steel head) running up, or have you ever heard of them running up Spencer Creek?

Ans: Yes, even had a picture in the Klamath Nickel, I can show you where my Dad used to go down there and spear them as they jumped up over the falls. It was right below where John Boyle dam is now, I can show you exactly where he stood to take the salmon out. But, I never knew anything about it because I was to young. They had a smoke house, and they smoked them as long as the salmon came up, but then Copco put in that dam down below, above Hornbrock and that was the end of the salmon run. I think they start working on the Copco dam during World War I.

Did you ever hear on any salmon going up Spencer?

Ans: Yes, in fact it mentions it in one of the autobiography of my grandfathers sister and brother, that was during the Modoc War when the Indians used to come up to get salmon.

Do you know how far they went up to spawn?

Ans: I have no idea.

We're wondering if they went all the way up to Buck Lake or not?

Ans: I have no idea, but I suppose they possibly could because there's a pretty good little head of water in there.

Today there isn't much water coming out of that?

Ans: There would be if they would let it go, I bet there is just as much water now as then. There are a few springs around that. We used to go up there. there was a big huckleberry patch at the upper end of Buck Lake, which Weyco destroyed, along with everything else. Several families would get together when the huckleberries were ripe and go up there, some would spend a week, some 2/3 days, camp together and everyone would pick huckleberries and have a good vacation. This was on the west edge of Buck Lake in the timber a little bit. Used to be little small huckleberries. Nothing there now. Could pick two three gallons a day.

Was there a lot of water in Buck Lake or was it swampy?

Ans: It was swampy, the later part of the year it was dried up. The creek was one stream right in the middle of the lake. Kids used to take boat down the creek. Might have been higher in the spring, with snow run off. The creek came down where the dam is now. I remember the folks wondered how the dam was going to effect the creek. The old man "Charlie" never backed it up to much, he let a good stream go through. He backed it up a foot or so. When the later Charlies came in it got worse and worse each year. After Jerry got to living on the creek and they would cut it off, and Jerry would make a squawk, here would come the water and the whole meadow would be flooded and everything else.

"Jerry who???"

Ans: That's one of my boys that lives on Spencer Creek now. They would let him go for a day or two with a good stream of water, then they would shut her back. Wouldn't shut it completely off, but it would be so far back that you couldn't even irrigate your pasture. So, we knew what "Charlie" was doing, but we couldn't do anything about it. We complained to the game commission and they squawked about it for a while, but I don't think "Charlie" paid much attention to them. He would let a little more out next fall.

Did you ever hear anything about back in the twenties, John Boyle apparently did a survey up there, and after that someone wanted to dig a tunnel through the mountain and divert all the Spencer Creek water into the Rogue Valley. Do you remember anything about that?

Ans: Yes I remember reading about it, hearing about it, I didn't know exactly what it was, but I know they turned it down.

Who's they?

Ans: I don't know who turned it down.

Did Charlie family own the land?

Ans: I don't know if they own it yet. It may be leased to something.

Ever hear of anyone named Walters up there?

Ans: I don't know, there was a little cabin about three or four miles from us back up in the heavy timber we called Walter's cabin and he homesteaded that. It was a small little cabin made out of logs. Last time I was up there the roof had all caved in, but it might not even be there now.

It seems as though the lake fluctuated and dried up during the fall of the year.

Ans: Yes, it was pretty dry, I don't know what it was like in the spring, I imagine from the snow run off it was probable moist.

Do remember any of the plants that were up there?

Ans: I never paid any attention to the plants, I wouldn't know one from another.

How many head of cattle did you family run up there?

Ans: Had 20/30 head in the lower part, they were just grazed locally around there and up in the meadows. After the folks were gone I ran a few head down at Keno ranch. Went through 80 ton of hay through the winter counting both ranches.

Did you grow your own hay?

Ans: Yes, Keno barn held about 60 ton hay, and barn at Spencer Creek held about 30 ton. I remember one year we had them full and stacked about 10 ton below the barn, so we must have had 100 tons. Would often take all of it during the winter. Cattle need a lot of hay, sometimes we would run out and have to buy hay, and that would hurt. You always got stuck in the snow coming out from Spencer Creek during the winter.

How did you travel?

Ans: To begin with I had a car and finally got an old pickup, I ran around as long as I could without getting stuck, after that I walked. Never learned to use snow shoes, so just walked. I would get a trail worn and then just walk in that trail. There was usually around three feet of snow around Spencer Creek each winter. Sometimes we would get a little more than that, you could see the tops of the fence posts sticking out. Them kind of winters don't happen any more, much milder now, snows then it melts off, then it stayed all winter. I think Weyco cutting all the timber changed the climate to, because where the timber used to be is nothing but bare hillside now.

Can you remember any other families with kids that lived up Spencer Creek upstream from where you were?

Ans: No there weren't any.

There were a lot of homesteads entered, and then most of them were canceled. We were wondering if people went in there just to cut timber and then left.

Ans: A lot of it was homesteaded by the people that Weyco put in there. Weyco built the houses for them and they stayed there until they were approved of, then they moved out to work in sawmills. We always wondered how those people lived when they didn't do anything, we found out that they were being paid by Weyco. Weyco took over the timber when it was done, they signed it over to Weyco. That is were most of that homesteaded timber went, to Weyco.

Can you remember Weyco Camp 7?

Ans: I don't remember 7.

What was the Weyco Camp they mainly worked out of?

Ans: Well, there was 2, 4

Did you remember the Weyco railroads

Ans: Yes, I was going to school in Keno, when they started building those railroads, it must been in the late twenties.

Were they logging with horses or oxen before that?

Ans: The first logging they did, I think they started cutting lodgepole pine, and they used that lodgepole to make railroad ties After they got out into the timber with the railroad, they started cutting large timber. Found that the lodgepole didn't make good ties, it split up, broke, etc. so they cut ties out of red fir and didn't have anymore trouble after that.

Was there more red fir that anything else up in that country?

Ans: No, there was more pine, in our area especially. Mainly Ponderosa, some sugar, some white fir, and red fir.

Can you remember if there was anything along the banks of the creek like wild cherries, or any shrubs of that kind?

Ans: Yes, I think there was something they called cherries, tiger lilies. I remember those because we used to pick them every spring and take home for a bouquet.

How about strawberries?

Ans: I can remember picking wild strawberries.

Do you know what Yampa is, Indians call them epaws? Were they up there in Spencer Creek?

Ans: Yes, I can remember them down in the flats, you have to dig down quite far, kind of hard diggen, gave up on them quickly, but they were tasty.

In one of the histories it talks about Captain Jack coming up and eating at your great grandparents place, at the station.

Ans: That was in the autobiography.

He (Capt. Jack) appears to have the habit of just walking in on people whether they liked it or not, and demanding to be fed. Do you think that was the case or was he an invited guest?

Ans: I think that was probably the case, that was the way the Indians were, they just walked in and wanted food.

They didn't seem to molest anyone, just sort of terrorized them.

Ans: I think they scared them more that anything else to begin with, until we started fighting with them. Captain Jack and the rest of those got pretty mean I guess. You ought to read those two autobiographies, they will give you a pretty good insight.

Back up where I'm from the Indians were still coming around in the twenties and thirties and knocking on doors. This was back up in Idaho. Were they still coming around when you were a boy?

Ans: No, I don't remember seeing any, they were all cleared out of there I guess. We would see them when we went to town, that was about the only place we saw them.

They were pretty well contained by then?

Ans: Evidently, or up on the reservations. In later years there were a few of them, some of the boys married Indian girls, and you would see them around Keno. Some of there in-laws would come to visit, or something. I remember somebody hammering on the door at the Keno place one time. That was after the wife and I were married. In the middle of the night there was hammering on the door and I got up, there was a great big old Indian standing there. He had run off the road, and he wanted to know where a certain fella lived in Keno. His sister had married this fella. I seen him several time after, but he sure gave me a start that night.

You don't remember any Indians using Spencer Creek for hunting, or anything when you were a kid?

Ans: No

They just weren't up there at all. The reason that we need to know that is we need to know if there was any what we call "Traditional Use".

Ans: I don't of any.

I going to shut this off for just a moment. I have a list of questions that Bill Lindsey wanted me to ask you.

What levels of grazing use occurred in area prior to the 1960's. He particularly wanted me to ask you this would be levels of use on Weyco dominated lands in the lower portions of the watershed where your lands are. Was there grazing going back up into the Weyco area prior to the 1960's?

Ans: Yes, they had sheep and grazing rights, and then anyone that had cattle had to get permission from the sheep men and pay so must a head to the sheep men to graze the cattle. Later the ???? law came in, but that was quite a bit later and they paid so much a head. I used to pay so much a head, but I only paid it to the sheep men, and that helped pay his dues.

Was there more grazing then than there is now, or was there a lot less?

Ans: There's more, the sheep have practically all left. Weyco protected the coyotes. The coyotes got so bad and killed so many sheep that even Larspol (in the Genny Creek area) said that he lost one tenth of his sheep to coyotes that last year.

Do you remember how long ago that was?

Ans: Well it must have been in the late fifties, and I wouldn't be surprised if it didn't go into the sixties before he finally quit. Got

Ans: After

You can still large chunks of concrete there now.

Ans: This is a abstract that goes back to 1890 that shows the owners over the years and states something to do with the water rights, any water coming out of Buck Lake can't be sent any place else other than the Klamath River. So that must have been put in there when they were thing about putting in the tunnel to send the water to Ashland. They wanted the water to stay on this side of the mountain.

This one doesn't have Grover Cleveland's signature on it, but there is one some where that does.

Ans: I wish that they had dated these pictures, I guessing that it was some where in 1942, or 43. He drained it in 44. It was 41 when he purchased it so I'm sure it took him a year or so to plan to drain it.

He must have taken April and May?

Ans: Yes, by looking at the snow on the mountains behind it, it had to be in the spring of the year.

Can you remember any stories of fish spawning in the lake?

Ans: No

Belle Spencer in her memoirs states that salmon used to run up Spencer Creek.

Ans: I have never heard any stories about that.

We wondered how far, we don't find any record of the Indians trapping salmon or fishing there. We find them fishing all around there, but we don't find any record at Buck Lake. Right near the outlet is a large lithic site with all kinds of flakes from tool making to sharping and so on.

Ans: You can see where he dredged that out to drain it. So it was probably a fairly decent drop back then. When we were kids there was a couple pretty good holes down there. The rocks have fell in now. As soon as we would get out of school, we lived over in the Rogue Valley, as soon as we got out of school Mom and Dad and us would go to the mountains and live there all summer until school started again in the fall.

Did you ever fish that section?

Ans: Yes, I can remember when I was in junior high, right after the season opened, we still hadn't had cows in there yet and we went in, my dad was working on some fence or something and we went in and we caught some pretty nice fish. Just right through the rock section there, in the pools.

They just looked like your standard Rainbow Trout?

Ans: Yes, as far as I knew anyway, I never paid much attention, I really wasn't much of a fisherman.

They show up in the lake to?

Ans: Yes The channel has filled in through the years, in recent years you see more fish over on the westside where our headgate is, where we dam the water up, there's a lot of fish over on that side.

Is there any fish still in that channel?

Ans: Yes, you see them, but like I said, its kind of filled in a bit, and there not as many as we used to see in the channel. We never used to see as many as we do now over on the westside where our headgate is. The water has been so low in the channel due to the draught that there just hasn't been any good holes for the fish.

It seems that there were a couple centers of population on Spencer Creek, one around Buck Lake and the other down by the confluence where the Spencers were, and there was a Ranger Station up fairly close to where your place was at one time. Can you remember any neighbors being in there at all?

Ans: No

Was there ever anyone in between you?

Ans: Not that I know. We always came in from the Jackson County side, every so often we would come around because the snow was to deep, like if we came up in the spring. We would come in on the Greensprings road, but I can never remember seeing any.

Did you ever hear of a Walters homestead?

Ans: I heard of a Walters cabin. I've seen a sign that said Walters Cabin or something. Years ago, I can remember seeing that.

You never went to it?
Ans: No

I would like to locate that.

Ans: I can't even remember exactly where I saw the sign that said Walters cabin.

I wonder if it was on the old road, could be.

Bill Lindsey had a couple of questions:

He wanted to know what levels of grazing occurred in the area prior to the 1960s? Is it about the same as now?

Ans: No, there is more now. I can remember when I was a kid and my dad was irrigating up there that there was a lot of places after they drain it that were just like the dust bowel that is out in the center of it now, probably three quarter of it was like that. So they didn't really run to many cows on the lake itself, we've increased them over the years as the sod has taken over. I can remember when I was a kid that there was a lot of areas that were just dust.

How far do your run your cattle, you run them outside of the lake bed?

Ans: On the Forest Service, BLM, and Weyco.

How many acres do you run out there?

Ans: We have about a 320 head permit on the Forest Service, BLM, and Weyco lands, altogether. I don't know what the acreage is.

They all just roam around there?

Ans: Yes, our Forest Service permit starts at the Lake-of-the-Woods and comes back to Buck Lake, and then the BLM starts on the southside of Buck Lake and goes to Surveyor Mountain.

It's more in recent years due to the opening up of forested lands, or it's more due to the fact that you increased the graze in the lakebed?

Ans: Probably the grazing on the lakebed has been able to hold more inside. But, as far as our numbers on the outside I think we have been able to acquire a couple of permits over the years. When we were first running out there I don't know what our numbers were, but there were a couple of other people around us that had range permits, that have acquired.

No one ever ran sheep up there?

Ans: Not that I know of. I can remember sheep down in what they called the Buck Pasture, which would be on wester Hentons range there, right of Clover Creek road. We have had sheep come into Buck Lake years ago that they had lost a ewe or something that would get in with the cows. We used to drive our cows from Sam's Valley to Buck Lake in the spring and turn around and drive them home in the fall time of the year. I remember driving them sheep back with the cows, those cows would beat the heck out of the sheep, but the sheep would leave them. They had been off by themselves and pretty lonely, so that by the time they got with the cows they stayed with them all the way.

Do you have a lot of coyotes up there?

Ans: Yes, they don't bother us any, so I never shoot them. We can see ten or twelve at a time out there in the lake. We have those little "sage rat" they're like a prairie dog, there just millions of them out on the lakebed itself, and they bore hole through the ditches. I think the coyotes help us on them quite a bit. That's the main reason I don't bother the coyotes, and they don't bother the cows any unless one is real sick or something. We never have had any coyote problems.

Some sheep did come in?

Ans: Yes

Any horses in there at all?

Ans: No, not that I ever knew of.

We have a wild horse herd up at Pokagama. I wondered it they had ever come down in there.

Ans: No, I have never seen any.

Any knowledge of grazing levels prior to Tayler Grazing Act prior to 1934 and/or prior to forest designation in the early 1900's? You've really answered that already, because you increased!

Ans: Yes

Have you noticed any vegetation changes over time due to the grazing of livestock?

Ans: No, not that I could think of anyway.

Just an increase of grass?

Ans: Grass on the lakebed itself. There is more feed due to the fact that logging has gone on. I can remember when we were kids there was lots of thick timber. The old road used to come in off the Dead Indian road, and I can that all there was trees and more trees. Now there is more feed out in the places where they've logged, so that would be an increase.

If the forest is open than the grass is increased, you don't have that duff on the floor anymore.

Ans: Yes

Have there been any fires up there in your time?

Ans: No, nothing real big, just little stuff.

We have a record of Mr. Liburg back in 1900 made a report to USGS. In their annual report he talks about well over 20,000 acres around Buck Lake burned.

Ans: When I was a kid, well in my early teens, my dad got a permit to cut posts from trees that were burnt. This was just east of Buck Lake, and we cut a lot of whole pine trees that were burnt.

Was it lodgepole?

Ans: No, Ponderosa pine. We cut quite a few, so there had to have been a pretty good fire there at one time.

I think that fire must have been pre-1850, but there were still a lot of scars from it 50 years later. Because there is no record of it in the historical records.

Ans: Yes, there were lots of trees that were probably a hundred year old around the ones that we cut.

We were wondering, how deep is your well for your house?

Ans: We use a spring.

We were wondering where the water table is.

Ans: USGS hit water at around twenty/twenty-five out in the lakebed. This was three or four year ago. I think that is what they said. It was a good pocket of water, but nothing real big, it didn't come gushing out of the hole or anything. Twenty-seven stands out in my mind. They hit a layer of gravel for about ten feet that had washed in from some place at one time or another.

There's a layer of what they call Mazama Ash that is down in there at about six or eight feet.

Ans: Well this gravel was below that. They figured that the gravel came from the south off of Surveyor. The lake froze over and there was a real deep freeze, then there was a thaw that pushed all the gravel out there, and there was a layer of a foot or so of just rocks that had traveled off the mountain. At the time that is what the USGS told me.

Did they drill at various places in the lake?

Ans: They wanted to get dead center in the lake, but the year they came up here it was real soft in the middle, so we were probably only a quarter of the way or a third of the way out. Then they came back the following year and went down with just a hand drill, I don't how far that went out to the center. They've got a book out on it now, I don't understand most of it, but it tells what they

Need to
insert a history of
Isobel Spencer Hight -
autobiography

(see intro)

Appendix 4
Soils

Appendix 4. Values for Soil Factors Used for Analysis

Soil Type	Acres	Runoff/ Erosion Hazard	Hydrologic Group	K Factor	Equipment Limitation[1]	Soil Depth	Slope (Percent)	Percent Coarse Fragments (0-11")[2]	Surface Texture
10	295	Low	B	N/A	Mod/C Mod/D	Deep	0-5	0-15	SL
11	2138	Low	B	N/A	Mod/C Mod/D	Deep	0-5	0-25	SL,L
129B	24	Mod	D	.10	Loamy Juniper Scabland	Shallow	1-8	30-55	L
135E	2466	Mod	B	.15	Mod/C	Very Deep	12-35	15-25	L
135G	282	Sev	B	.15	Sev/C	Very Deep	35-65	15-25	L
136E	701	Mod	B	.15	Mod/C	Very Deep	12-35	15-25	L
137C	908	Low	B	.15	Mod/C	Very Deep	0-12	15-25	L
138C	3518	Low	B	.15	Mod/C	Mod.-Very Deep	0-12	15-25	L
13C	2382	Low	B,C	.15-.24	L-Mod/C	Mod.-Very Deep	1-12	0-10	L
13E	106	Mod	B,C	.15-.24	Mod/C	Mod.-Very Deep		12-35	L
145C[3]	2963	Low	B	.20-.24	L-Mod/C	Deep-Very Deep	1-12	0-10 15-45	L CL,L
147C[3]	5985	Low	B	.17-.20	Mod/C	Deep-Very Deep	1-12 15-45	0-10	L CL,L
202F	91	Sev	B	.20	Sev/C	Very Deep	35-55	10-30	L,CL
203F	118	Sev	B	.20	Sev/C	Very Deep	35-55	10-30	L,CL
204E	1437	Mod	B	.17-.20	Mod-Sev/C	Deep-Very Deep	12-35	10-30	L,CL
205E	2025	Mod	B	.17-.20	Mod/C	Deep-Very Deep	12-35	10-30	L,CL
4	449	Sev	Not Rated	N/A	Low/C Low/D	Not Rated	Not Rated	High	Not Rated
6P	12	Low	A	N/A	Low/C Sev/D	Deep	0-20	0	LS
79E[3]	199	Mod	B	.20-.24	Mod-Sev/C	Deep-Very Deep	12-35	0-10 15-45	L CL,L
80E[3]	1146	Mod	B	.20-.24	Mod-Sev/C	Deep-Very Deep	12-35	0-10 15-45	L CL,L
85A	1665	Low	D	.32	Wet Meadow	Very Deep	0-1	0	SiL
99A	478	Low	D	.32	Wet Meadow	Very Deep	0-1	0	SiL
R1	5850	Low-Mod	A and B	N/A	See Winema SRI	Deep	0-35	Not Rated	FSL,L
R10	453	Low	A and B	N/A	"	Deep	0-35	Not Rated	FSL
R11	613	Low-Sev	A and B	N/A	"	Deep	10-60	Not Rated	SL
R1R3	1178	Low	A and B	N/A	"	Deep	0-35	Not Rated	FSL, SL,L
R2	109	Sev	A and B	N/A	"	Deep	35-70	Not Rated	FSL, SL,L
R3	291	Low	A and B	N/A	"	Deep	0-35	Not Rated	FSL, SL,L
R4	5524	Low-Mod	A and B	N/A	"	Deep	0-35	Not Rated	SL
R5	780	Sev	A and B	N/A	"	Deep	35-70	Not Rated	SL
R6	2285	Low	A and B	N/A	"	Deep	0-35	Not Rated	FSL

Appendix 4. Values for Soil Factors Used for Analysis (continued)

R7	184	Sev	A and B	N/A	"	Deep	35-70	Not Rated	SL
R8	3629	Low-Mod	A and B	N/A	"	Deep	0-35	Not Rated	SL
R10	827	Low	A and B	N/A	"	Deep	0-35	Not Rated	FSL.SL
R9	712	Sev	A and B	N/A	"	Deep	35-75	Not Rated	SL
X2	1120	Low-Mod	B and C	N/A	"	Shallow	0-35	Not Rated	SL,LS

[1]The equipment limitation rating reflects soil characteristics that limit the use of equipment. Slope, wetness, and the susceptibility of the soil to compaction are the main factors that cause an equipment limitation. C=Compaction limitation/hazard. D=Displacement limitation/hazard.

[2]Abbreviations used for soil texture classes are as follows:

S	Sand
LS	Loamy Sand
SL	Sandy Loam
L	Loam
SiL	Silt Loam
Si	Silt
SCL	Sandy Clay Loam
CL	Clay Loam
SiCL	Silty Clay Loam
SC	Sandy Clay
SiC	Silty Clay
C	Clay

These texture classes are listed in order of increasing proportion of fine particles.

[3]These soil types are a complex of two soils; therefore, values for both are provided.

so that Weyco give them certain allotments of land, which I understand, and they have to be careful not to get over into the Weyco land or they would get in trouble. They didn't know exactly where the lines were, and they would always be in trouble for grazing where they shouldn't. Then the coyotes!!

Did you run cattle up around Weyco?

Ans: Yes, around the Spencer Creek area. In the fall we would take them to Keno for winter.

Was it always the same season of use, in those days as it is now?

Ans: Pretty much the same, same ones, same cattle came in each year.

Is it more in recent years?

Ans: It's less.
What type of domestic animals used the area?

Ans: More sheep than cows then, more cows now than sheep.

What about wild horses?

Ans: There were horses, still is. None in Spencer Creek drainage.

1934 Taylor Grazing, do you know anything about levels of grazing use before then?

Ans: Seemed like it was a little bit earlier than that when there were so many sheep in there.

So there was probably more grazing before 1934?

Ans: Yes, cause there was Quinlin, Fitzgerald, and someone else that had herds in there.

Have you observed or noted any vegetation changes over time due to the grazing of livestock.

Ans: I know there's a lot more thistles than there used to be. After we quite cutting timber the thistles started taking over, and they're sure heavy in some parts.

Is the grass pretty much the same?

Ans: I would think so. In fact I suppose there's a little more grass than there used to be, because it's opened up more then it used to be. A lot of grass where there used to be nothing but timber.

Is there a noticeable increase in weeds or undesirable plants?

Ans: Yes, that would be thistle.

Is there places where they're thicker than others?

Ans: No, they are thick in some places more than other, but no particular places.

I think I've asked all the questions that everyone has asked me to ask you.

The fisheries people are interested in any fish that were going up and down the creek at any given time. They think there are some very big trout that go in there and they think they might be remnants of the big steel head that used to go up there and spawn. There is a lot of remnants of salmon that are between the dam and Agency lake.

Did you used to fish in there when you were a boy?

Ans: I used to fish in Spencer Creek even if it was closed. It was always closed when I was a kid, but I used to fish in it.

Was there a fish hatchery down there?

Ans: Yes
What was that like?

Ans: That was where the mill site was. They used the same pond that was on the hill. I can remember when I was a little kid, I was just about seven, Dad had a little sled scraper and the game commission took it over to clean out the old mill pond. He worked over there for several days cleaning it out, and I played over there while he did it. Shortly after that they built the fish hatchery there. The water came from the pond down through the pipes and ran through the fish hatchery draws all the time, day and night. I was thinking that the hatchery finally burned down, but my nephew straightened me out on that. That they tore it down, I guess the moss formed on the pipes because Buck Lake was sending that manure water down from that lake and that was causing algae and what not, causing moss in the pipes and they couldn't keep their pipes open. So, that was why they discontinued the hatchery there. Before the hatchery was there they had a holding pen that they would put in every spring and catch the trout and spawn the eggs and pack them in ice and take them back to Ft. Klamath and hatch them out up there because they had a better hatch out of Spencer Creek trout that they did any place else.

I really surprised me to find that Oli Sterns homesteaded right up near where Weyco mill is today, and he used to walk every third day eleven mile, one way to Brown station, before it was Spencer station, cause Brown had a sharpening wheel, he would take his two scythes down there to be sharpened. He was a young fella and Mrs. Brown would feed him lunch, then he would walk back and work for two more days and then would start the walk all over again. The following year he got his stock. I wondered why he didn't go to Linkville, but Linkville probable wasn't there. I think someone was in Spencer Creek before anyone was in Linkville. Brown went in there in the early sixties, then Camp Day was right there by you family's place isn't it.

Ans: The nearest we can figure out is that it's just a little bit east of the cemetery. Before you drop over to Cedar Creek. There's a little flat there and the nearest we can figure out is that is where it was. I think it mentioned it as about a half a mile west of Spencer Creek.

It's interesting that Brown was over there in the 1860 in July and August. They must of walked and rode until they got over there.

Ans: Took about ten years before my great granddad walked in.

Lot of history at the mouth of Spencer Creek isn't there?

Ans: Yes, and where that old barn used to be they dig up square nails. It was just across the creek by the old bridge. I think the old cemetery is interesting. Merle put a new marker down for his twin brother buried there. Lots of vandalism, etc. One childs grave is where they have put a coloring book. Merle's twin was the last one to be buried there, 81 years ago. Merle's grand-aunts were buried there, more on the westside, can't even tell where with the marker all gone. Where the pickets are, those were the Connellys, I think there's three or four buried there. He just had a sawmill down where near Topsy park is now. Just above where the John Boyle dam is now. He used to cut and sell shingles.

Was he married to one of your aunts?

Ans: No they were no relation. There used to be an old rail fence around the cemetery. People still go in every few years and tear things up. Jerry wants to be buried there, he just loves it there. There is a lady buried there by the name of Decker, never heard of her before, didn't know who she was. A surveyor friend of mine says she came from Round Lake, some of the fellas stayed there all winter, and she got phenomia and they couldn't get out to get medicine in Klamath Falls, so they tried to get to Spencer Creek to bury her. They brought her down on sleds and buried her.

It was pretty hard to get around. The story says that when you great grandmother was killed they had to keep her until spring when the ground thawed so they could bury her over at the cemetery.

Ans: I don't whether that happened or not. This Leland Spencer that wrote that autobiography, he explains that very carefully, about that had such a time trying to take her to Keno, and the snow was deep and the horses gave out about Cooper Station, I guess. They had a dog so they left the dog with his mother in a box to keep the coyotes away. The next morning when they came back with a new team to get the body, the coyotes had been all around there, but the dog kept them away. You must read the family history, our granddaughter dug them up in Jacksonville. The one that Fred wrote a lot of it you can't hardly make out, but you get the just of it. The one my great aunt

Nell, my mothers aunt wrote, her last name was High, there's a High street in both Klamath Falls and Ashland, they're both named after the same High. It's because they lived in Ashland and then moved to Klamath Falls.

An Oral History of Mr. Hugh Charley

Given to
William D. Yehle, M. A.
Archaeologist
Bureau of Land Management
Klamath Falls Resource Area
December 1994

Oral History Interview with Mr. Hugh Charile, Rancher at Buck Lake in the Spencer Creek Watershed

Present is Andy Hamilton and Patti Buettner, both Biologists, myself (Bill Yehle), and Mr. Charlie.

We have a few questions to ask you, but I would like you to remember things that your dad and uncle told you. Patti has a few questions.

Do you ever remember hearing about a scheme to drain Buck Lake and revert the flow into Rogue River valley?

Ans: I hear that is why they named Tunnel Creek, tunnel creek. They were going out through there and Ashland was going to buy the water. That's the story I heard. Here are some pictures when it was still a lake. My great grandfather went out with a cat and pushed berms up, he was trying to raise muskrats. This picture was during the spring time of the year. He pushed up dikes so the muskrats would have places to build their dens, or whatever.

Did you ever hear how deep it was at that time?

Ans: I talked to my Mom and she couldn't remember. There was one channel out near the middle of the lake and they would have to take their boat there, or they would run a ground. That was in the summer time, I guess there was a low spot near the center that was about ten feet deep when it was at it's fullest.

My dad ran range cows out on the outside, and he can remember in the mid thirties he went up there when he was a kid to bring cows out of the mountains, he could ride out across the lake quite a ways, that was in the fall of the year.

Do you think the water flow from the springs has stayed pretty much the same?

Ans: As far as my recollections go it has been about the same. It has its ups and downs, this last summer is the lowest that I have ever seen it. The main spring was hardly running when we got there with the cows in May. I remember in 77 when we had the draught it rained early in the summer, but then it dried up later in the summer. Those springs seem to they don't run a whole lot earlier in the summer, from the end of July to early September is when they run the most. There's more water comes out of the springs that time of the year than earlier in then the year, then they taper off for winter.

Was there any kind of cattails or any other kinds of vegetation there?
Ans: These pictures show some things growing.

Do you know the date of the picture?

Ans: No, it was right after my grandfather purchased it, he drained it in 1944. so these pictures were 42 or 43, I believe he bought it in 1941.

What was your grandfathers name?

Ans: Bill Vanderhelen

We have some aerials from 1940 and they show some water there, but they don't show it like this. This is phenomenal. it is really a lake.

Did he make any attempt to raise the level?

Ans: Yes, he built a little cement dam to raise the water up.

Was the dam done before or after these pictures were taken?

Appendix 5
Wildlife

Introduction

This appendix has three main parts. The first is a description of the process of prioritizing species for determination of potential occurrance and/or habitat in the Spencer Creek watershed. The second part gives the model assumptions and ratings for the different species groups. The third part is a wildlife species table listing the different species that are suspected or documented in the watershed.

Species Priority Identification for Analysis for the Spencer Creek Watershed Analysis

The following process describes the definitions for prioritization of species for determination of occurrence and/or potential habitat, during watershed analysis. This priority scheme should apply only to those species which have either been documented, are known to occur, or have the potential to occur, based upon habitat availability, and/or historic presence. Certain species are of high priority, or even mandatory (federally listed species) for consideration based upon their status. Other species are optional based upon their relavance in the watershed and whether or not an issue has been identified for the species. A species is considered relevant for analysis if it has a high potential of occurring and if the watershed is important for the species in terms of its distribution and numbers. A species is considered non-relavant if there is no threat to the species' habitat, or if the watershed plays a very minor role for the viability of the species.

Not all of the species listed below were considered relevant for individual analysis for the Spencer Creek Watershed Analysis. The species listed are those which fall under the designated category and which may occur within the watershed.

Some of the species listed below were analyzed individually such as the bald eagle and the northern spotted owl. Due to time limitations, others were addressed as a group as appropriate, or not at all. Species listed do include those that are not considered relevant to the analysis, that is the watershed is not believed to play a significant role in providing habitat for these species.

Priority #1

- Species listed as threatened or endangered by either the U.S. Fish and Wildlife Service or the Oregon Department of Fish and Wildlife, or which are Federally proposed as threatened or endangered.

Bald eagle
Northern spotted owl
California wolverine

- Species listed in the ROD for the Northwest Forest Plan (Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl) as requiring protection buffers.

White-headed woodpecker
Black-backed woodpecker
Pygmy nuthatch
Flammulated owl

- Category 1 and 2 candidates for Federal listing as threatened or endangered. Category 1 = taxa for which the U.S. Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened; Category 2 = taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

Spotted frog
Cascades frog
Foothill yellow-legged frog
Western pond turtle
Fisher
Pacific western big-eared bat
Northern goshawk
Ferruginous hawk
Mountain quail
Western least bittern
White-faced ibis
Black tern
Tri-colored blackbird

- "Survey and Manage Species" falling under survey strategy #1 in the Northwest Forest Plan.

Great gray owl
Fringed myotis
Silver-haired bat
Long-eared myotis
Long-legged myotis
Pallid bat

- Species which have been identified in issues for the watershed.

Pacific giant salamander
Deer
Elk
Marten

- Species listed as Sensitive by Region 6 of the U.S. Forest Service.

American white pelican
Greater sandhill crane
Yellow rail
Long-billed curlew

Species which would fall under Priorities 2 and 3 are recommended for analysis as time allows; however, when the final U.S. Forest Service Region 6 Sensitive Species list becomes final, the species on that list will fall under Priority #1 for analysis where they are relevant to the watershed.

Priority #2

- BLM BSO status species

*1-Lewis' woodpecker
*1-Three-toed woodpecker
*1-Pileated woodpecker
*1-Purple martin

- Species listed as "Proposed Sensitive" by Region 6 of the U.S. Forest Service.

Rough-skinned newt
*Three-toed woodpecker
*Pileated woodpecker

- Oregon State Critical

*Lewis' woodpecker
*Three-toed woodpecker
*Pileated woodpecker
*Purple martin

- BLM BAO status species

*1-Merlin
Snowy egret
Bufflehead
*1-Greater yellowlegs

- Species designated for protection under the Winema Land and Resource Management Plan

Golden eagle
Osprey
Prairie falcon
*Three-toed woodpecker
*Pileated woodpecker

- Neotropical migrants (Possibly analysed by guild or habitat type).

Approximately 62 bird species (See species list for the Spencer Creek watershed)

- "Survey and Manage Species" falling under survey strategy #2 in the Northwest Forest Plan.

For wildlife, these species are the same as those listed for survey strategy #1.

- Species which are important to maintaining forest biodiversity through their function as dispersal agents for lichens and fungi.

Northern flying squirrel
(there may be others)

- Species listed in the Oregon Natural Heritage Program's List #2. These are species for which populations within the watershed being analysed occur as disjunct populations, are peripheral to the normal range of the species, or are extremely rare. Such species occurrances can be significant for protecting the genetic diversity of a taxon.

*Merlin

For priority numbers 3 to 5, individual species are not listed.

Priority #3

- Oregon Vulnerable, Oregon Peripheral or Naturally Rare, and Oregon Undetermined Status.

- Species designated for monitoring under the Winema Land and Resource Management Plan.

- BLM BTO status species.

Priority #4

- Species identified in the Northwest Forest Plan as being closely associated with late-successional forest and/or riparian areas. These species are listed as follows in Volume 1 of thePlan:

Amphibians-3&4-174; Birds-3&4-179 & 180; Mammals-3&4-184; Bats-3&4-188; Fish-3&4-197.

- Species for which there may be social demand.

- Species from the Oregon Natural Heritage Program List #3 (Review List) which do not fall under a more restrictive classification (Federal Endangered Species Act or the Oregon State Endangered Species Act).

Priority #5

- "Survey and Manage Species" falling under survey strategies #3 and #4 in the ROD.

- Species from the Oregon Natural Heritage Program List #4 (ONHP Watch List) which do not fall under a more restrictive classification (Federal Endangered Species Act or the Oregon State Endangered Species Act).

LEGEND

*1 - First listing of species which are repeated within the same priority.
* - Duplicate listings of species within the same priority

Wildlife Species Groups

Introduction

The following appendix material is related to the material in the previous section of this appendix. See that section for more information on what this material signifies.

Species Group

1 WHITE FIR
1 WHITE FIR/MIX-VARIOUS CONIFERS
1 SHASTA RED FIR
1 SHASTA RED FIR/MIX-CONIFERS
1 WHITE DOUGLAS FIR/PONDEROSA

1 MIX-VARIOUS CONIFER SPECIES

Canopy Closure

10 TREE CC 56-70%
10 TREE CC 71-100%

Size Structure

100 MEDIUM-LARGE
100 SMALL/MS+
100 SMALL/MS++
100 MEDIUM/MS-
100 MEDIUM/MS+
100 LARGE/MS-
100 LARGE/MS+

Northern Spotted Owl Dispersal Habitat Query Criteria Value PMR Category Description

Species Group

1 WHITE FIR
1 WHITE FIR/MIX-VARIOUS CONIFERS
1 SHASTA RED FIR/MIX-CONIFERS
1 SHASTA RED FIR
1 MIX-VARIOUS CONIFER SPECIES
1 LODGEPOLE PINE/PONDEROSA PINE
1 PONDEROSA PINE
1 INCENSE CEDAR
1 PACIFIC SILVER FIR
1 ENGLEMAN SPRUCE
1 WESTERN HEMLOCK
1 DOUGLAS FIR
1 MOUNTAIN HEMLOCK
1 LODGEPOLE PINE
1 WHITE/DOUGLAS FIR/PONDEROSA

Size Structure

10 SMALL-MEDIUM
10 SMALL/MS+
10 MEDIUM/MS-
10 SMALL/MS++
10 LARGE/MS+
10 LARGE/MS-
10 MEDIUM/MS+
10 POLE/MS++
10 MEDIUM-LARGE
10 POLE/MS+

Canopy Closure

100 TREE CC 41-55%
100 TREE CC 56-70%
100 TREE CC 71-100%

Bald Eagle (HALE) Nesting Habitat PMR Model/Map Query Summary

See the attached list of habitat query criteria and the electronic CLI file named PMR_MODEL (USFS), for a complete list of Pacific Meridian Resource (PMR) categories pertinent to this species. Ranking values for the PMR categories for nesting bald eagle habitat and the combinations which were used as criteria for mapping are as follows:

Canopy closure = Third most important habitat attribute; Value = 1;
Species value = Second most important attribute;
Primary value = 20, Secondary value = 10
Size structure = Most limiting habitat attribute;
Primary value = 200, Secondary value = 100

For the highest suitability habitat, the following combinations were mapped:

1^{o}spp + 1^{o}ss = 220
2^{o}spp + 1^{o}ss = 210
cc + 1^{o}spp + 1^{o}ss = 221
cc + 2^{o}spp +1^{o}ss = 211

The above criteria were mapped within .75 mile of Spencer Creek, Buck Lake, and the Klamath River (the portion of habitat within .75 mile of the river which falls within the watershed).

Questionable habitat would include the following combinations:

110, 111, 120, & 121 - These combinations were not mapped.

References:

U.S.F.W.S. 1986
Anthony and Isaacs 1989

Bald Eagle Nesting Habitat Query Criteria Value PMR Category Description

Canopy Closure

1 TREE CC 26-40%
1 TREE CC 41-55%
1 TREE CC 56-70%
1 TREE CC 71-100%

Tree Species

10 /ABAM//MIX//
10 /ABCO//MIX//
10 ///ABCO/MIX/
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10 EDIT /ABCO//MIX//
10 ///ABAM/MIX/
10 /MIX//ABCO//
10 /MIX////
10 MIX/////
10 EDIT ///ABMAS/MIX/
10 EDIT /ABMAS//MIX//
10 ///ABMAS/MIX/TSME
10 ///ABMAS/MIX/
10 /ABMAS//MIX//
10 EDIT ///MIX/TSME/
10 EDIT //MIX/PICO/
10 EDIT //MIX//
10 EDIT /MIX////
10 //MIX/TSME/
10 //MIX/PICO/
10 //MIX//
10 /MIX//ABMAS//
10 EDIT ///ABCO/MIX/
10 EDIT /ABAM//MIX//
20 ///ABAM/PSME/
20 /ABCO//PSME//
20 ///ABCO/PILA/
20 ///ABCO/PIPO/
20 ///ABCO/PSME/
20 ///ABCO/PSME/TSME
20 EDIT ///PSME//
20 ///PSME//
20 /PSME//MIX//
20 /PSME//ABCO//
20 /PSME////
20 PSME/////
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20 EDIT ///PIPO//
20 EDIT /PIPO////
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20 ///PIAL/PICO/
20 EDIT //MIX/PSME/
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20 EDIT /MIX//PSME//
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20 PIPO/////
20 EDIT ///PILA//
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20 EDIT ///PICO/PIPO/
20 EDIT /PICO//PIPO//
20 ///PICO/PIPO/
20 ///MIX/PILA/PSME
20 ///ABMAS/PSME/
20 ///ABMAS/PIPO/
20 /ABMAS//PSME//
20 EDIT ///ABCO/PSME/
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20 EDIT /ABCO//PSME//

Size Structure

100 SMALL/MS+
100 MEDIUM/MSLD
100 MEDIUM/MS-
200 MEDIUM-LARGE
200 SMALL/MS++
200 MEDIUM MS+
200 LARGE/MSLD
200 LARGE/MS-
200 LARGE/MS+

White-Headed Woodpecker Breeding/Feeding Habitat PRM Model/Map Query Summary

See the attached list of habitat query criteria and the electronic CLI file named PMR_MODEL (USFS), for a complete list of Pacific Meridian Resource (PMR) categories pertinent to this species. Ranking values for the PMR categories for nesting/breeding habitat for the white-headed woodpecker and the combinations which were used as criteria for mapping are as follows:

Canopy closure = Third most important habitat attribute; Value = 1

Size structure = Second most important; Value = 10

Tree species = Most important; Primary value = 200; Secondary value = 100

The following combinations were mapped:

ss + 2°spp = 110
ss + 1°spp = 210
cc + ss + 2°spp = 111
cc + ss + 1°spp = 211

References

Blair 1993
Frederick and Moore 1991
Marshall 1992a

White-Headed Woodpecker Breeding/Feeding Habitat Query CriteriaValue and PMR Category Description

Canopy Closure

1 TREE CC 11-25%
1 TREE CC 26-40%
1 TREE CC 41-55%

Size Structure

10 MEDIUM-LARGE
10 MEDIUM/MSLD
10 SMALL/MS+
10 SMALL/MS++
10 MEDIUM/MS-
10 LARGE/MSLD
10 MEDIUM/MS+
10 LARGE/SEED-SAP-POLE
10 MEDIUM/SEED-SAP
10 LARGE/MS+
10 LARGE/MS-

Tree Species

100 /ABAM//MIX//
100 ///ABAM/MIX/
100 ///ABAM/PSME/
100 EDIT /ABAM//MIX//
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Black-Backed Woodpecker (PIAR) Breeding/Feeding Habitat PMR Model/Map Query Summary

See the attached list of habitat query criteria and the electronic CLI file named PMR_MODEL (USFS), for a complete list of Pacific Meridian Resource (PMR) categories pertinent to this species. Ranking values for the PMR categories for nesting/breeding habitat for the black-backed woodpecker and the combinations which were used as criteria for mapping are as follows:

Species - Most important habitat attribute;
Values = 200, 100
Size structure - Second most important;
Value = 10
Canopy closure - Third most important;
Value = 1

The following combinations were mapped.

Preferred Habitat

1°SP + SS + CC = 211
1°SP + SS = 210

Secondary Habitat

2°SP + SS + CC = 111
2°SP + SS = 110

References:

Marshall 1992a
Marshall 1992b
Goggans, Dixon, and Seminara 1988

Black-Backed Woodpecker Breeding/Feeding Habitat Query Criteria Value PMR Category Description

Canopy Closure

1 TREE CC 26-40%
1 TREE CC 41-55%
1 TREE CC 56-70%
1 TREE CC 71-100%

Size Structure

10 SMALL-MEDIUM
10 MEDIUM-LARGE
10 POLE/MS++
10 SMALL/MS+
10 MEDIUM/MSLD
10 SMALL/MS++
10 LARGE/MS+
10 LARGE/MS-
10 LARGE/MSLD
10 MEDIUM/MS+
10 MEDIUM/MS-
10 SMALL/MSLD

Trees Species

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200 EDIT ///ABCO/PIPO/

7 18 95

Pygmy Nuthatch (SIPY) Breeding/Feeding Habitat PMR Model/Map Query Summary

See the attached list of habitat query criteria and the electronic CLI file named PMR_MODEL (USFS), for a complete list of Pacific Meridian Resource (PMR) categories pertinent to this species. Ranking values for the PMR categories for breeding/feeding habitat for the pygmy nuthatch and the combinations which were used as criteria for mapping are as follows:

Species - Most important habitat attribute; Values = 200, 100
Size structure - Second most important; Value = 10
Canopy closure - Third most important; Value = 1

The following combinations were mapped:

Preferred Habitat

1°SPP + SS + CC = 211
1°SPP + SS = 210

Secondary Habitat

2°SPP + SS + CC = 111
2°SPP + SS = 110

References:

Chapel et al. 1991
Marshall 1992

Pygmy Nuthatch Breeding/ Feeding Habitat Query Criteria Value PMR Category Description

Canopy Closure

1 TREE CC 26-40%
1 TREE CC 41-55%
1 TREE CC 56-70%

Size Structure

10 MEDIUM-LARGE
10 SMALL/MS++
10 POLE/MS++
10 SMALL/MS+
10 MEDIUM/MSLD
10 MEDIUM/MS+
10 MEDIUM/MS-
10 LARGE/SEED-SAP-POLE
10 MEDIUM/SEED-SAP
10 LARGE/MS+
10 LARGE/MS-

Tree Species

100 /ABAM//MIX//
100 ///ABAM/MIX/
100 EDIT /ABAM//MIX//
100 EDIT /ABCO/MIX//
100 EDIT ///ABCO/MIX/
100 ///ABMAS/MIX/
100 /ABMAS//MIX//
100 /MIX//ABMAS//
100 /MIX//ABCO//
100 /MIX////
100 MIX/////
100 EDIT ///JUOC//
100 ///CADE3/MIX/
100 EDIT ///ABMAS/MIX/
100 EDIT /ABMAS//MIX//
100 EDIT ///PILA//
100 EDIT /PICO//MIX//
100 EDIT ///PIAL//
100 ///PIAL/PICO/
100 EDIT ///MIX/TSME/
100 EDIT ///MIX/PSME/
100 EDIT ///MIX/PICO/
100 EDIT ///MIX//
100 /PSME//MIX//
100 EDIT /MIX//PSME//

100 ///MIX/TSME/
100 ///MIX/PSME/
100 ///MIX/PILA/PSME
100 ///MIX/PICO/
100 ///MIX//
100 EDIT ///ABAM/MIX/
100 /ABCO//MIX//
100 ///ABCO/MIX/
100 ///ABCO/PILA/
200 ///ABCO/PIPO/
200 /PICO//PIPO//
200 EDIT /PICO//PIPO//
200 PIPO/////
200 /PIPO//PSME//
200 /PIPO////
200 EDIT ///PIPO/PSME/
200 EDIT ///PIPO//
200 EDIT /PIPO////
200 EDIT PIPO/////
200 ///PIPO/PSME/
200 ///PIPO//
200 EDIT ///PICO/PIPO/
200 ///PICO/PIPO/
200 EDIT ///MIX/PIPO/
200 ///MIX/PIPO/
200 ///ABMAS/PIPO/
200 EDIT ///ABCO/PIPO/

Flammulated Owl (OTFL) Breeding/Feeding and Roosting Habitat PMR Model/Map Query Summary

See the attached list of habitat query criteria and the electronic CLI file named PMR_MODEL (USFS), for a complete list of Pacific Meridian Resource (PMR) categories pertinent to this species. Ranking values for the PMR categories for the flammulated owl and the combinations which were used as criteria for mapping are as follows:

Nesting/Foraging Habitat

Species - Most important habitat attribute; Values = 300, 200, 100
Size Structure - Second most important habitat attribute; Value = 10
Canopy Closure - Third most important habitat attribute; Value = 1

The following combinations were mapped:

Preferred Habitat

Primary species + cc + ss = 311
Primary species + ss = 310

and

Suitable Habitat

Secondary species + cc + ss = 211
Secondary species + ss = 210

Roosting Habitat

Canopy closure - Most important habitat attribute; Value = 100
Size structure - Second most important habitat attribute; Value = 10
Species group - Third most important habitat attribute; Value = 1

The following combinations were mapped:

Preferred Habitat

cc + ss + spg = 111

Flammulated Owl Breeding/Feeding Habitat Query Criteria Value PMR Category Description

Canopy Closure

1 GRASS
1 TREE CC 26-40%
1 TREE CC 41-55%
1 TREE CC 56-70%

Size Structure

10 GRASS
10 SMALL/MS++
10 MEDIUM/MS+
10 LARGE/MS+
10 LARGE/MS-
10 MEDIUM/MS-
10 MEDIUM-LARGE

Species

100 /ABCO//MIX//
100 MIX/////
100 /MIX//ABCO//
100 EDIT /MIX////
100 EDIT ///MIX//
100 MIX//
100 MIX///
100 ///ABCO/MIX/
100 EDIT /ABCO//MIX//
100 EDIT ///ABCO/MIX/
100 ///CADE3/MIX/
200 /ABCO//PSME//
200 ///PICO/PIPO/
200 /PICO//PIPO//
200 EDIT ///MIX/PSME/
200 EDIT ///MIX/PIPO/
200 EDIT /MIX//PSME//
200 ///MIX/PSME/
200 ///MIX/PIPO/
200 ///MIX/PILA/PSME
200 EDIT ///PILA//
200 ///PILA//
200 EDIT ///PICO/PIPO/
200 EDIT /PICO//PIPO//
200 ///CADE3/PSME/
200 ///ABCO/PILA/
200 EDIT /ABCO//PSME//
200 EDIT ///ABCO/PIPO/
200 EDIT ///ABCO/PSME/
200 ///ABCO/PIPO/
200 ///ABCO/PSME/
300 PIPO/////
300 /PIPO////
300 /PIPO//PSME//
300 ///PIPO//
300 ///PIPO/PSME/
300 EDIT PIPO/////
300 EDIT /PIPO////
300 EDIT ///PIPO//
300 EDIT ///PIPO/PSME/
300 PSME/////
300 /PSME////
300 /PSME//ABCO//
300 /PSME//MIX//
300 ///PSME//
300 EDIT ///PSME//

Flammulated Owl Roosting Habitat Query Criteria Value PMR Category Description

Species Group

1 WHITE FIR/MIX-VARIOUS CONIFERS
1 SHASTA RED FIR/MIX-CONIFERS
1 MIX-VARIOUS CONIFER SPECIES
1 WHITE/DOUGLAS FIR/PONDEROSA

Size Structure

10 POLE/MS++
10 MEDIUM/MS+
10 LARGE/MS+
10 LARGE/MS-
10 MEDIUM/MS-
10 SMALL/MS+
10 SMALL/MS++

Canopy Closure

100 TREE CC 71-100%

Deer (ODHE) Hiding Cover Habitat PMR Model/Map Query Summary

See the attached list of habitat query criteria and the electronic CLI file named PMR_MODEL (USFS), for a complete list of Pacific Meridian Resource (PMR) categories pertinent to this species. Ranking values for the PMR categories for deer, and the combinations which were used as criteria for mapping are as follows:

Hiding Cover Habitat

Species group - Least important habitat attribute; Value = 1
Size Structure - Second most important habitat attribute; Value = 10
Canopy Closure - Most important habitat attribute; Value = 100

The following combination was mapped:

SG + SS + CC = 110

Deer Hiding Cover Habitat Query Criteria Value PMR Category Description

Species Group

1 SHRUB
1 WHITE FIR
1 SHASTA RED FIR
1 SHASTA RED FIR/MIX-CONIFERS
1 WHITE FIR/MIX-VARIOUS CONIFERS
1 WESTERN JUNIPER
1 WHITE/DOUGLAS FIR/PONDEROSA
1 LODGEPOLE PINE
1 QUAKING ASPEN
1 PONDEROSA PINE
1 WESTERN HEMLOCK
1 DOUGLAS FIR
1 PACIFIC SILVER FIR
1 ENGLEMAN SPRUCE
1 INCENSE CEDAR
1 LESS THAN 25% ANY SPECIES
1 MOUNTAIN HEMLOCK
1 LODGEPOLE PINE/PONDEROSA PINE
1 MIX-VARIOUS CONIFER SPECIES

Size Structure

10 DECADENT
10 SMALL-MEDIUM
10 SEED-SAP-POLE
10 MEDIUM-LARGE
10 SMALL/MS+
10 MEDIUM/MS-
10 LARGE/MS-
10 MEDIUM/MS+
10 LARGE/MS+
10 SMALL/MS++
10 POLE/MS++

Canopy Closure

100 SHRUB 56-70%
100 TREE CC 41-55%
100 TREE CC 56-70%
100 TREE CC 71-100%

Wildlife Species Table

Table 5-1

List of the amphibians, reptiles, birds, and mammals documented or with the potential to occur within the Spencer Creek Watershed, their status, association with course woody debris, snags, late-seral-stage forest, ponderosa pine forest, or riparian/wetland/wet meadow habitats.

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
AMPHIBIANS								
Spotted Frog	*Rana pretiosa*	D	PS,FC1,OU,3					X
Cascades Frog	*Rana cascadai*	D	PS,FC2,OV,3					X
Pacific Chorus Frog	*Hyla regilla*	D		X				X
Foothill Yellow-legged Frog	*Rana boylii*	P (H)	FC2,OV,3					X
Bull Frog	*Rana catesbeiana*	D (I)						X
Western toad	*Bufo boreas*	D	OV,3	X				X
Long-toed Salamander	*Ambystoma macrodactylum*	D		X				X
Pacific Giant Salamander	*Dicamptodon tenebrosus*	D				X		X
Rough-skinned Newt	*Taricha granulosa*	P	PS			X		X
REPTILES								
Western Pond Turtle	*Clemmys marmorata*	K	S,FC2,OC,2,M					X
Western Fence Lizard	*Sceloporus occidentalis*	D		X				X
Western Skink	*Eumeces skiltonianus*	D		X				X
Southern Alligator Lizard	*Gerrhonotus multicarinatus*	P						
Northern Alligator Lizard	*Gerrhonotus coeruleus*	D		X				
Short-horned lizard	*Phrynosoma douglassi*	LP					X	
Rubber Boa	*Charina bottae*	P		X				X
Western Yellow-bellied Racer	*Coluber constrictor mormon*	D						
Sharptail snake	*Contia tenuis*	P	OV,4					
Gopher Snake	*Pituophis melanoleucus*	P						
Klamath Garter Snake	*Thamnophis elegans*	D		X				X
Common Garter Snake	*Thamnophis sirtalis*	K		X				X
Western Rattlesnake	*Crotalis viridis*	D						

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
MAMMALS								
FURBEARERS								
Bobcat	*Lynx rufus*	D		X				
Wolverine	*Gulo gulo*	P(H)	S,FC2,OT,2,M	X				
Fisher	*Martes pennanti*	P(H)	PS,FC2,OC,2	X	X	X		
American Marten	*Martes americana*	D	PS,OC,3,M,BSO	X	X	X		X
Ermine	*Mustela erminea*	K		X				X
Long-tailed Weasel	*Mustela frenata*	K		X				X
Mink	*Mustela vison*	D		X				X
Red Fox	*Vulpes vulpes*	P(H)		X				
Common Gray Fox	*Urocyon cinereoargenteus*	P		X				
Coyote	*Canis latrans*	D		X				
American Badger	*Taxidea taxus*	K						
Northern River Otter	*Lutra canadensis*	K						X
American beaver	*Castor canadensis*	D						X
Common Muskrat	*Ondatra zibethicus*	P(H)						X
Ring-tailed Cat	*Bassariscus astutus*	D	OU,3					
Raccoon	*Procyon lotor*	K		X	X			X
BATS								
Pacific Western Big-eared Bat	*Plecotus townsendii townsendii*	P	S,FC2,OC, M					X
Fringed Myotis	*Myotiš thysanodes*	D	OV,1,			X		X
Pallid Bat	*Antrozous pallidus*	P	OV,3					X
Hoary Bat	*Lasiurus cinereus*	D				X		X
Big Brown Bat	*Eptesicus fuscus*	D			X	X		X
Silver-haired Bat	*Lasionycteris noctivagans*	D			X	X		X
Little Brown Myotis	*Myotis lucifugus*	D			X	X		X
Long legged Myotis	*Myotis volans*	D	FC2		X	X		X

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
BATS								
Yuma Myotis	*Myotis yumanensis*	D	FC2			X		X
Long-eared Myotis	*Myotis evotis*	D	FC2		X	X		X
California Myotis	*Myotis californicus*	D			X	X		X
Western Pipistrel	*Pipistrellus hesperus*	P						X
Western small-footed Myotis	*Myotis ciliolabrum* aka *leibii* and *subulatus*	P	FC2					X
BIG GAME								
Elk	*Cervus elaphus*	D	M					
Black-tailed deer	*Odocoileus hemionus*	D						
Mountain Lion	*Felis concolor*	D						
Black Bear	*Ursus americanus*	D		X	X			
SMALL MAMMALS								
Bushy-tailed Woodrat	*Neotoma cinera*	D		X	X			
Dusky-footed Woodrat	*Neotoma fuscipes*	D		X		X		
Marsh Shrew	*Sorex bendirii*	P		X				X
Water Shrew	*Sorex palustris*	K		X				
Vagrant Shrew	*Sorex vagrans*	D		X				X
Trowbridge shrew	*Sorex trowbridgii*	D			X			
Dusky shrew	*Sorex obscurus*	D						X
Shrew-mole	*Neurotrichus gibbsii*	D		X		X		X
Mole	*Scapanus latimous*	D						
Western Red-backed Vole	*Clethrionomys californicus*	D		X		X		
Heather Vole	*Phenacomys intermedius*	D		X				
Long-tailed Vole	*Microtus longicaudus*	D		X				X
Montane Vole	*Microtis montanus*	D						X
Water Vole	*Microtus richardson*	P						
Western Harvest Mouse	*Reithrodontomys Megalotis*	D						

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
SMALL MAMMALS								
Deer Mouse	*Peromyscus maniculatus*	P		X	X	X		
Western Jumping Mouse	*Zapus princeps*	P						X
Pacific Jumping Mouse	*Zapus trinotatus*	P						X
Yellow-pine chipmunk	*Tamias amoenus*	D						
Least Chipmunk	*Tamias minimus*	D						
Yellow-bellied marmot	*Marmota flaviventris*	P						
Western gray squirrel	*Sciurus griseus*	D	OU					
Northern Flying Squirrel	*Glaucomys sabrinus*	D			X	X		
California Ground Squirrel	*Spermophilus beecheyi*	D						
Belding's Ground Squirrel	*Spermophilus beldingi*	P						
Golden mantled Ground Squirrel	*Spermophilus lateralis*	D		X				
Douglas Squirrel	*Tamiasciurus douglasii*	D			X	X		
SMALL MAMMALS (Continued)								
Botta's Pocket Gopher	*Thomomys bottae*	P						
Western Pocket Gopher	*Thomomys mazama*	D						
Common Porcupine	*Erethizon dorsatum*	K		X				
Striped Skunk	*Mephitis mephitis*	K						X
Spotted Skunk	*Spilogale putorius*	P						
American Pika	*Ochotona princeps*	P						
Mountain Cottontail	*Sylvilagus nuttallii*	D		X				
Snowshoe Hare	*Lepus americanus*	D		X				
Black-tailed jack rabbit	*Lepus californicus*	K						
BIRDS OF PREY								
Golden Eagle	*Aquila chrysaetos*	D	P					
Bald Eagle	*Haliaeetus leucocephalus*	D	FT,OT,1,P,M			X	X	
Northern Harrier	*Circus cyaneus*	K						

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
BIRDS OF PREY								
Sharp-shinned Hawk	*Accipiter striatus*	K						
Cooper's Hawk	*Accipiter cooperii*	K						
Northern Goshawk	*Accipiter gentilis*	D	PS,FC2,OC,3,P,M			X	X	
Swainson's Hawk	*Buteo swainsoni*	LP	OV,3				X	
Red-tailed Hawk	*Buteo jamaicensis*	D						
Rough-legged Hawk	*Buteo lagopus*	D						
Ferruginous Hawk	*Buteo regalis*	K	S,FC2,OC,3,M					
Osprey	*Pandion haliaetus*	D	P		X			
American Kestrel	*Falco sparverius*	D			X			
Merlin	*Falco columbaris*	P	2,BAO		X			
Peregrine Falcon	*Falco peregrinus*	LP	FE,OT,1,P,M					
Prairie Falcon	*Falco mexicanus*	P	P					
Flammulated Owl	*Otus flammeolus*	D	PS,OC,4,P,BSO		X	X	X	
Western Screech Owl	*Otus kennicottii*	P			X			
Great Horned Owl	*Bubo virginianus*	D						
Northern Pygmy Owl	*Glaucidium gnoma*	K	OU,3		X	X		
Northern Spotted Owl	*Strix occidentalis caurina*	D	FT,OT,1,P,M	X	X	X		
Barred Owl	*Strix varia*	P			X	X		
Great Gray Owl	*Strix nebulosa*	D	PS,OV,4,P		X	X		
Long-eared Owl	*Asio otus*	P						
BIRDS OF PREY (Continued)								
Boreal Owl	*Aegolius funereus*	LP	3					
Northern Saw-whet Owl	*Aegolius acadicus*	K			X			
Barn Owl	*Tyto albo*	P			X			

Common Name	Scientific Name	Occur-rence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
UPLAND BIRDS								
Blue Grouse	*Dendragapus obscurus*	D						
Ruffed Grouse	*Bonasa umbellus*	K(H)		X				
Wild Turkey	*Meleagris gallopavo*	P						
California Quail	*Callipepla californica*	K						
Mountain Quail	*Oreortyx pictus*	D	FC2,4					
Mourning Dove	*Zenaida macroura*	D					X	
WOODPECKERS								
Red-naped Sapsucker	*Sphyrapicus nuchalis*	K						
Williamson's Sapsucker	*Sphyrapicus thyroideus*	P	OU,4,		X	X	X	
Lewis' Woodpecker	*Melanerpes lewis*	P	OC,3,BSO	X	X		X	
Acorn Woodpecker	*Melanerpes formicivorus*	LP	OU,3					
Red-breasted Sapsucker	*Sphyrapicus ruber*	D				X		
Downy Woodpecker	*Picoides pubescens*	D			X			X
Hairy Woodpecker	*Picoides villosus*	K		X	X	X		
White-headed Woodpecker	*Picoides albolarvatus*	K	PS,OC,3,BSO	X	X	X	X	
Three-toed Woodpecker	*Picoides tridactylus*	P	PS,OC,4,P,M,BSO	X	X	X		
Black-backed Woodpecker	*Picoides arcticus*	K	PS,OC,4,BAO	X	X	X	X	
Northern Flicker	*Colaptes auratus*	D		X	X	X	X	
Pileated Woodpecker	*Dryocopus pileatus*	K	PS,OC,4,P,M,BSO	X	X	X	X	
WATER ASSOCIATED BIRDS								
American White Pelican	*Pelecanus erythrorhynchos*	K	S,OV,2,BAO					X
Double-crested cormorant	*Phalacrocorax auritus*	P						X
Western least bittern	*Ixobrychus exilis hesperis*	P	FC2,OP/NR,2					X
American Bittern	*Botaurus lentiginosus*	P						X
Great Blue Heron	*Ardea herodias*	K						X
Great Egret	*Casmerodius albus*	P	OU,4					X

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
WATER ASSOCIATED BIRDS (Continued)								
Snowy Egret	*Egretta thula*	P	OV,2					X
White-faced Ibis	*Plegadis chihi*	P	PS,FC2,OV,4					X
Black-crowned Night Heron	*Nycticorax nycticorax*	K						X
Green-backed Heron	*Butorides striatus*	P						X
Greater Sandhill Crane	*Grus canadensis tabida*	D	S,OV,4,S					X
Tundra Swan	*Cygnus columbianus*	K						X
White-fronted Goose	*Anser albitrons*	P						X
Snow Goose	*Chen caerulescens*	P						X
Ross' Goose	*Chen rossii*	P						X
Canada Goose	*Branta canadensis*	D						X
Wood Duck	*Aix sponsa*	D			X	X		X
Green-winged Teal	*Anas crecca*	P						X
Mallard	*Anas platyrhynchos*	K						X
Northern pintail	*Anas acuta*	P						X
Blue-winged Teal	*Anas discors*	P						X
Cinnamon Teal	*Anas cyanoptera*	LP						X
Northern Shoveler	*Anas clypeata*	K						X
Gadwall	*Anas strepera*	P						X
American Wigeon	*Anas americana*	P						X
Redhead	*Aythyra americana*	P						X
Ring-necked Duck	*Aythyra collaris*	P	4					X
Common Goldeneye	*Bucephala clangula*	P						X
Barrow's Goldeneye	*Bucephala islandica*	P	OP/NR,4		X	X		X
Bufflehead	*Bucephala albeola*	P	OP/NR,2,BAO		X	X		X
Hooded Merganser	*Lophodytes cucullatus*	P			X	X		X
Common Merganser	*Mergus merganser*	P			X	X		X
Ruddy Duck	*Oxyura jamaicensis*	P						X
Yellow Rail	*Coturnicops noveboracensis*	LP	S,OC,2,M,BSO					X
Virginia Rail	*Rallus limicola*	LP						X
Sora	*Porsana carolina*	LP						X
American Coot	*Fulica americana*	LP						X
Killdeer	*Charadrius vociferus*	K						X
Black-necked Stilt	*Himantopus mexicanus*	P						X

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
WATER ASSOCIATED BIRDS (Continued)								
American Avocet	*Recurvirostra americana*	P						X
Marbled Godwit	*Limosa fedoa*	LP						X
Greater Yellowlegs	*Tringa melanoleuca*	P	2,BAO					X
Willet	*Catoptrophorus semipalmatus*	P						X
Long-billed Curlew	*Numenius americanus*	P(H)	S,FC3,4,M					X
Western Sandpiper	*Calidris mauri*	P						X
Spotted Sandpiper	*Actitis macularia*	D						X
Long-billed Dowitcher	*Lomnodermuis scolopaceus*	P						X
Common Snipe	*Galinago gallinago*	K						X
Wilson's Phalarope	*Phalaropus tricolor*	P						X
Bonaparte's Gull	*Larus philidelphia*	LP						X
Ring-billed Gull	*Larus californicus*	K						X
California Gull	*Larus californicus*	K						X
Caspian Tern	*Sterna caspia*	LP						X
Forster's Tern	*Sterna forsteri*	LP	3					X
Black Tern	Chlidonias nigar	LP	PS,FC2,4					X
NEOTROPICAL MIGRANTS								
Common Nighthawk	*Chordeiles minor*	D						
Common Poorwill	*Phalaenoptilus nuttallii*	K		X				
Vaux's Swift	*Aeronautes saxatalis*	P			X	X		
Black-chinned Hummingbird	*Archilochus alexandri*	LP	3					
Anna's Hummingbird	*Calypte anna*	P						
Calliope Hummingbird	*Stellula calliope*	D						
Rufous Hummingbird	*Selasphorus rufus*	P						
Belted Kingfisher	*Ceryle alcyon*	K						
Western Kingbird	*Tyrannus verticalis*	P						
Olive-sided Flycatcher	*Contopus borealis*	D						
Western Wood Peewee	*Contopus sordidulus*	D						
Willow Flycatcher	*Empidonax traillii*	D						X
Hammond's Flycatcher	*Empidonax hammondii*	P				X		
Dusky Flycatcher	*Empidonax oberholseri*	D						

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
NEOTROPICAL MIGRANTS (Continued)								
Gray Flycatcher	*Empidonax wrightii*	K						
Pacific-slope Flycatcher	*Empidonax difficilis*	LP						
Cordilleran Flycatcher	*Empidonax occidentalis*	P						
Say's Phoebe	*Sayornis saya*	LP						
Ash-throated Flycatcher	*Myiarchus cinerascens*	LP						X
Purple Martin	*Progne subis*	P	OC,3,BSO		X			X
Tree Swallow	*Tachycineta bicolor*	D			X			X
Violet-green Swallow	*Tachycineta thalassina*	P			X			X
N. Rough-winged Swallow	*Stelgidopteryx serripennis*	P						
Bank Swallow	*Riparia riparia*	P	OU,3					
Cliff Swallow	*Hirundo pyrrchonota*	D						
Barn Swallow	*Hirundo rustica*	D						
House Wren	*Troglodytes aedon*	D		X	X			
Ruby-crowned Kinglet	*Regulus calendula*	P						
Blue gray Gnatcatcher	*Polioptila caerulea*	LP						X
Mountain Bluebird	*Sialia currucoides*	K			X			
Swainson's Thrush	*Catharus ustulatus*	K						
Hermit Thrush	*Catharus guttatus*	D				X		
American Robin	*Turdus migratorius*	D						
American Pipit	*Anthus rubescens*	LP						
Cedar Waxwing	*Bombycilla cedrorum*	K						
European Starling	*Sturnus vulgaris*	K			X			
Solitary Vireo	*Vireo solitarius*	K						
Warbling Vireo	*Vireo gilvus*	K				X		X
Orange-crowned Warbler	*Vermivora celata*	K						
Nashville Warbler	*Vermivora ruficapilla*	K						
Yellow Warbler	*Dendroica petechia*	D						X
Yellow-rumped Warbler	*Dendroica coronata*	K						
Black-throated Gray Warbler	*Dendroica nigrescens*	LP					X	
Townsend's Warbler	*Dendroica townsendii*	P				X		
Hermit Warbler	*Dendroica occidentalis*	P				X		

Common Name	Scientific Name	Occurrence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
NEOTROPICAL MIGRANTS (Continued)								
MacGillivray's Warbler	*Oporornis tolmiei*	K				X		X
Wilson's Warbler	*Wilsonia pusilla*	K						X
Black-headed Grosbeak	*Pheucticus lelanocephalus*	D						X
Lazuli Bunting	*Passerina amoena*	K					X	
Green-tailed Towhee	*Pipilo chlorurus*	D						
Chipping Sparrow	*Spizella passerina*	D						
Brewer's Sparrow	*Spizella breweri*	D						
Vesper Sparrow	*Pooecetes gramineus*	D	CU					X
Savannah Sparrow	*Passerculus sandwichensis*	P						X
Lincoln's Sparrow	*Melospiza lincolnii*	P						X
Fox Sparrow	*Passerella iliaca*	K						
White-crowned Sparrow	*Zonotrichia leucophrys*	P						
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	P						X
Brewer's Blackbird	*Euphagus cyanocephalus*	D						X
Brown-headed Cowbird	*Molothrus ater*	D						X
Northern Oriole	*Icterus galbula*	P						
Western Tanager	*Piranga ludoviciana*	D						X
American Goldfinch	*Carduelis tristis*	P						
Cassin's Finch	*Carpodacus cassinii*	K						
Turkey Vulture	*Cathartes aura*	D		X				
OTHER BIRDS								
Wrentit	*Chamaea fasciata*	LP						
Black-capped Chickadee	*Parus atricapillus*	K			X			
Mountain Chickadee	*Parus gambeli*	D			X			
Chestnut-backed Chickadee	*Parus rufescens*	P			X	X		
Plain Titmouse	*Parus inornatus*	P			X			
Bushtit	*Psaltriparus minimus*	P						
Red-breasted Nuthatch	*Sitta canadensis*	D	OV,4,		X	X		
White-breasted Nuthatch	*Sitta carolinersis*	K			X	X		

Common Name	Scientific Name	Occur-rence[1]	Status[2]	Coarse Woody Debris	Snags	Late Seral	Ponderosa Pine	Riparian/ Wetland/ Aquatic
OTHER BIRDS (Continued)								
Pygmy Nuthatch	*Sitta pygmaea*	K	OV,		X	X		
Brown Creeper	*Certhia americana*	K			X	X		
Bewick's Wren	*Thryomanes bewickii*	K		X			X	
Winter Wren	*Troglodytes troglodytes*	P		X		X		
Golden-crowned Kinglet	*Regulus satrapa*	K				X		
Western Bluebird	*Sialia mexicana*	K	OV,4		X		X	
Townsend's Solitaire	*Myadestes townsendi*	K		X				
Varied Thrush	*Ixoreus naevius*	D				X		
American Dipper	*Cinclus mexicanus*	K						
Rufous-sided Towhee	*Pipilo erythrophthalmus*	K		X				X
Fox Sparrow	*Passerella iliaca*	K						
Song Sparrow	*Melospiza melodia*	D						X
Golden-crowned Sparrow	*Zonotrichia atricapilla*	P						X
Dark-eyed Junco	*Junco hyemalis*	D						
Western Meadowlark	*Sturnella neglecta*	P						
Red-winged Blackbird	*Agelaius phoeniceus*	D						X
House Sparrow	*Passer domesticus*	K						
Pine Siskin	*Carduelis pinus*	K						
Lesser Goldfinch	*Carduelis psaltria*	P						X
Red Crossbill	*Loxia curvirostra*	K				X		
Purple Finch	*Carpodacus cassinii*	D						
House Finch	*Carpodacus mexicanus*	P						
Evening Grosbeak	*Coccothraustes vespertinus*	K						
Gray Jay	*Perisoreus canadensis*	K						
Steller's Jay	*Cyanocitta stelleri*	K						
Scrub Jay	*Aphelocoma coerulescens*	K						
Clark's Nutcracker	*Nucifraga columbiana*	K						
Black-billed Magpie	*Pica pica*	K					X	
American Crow	*Corvus brachyrhynchos*	K						
Common Raven	*Corvus corax*	D						

Abbreviations Used:

[1] Occurrence: D = Documented; P = Potential; LP = Low potential; H = Historic records; I = Introduced

[2] Status: PS = May be listed in the near future as sensitive by Region 6 of the U.S. Forest Service; S = Listed as sensitive by Region 6 of the U.S. Forest Service; FE = Listed as endangered by U.S. Fish and Wildlife Service; FT = Listed as threatened by the U.S. Fish and Wildlife Service; FC1 = Federal Category 1 Candidate for Federal listing as threatened or endangered; FC2 = Federal Category 2 Candidate for Federal listing as threatened or endangered; OT = Oregon Threatened; OC = Oregon Critical; OV = Oregon Vulnerable; OU = Oregon Undetermined; OP/NR = Oregon peripheral species or naturally rare; 1 = Oregon Natural Heritage Program List 1; 2 = Oregon Natural Heritage Program List 2; 3 = Oregon Natural Heritage Program List 3; 4 = Oregon Natural Heritage Program List 4; P = Winema National Forest Plan Protection Species; M = Winema National Forest Plan Monitor Species; BSO = BLM Sensitive in Oregon; BAO = BLM Assessment in Oregon.

Appendix 6
Water Quantity

"Recovered" in this analysis is considered to be "hydrologically recovered". Harvest units are hydrologically recovered when re-establishment of leaf area is sufficient to return transpiration rates to pre-harvest levels and canopy closure is sufficient to prevent excessive snow loading. Leaf area index is the ideal variable to quantify to express recovery, however, considering the size of the watershed leaf area is not feasible and canopy closure was used as a surrogate. To standardize the data and facilitate comparisons among watersheds, recovery was expressed in terms of equivalent clearcut acres (ECA). For details on acreage and recovery rate assignments see Table 6-1.

Past harvest units are expected to fully recover in year 30. Site specific data on stand density index versus time was used to support this conclusion. Research indicates that a 35 percent water increase occurs in 100 percent vegetation removal and a 0 percent increase in 10 percent vegetation removal with a linear fit between the two points (Troendle 1987). Temporally, the maximum difference in streamflow response generally occurs in the first five years following vegetation removal and decreases logarithmically with time.

For a baseline or historical perspective, the watershed was assumed to be hydrologically mature expect for fire disturbed areas. According to 1940 aerial photographs and Leiberg's 1899 data, there was on average between 1,100 to 1,900 acres in burned areas at any one time in the watershed (for calculations of ECA, 1500 acres was chosen as a reprentative amount for burned areas). This represents the historical ECA. For details on vegetation zones and historic fire disturbances see Chapter 4.

To determine current equivalent clearcut acres, the watershed was divided into two vegetation zones based on historical canopy closure. Zone one includes the ponderosa pine zone, the lower elevation mixed conifer zone, and the high elevation mountain hemlock zone. Zone two is the upper elevation mixed conifer zone and the shasta red fir zone. Zone one units reach full recovery at 26 to 40 percent canopy closure; zone two units reach full recovery at 56 to 70 percent canopy closure. Table 6-1 summarizes vegetation units and assigned recovery. An additional 1,047 acres are unrecovered due to road surfaces.

From the table calculations and unrecovered road surfaces, 13,945 acres in the watershed are currently in an "unrecovered state" (equivalent clearcut acres). The net change in unrecovered acres is 13,945 minus the average historical unrecovered burned acres, 1,500 acres. This represents 12,445 acres, approximately 22 percent of the watershed.

Table 6-1. Canopy Closure and Equivalent Clearcut Acres

Tree Species	Canopy Closure (percent)	Acres	Recovery Factor	ECA
Lodgepole				
	11-25	715	0.5	357.5
	26-40	1221	1	0
	41-55	1115	1	0
	56-70	366	1	0
	71-100	216	1	0
Total				357.5
Mountain Hemlock				
	11-25	136	0.5	68
	26-40	388	1	0
	41-55	360	1	0
	56-70	228	1	0
	71-100	132	1	0
Total				68
Ponderosa Pine				
	11-25	232	0.5	116
	26-40	228	1	0
	41-55	10	1	0
	56-70	0	1	0
	71-100	0	1	0
Total				116
Lower Mixed Conifer				
	11-25	7574	0.5	3787
	26-40	4709	1	0
	41-55	2826	1	0
	56-70	2085	1	0
	71-100	823	1	0
Total				3787
Shasta Red Fir				
	11-25	2222	0.25	1666.5
	26-40	1970	0.5	985
	41-55	1907	0.75	476.75
	56-70	3080	1	0
	71-100	3259	1	0
Total				3128.25
Upper Mixed Conifer				
	11-25	5344	0.25	4008
	26-40	3411	0.5	1705.5
	41-55	2048	0.75	512
	56-70	1510	1	0
	71-100	596	1	0
Total				6225.5
Shrubs		2861	0.25	2145

Appendix 7
Life Histories of Aquatic Species

Life Histories of Aquatic Animals and Distributions in Spencer Creek Watershed

This appendix describes what is known about the life histories and ecology of aquatic species in Spencer Creek. The intent is not to provide species specific management strategies, but rather to gain perspective on the potential of the aquatic ecosystem and changes in habitat conditions.

Salmon and Trout

Klamath River migratory trout population. Redband/rainbow trout can be described as consisting of two populations in Spencer Creek; a migratory spawning population and a year-round stream resident population. Spencer Creek is one of two tributaries available for trout spawning between Copco and Klamath Lake. The other is Shovel Creek located 4.6 km below the Oregon boarder between J.C. Boyle and Copco dams. It is suspected that trout below Boyle Dam may spawn in the constant flow reach of the Klamath River between the dam and the Boyle power house (T. Olson pers. comm. 1994). Fish movements in the Klamath River below Klamath Lake were first monitored one year after the construction of J.C. Boyle dam in 1958. Trapping results indicated two peak upstream migration periods in the Spring and Fall with over 5,000 adult fish ascending the fish ladder at the dam that year (Hanel and Gerlach 1959). Since 1988 PacifiCorp (formerly Pacific Power and Light) in conjunction with Oregon Department of Fish and Wildlife research biologists, have studied fish migration patterns to asses the effect of Pacific Power and Light's hydroelectric operations on the redband/rainbow trout and endangered suckers (Shrier 1989; Pacificorp 1990, 1992; Hemmingsen et al. 1988; Buchanan et al. 1989-1992) Results show a major decline in overall passage at J. C. Boyle to between 2 and 10 percent of the 1959 level. However, peaks in migration remain evident in the spring and fall. This adds credence to the theory that coastal steelhead are the progenitors of Klamath River redband/rainbow trout (Benke 1979) since fall migration patterns are coincident with the timing of anadromous steelhead spawners returning to the lower Klamath River.

Oregon Department of Fish and Wildlife biologists trapped and tagged redband/rainbow trout moving in and out of Spencer Creek from 1989 to 1992. In general, spawning adults move downstream in the Keno reach of the Klamath into Boyle Reservoir to enter Spencer Creek starting in February and ending in June with a peak in April and early May. Apparently, relatively few adults migrate upstream from below Boyle to spawn in Spencer Creek. These fish spawn primarily between the mouth of Spencer Creek and mile eight, approximately one mile above the BLM hookup road as indicated by various spawning redd counts (Oregon Department of Fish and Wildlife unpublished district files). The lower intermittent reaches of Clover and Miners Creeks may provide limited fish habitat for spawning during higher flow years (see section on resident redband/rainbow). The migratory spawners leave Spencer Creek from March to July with peak out-migration in May. Fry (hatchling trout) begin leaving Spencer Creek (90 percent in 1991 and 82 percent in the 1992). About 30,000 fish migrated out of Spencer Creek in 1991 and 10,000 fish in 1992.

Spencer Creek is apparently a major source of recruitment of redband/rainbow trout in the Keno reach of the Klamath River.

Resident redband/rainbow trout. Quantitative data on the distribution and status of the resident redband/rainbow trout population in the watershed are not available. Various surveys and anecdotal accounts coupled with physiographic information allows for a limited assessment of these populations. At the headwaters of Spencer Creek two intermittent, partially spring fed streams flow into the north side of Buck Lake. It is possible but not documented that redband/rainbow trout could spawn in the lower reaches of these streams. In addition, one short, spring-fed perennial tributary (Tunnel Creek) feeds directly into the high volume springs at Buck Lake. Trout have been observed in this creek but the species was not identified. This area potentially supports resident redband/rainbow trout however, it has not been surveyed. The extent of trout in the canal system of Buck Lake is also unknown.

Information on redband/rainbow trout in the mainstem is more prevalent. Significantly higher summer flows were noted in the upper half of Spencer Creek than in the lower reaches during the summer of 1994. A gradual decline in flow below the Spencer Creek Hookup Road shows that up to 90 percent of the stream flow is evapotranspiration and/or becomes subsurface before it reaches the mouth. This may help explain observed distribution patterns which indicate that stream resident redband/rainbow trout dominate the upper portion of Spencer Creek during the summer after migratory adults have moved out .

The two perennial tributaries below Buck Lake (Miners and Clover Creeks) have interrupted flows in the summer before reaching Spencer Creek. The status of the resident redband/rainbow populations in these streams is a uncertain. Redband/ rainbow trout in the 12 to 20 inch range (likely migratory) were observed in the mid 1980s migrating downstream near the mouth of Miners Creek in May (Chris Sokei pers. comm). King et al. (1977) reported observing numerous brook trout in Miners Creek but did not specify whether redband/rainbow were present. In the summer of 1994 the perennial reach of Miners Creek was surveyed visually and only brook trout were observed.

Clover Creek has even less connectivity to Spencer Creek than Miners Creek. The actual frequency and duration of uninterrupted flow in unclear due to conflicting reports. It is apparent that Clover Creek after June first. A population of resident redband/rainbow of unknown taxonomic status exist in the impoundment at Dead Porcupine Spring and in the 1/4 mile perennial reach of Clover Creek directly below. A cursory observation of these fish during 1994 revealed that successful reproduction occurred in this population and even though Clover Creek did not connect with Spencer Creek in that year. The fish in the pond appeared relatively healthy, whereas the fish in the creek, fed entirely by seepage through the impoundment dam, were in extremely poor condition. These fish were severely imperiled by low flows (less than 0.1 cubic feet per second), lack of streamside shading, and heavy cattle use in the stream and its banks.

The interrupted flow of these Creeks may cause some degree of reproductive isolation between the perennial reach populations and the populations in Spencer Creek. Recent studies in trout genetic and life history differences indicate a high degree of adaptive divergence in Klamath Basin trout (Currens 1990, Benke 1992, Buchanan et at. 1988 to 1992) even where little or no physical barriers separate populations (Buchanan et al. 1991). There is also evidence of genetic divergence in resident versus anadromous forms occurring within the same watershed (Buchanan pers. comm. 1994). The taxonomy and ecology of stream resident redband/rainbow trout needs to be compared to the migratory trout population to make decisions about their management.

Anadromous salmon and trout. The potential for anadromous fish to reach Spencer Creek was eliminated in 1917 with the construction of Copco Dam. No historic data could be found to verify anadromous fish runs in Spencer Creek but evidence from oral histories is compelling. In 1918, J. O. Snyder, then an employee of the United States Bureau of Fisheries, interviewed fishermen and longtime residents of the Klamath Basin to learn about past salmon runs. As a result, he reported that "...large numbers of salmon annually passed the point where the Copco Dam is now located" (Snyder 1930). Evidence that salmon entered Spencer Creek is found from interviews made in 1965. Fortune et al. (1966) reported that "Salmon were known in Spencer Creek in the fall months of September and October as reported by four people." It is assumed here that the term salmon refers to Chinook salmon. Presently, it cannot be concluded that anadromous steelhead runs did or did not enter Spencer Creek historically. The presence of the current population of a migratory redband/rainbow trout population indicates that there is suitable habitat for steelhead. The egg taking station on Shovel Creek (4.8 kilometers below Oregon Boarder) reported in 1892 "...an early run of large silvery fish and a later run of short, colorful fish." (California State Board of Fish Commission 1892). This statement is open to speculation but no conclusions except that there were apparently two runs of salmonid fish; one of them was likely anadromous steelhead. The present middle Klamath River (below Klamath Falls) redband/rainbow trout population appears to have its closest affinities with the coastal form of redband/rainbow trout and not to the redband trout of the upper Klamath basin (Behnke 1979;1992). However, this distinction does little to explain past anadromy in the Klamath River (Logan and Markle 1993b) as both resident and landlocked forms have anadromous ancestors (Moyle 1976). Elsewhere in the basin steelhead may have reached the Link River Falls and Chinook salmon reached as far as Bly on the Sprague River and Chiloquin on the Williamson (J. Fortune pers. comm. 1994).

The possibility that sockeye salmon spawned in the Klamath basin was entertained by Fry (1973). He states that sockeye salmon usually ascend rivers from which it is possible to reach a lake. He then explains, "Before the construction of Copco Dam in 1917, salmon could reach Klamath Lake via the Klamath River and the river system may have supported a sockeye run." One could speculate that Buck Lake could have once been provided suitable sockeye salmon rearing habitat before major eutrophication occurred in that lake. Since 1917 only one sockeye salmon has been reported in the Klamath River. The Klamath River is considered the southern extent of the range of this species (Jordan 1905). There is no compelling evidence to suggest that either sockeye salmon or coho salmon ever spawned in Spencer Creek.

Hatchery rainbow trout. Hatchery rainbow trout were introduced throughout the streams and lakes of the Klamath basin since the 1920s (Buchanan et al. 1991). Rainbow trout were probably first introduced to Spencer Creek and the Keno reach of the Klamath at this time as well (J. Fortune pers. comm. 1994). The practice of stocking hatchery fish in the Klamath River (including Spencer Creek) was discontinued in 1977 after the Oregon Department of Fish and Wildlife and the California Department of Fish and Game adopted the Klamath River Trout Management Policy between Keno and Copco reservoirs (J. Fortune pers. comm. 1994). The influence of non-indigenous trout on native populations is believed to be negative (Moyle 1976) assuming that the introduced fish become self propagating or interbreed with native trout. However, evidence suggests that non-indigenous rainbow trout did not survive to become self propagating in the Klamath River or Klamath Lake (D. Buchanan pers. comm. 1994). Oregon Department of Wildlife researchers exposed hatchery fish of several origins to water in the Klamath River and found that many fish died when they became infected with *Ceratomyxa shasta*, a parasite, that native trout have high resistance to in the Klamath basin . The fish that did not succumb to the parasite died due to an apparent lack of adaptation to water quality conditions (high alkalinity and temperature) of the Klamath River (D. Buchanan pers. comm. 1994). The influence of hatchery fish on stream resident redband/rainbow trout populations in the Spencer Creek watershed is uncertain. Hatchery trout in Spencer Creek may not be exposed to the harsh conditions and diseases present in the Klamath River and therefore have a better chance to establish self perpetuating populations. This would allow them to interbreed with and or compete with indigenous trout.

Eastern brook trout. Eastern brook trout were probably introduced into the Spencer Creek watershed in the 1930s (J. Fortune pers. comm. 1994) in an attempt to increase the range of trout fishing opportunities. In the headwater regions of Spencer Creek, brook trout occur in Tunnel Creek and presumably in the cold water springs of Buck Lake (Roger Smith pers. comm. 1994). In the broad surveys conducted by King et al., (1977) brook trout were reported to be abundant in Miners Creek with a few occurring just below Buck Lake. Based on personal observations, brook trout probably occur throughout Spencer Creek at times and year-round in the perennial reach of Miners Creek and in the Buck Lake Springs including Tunnel Creek. Brook trout were also observed in Aspen Lake (a small alpine lake in the Mountain Lakes Wilderness), at the headwaters of Clover Creek, and in the perennial portion of Clover Creek (Hayes 1995). These fish are periodically stocked via helicopter by Oregon Department of Fish and Wildlife.

Brook trout do best in cold water (50 to 66 degrees Fahrenheit) but can tolerate high water temperatures of up to 79 degrees Fahrenheit (Moyle 1976). This helps explain their apparent dominance in the fish assemblage in Miners Creek where incidental temperature data and estimated shading values indicate water stays relatively cool compared to Spencer Creek (King et al. 1977, Winema National Forest Files 1992). Based on general life history characteristics for brook trout (Moyle 1976), it is reasonable to assume that brook trout spawn on the west side of Buck Lake where upwelling springs have created suitable spawning beds and water temperature is a constant 41 degrees Fahrenheit.

Minnows

Fathead minnow. Fathead minnows were first observed in Spencer Creek in 1974 (Andreasen 1975). This is incidentally the first reported occupancy of this species in Oregon. Presumably, they were illegally introduced as bait fish by fisherman (J. Fortune pers. comm. 1994). There is concern among fisheries managers and scientists, especially in the Klamath basin and central California, concerning fathead minnow competition with native fish (Moyle 1976, Logan and Markle 1993) and more recently as predators of fish and amphibian larvae (Dunsmoor 1993, M. Hayes pers. comm. 1994). Fathead minnows are unique in their ability to survive in a variety of extreme environmental conditions including extremes in alkalinity, low dissolved oxygen, organic pollution, turbidity, and temperature (Moyle 1976). Fathead minnows have been observed in large schools at the mouth of Spencer Creek in 1991 (J. Fortune pers. comm. 1994) and in low numbers just below Buck Lake in 1992 (Klamath Basin Adjudication, unpublished notes 1992). Based on their life history characteristics it is suspected that they occur in the canals at Buck Lake and possibly in the perennial pools of streams feeding into Spencer Creek.

Speckled Dace. Speckled dace are the most widely distributed native fish in the basin (Logan and Markle 1993). They occur throughout Spencer Creek watershed wherever there is perennial water, and probably occur in most of the intermittent streams as well. Speckled dace are tolerant of extremely high water temperatures and low flows (Moyle 1976). They were found in pools of intermittent streams even in late summer (A. Hamilton pers. obs., King et al. 1977). In Spencer Creek, they are commonly associated with schools of juvenile Klamath smallscale suckers and small chubs.

Large populations of speckled dace where food and space is limited may limit trout production. However, their habitat preference of shallow water for food and cover result in food utilization largely unavailable to trout (Moyle 1976).

Chub. Blue and Tui Chub are native to the upper Klamath River basin and are abundant in J. C. Boyle Reservoir so their presence in Spencer Creek is not surprising. Of interest is the lack of documented occurrences of these fish prior to 1993. This may be due to incomplete sampling and chance, but this seems unlikely based on the high numbers observed in the summer of 1994. Chub were observed at the mouth of Spencer Creek and at the Buck Lake outflow canal and elsewhere in Buck Lake (A. Hamilton pers. obs., Hayes 1995). One explanation for the lack of documented occupancy could be that conditions have recently changed and are now more favorable to these species. The proximity of J. C. Boyle Reservoir has provided easy access to Spencer Creek since 1958; therefore, it seems unlikely that their current presence is the result of recent transplants. Like the minnows in Spencer Creek, blue and tui chub are tolerant of high temperatures, high alkalinity, and low dissolved oxygen concentrations. Both species are faring well in the lakes and reservoirs of the Klamath basin (M. Buettner pers. comm. 1994) and probably provide a major food source for the redband rainbow trout in the Boyle reach of the Klamath River (Moyle 1976).

Lamprey

Three species of lamprey occur in Spencer Creek; Pit-Klamath brook lamprey (*Lampetra lethophaga*), Pacific lamprey (*L. tridentata*), and Klamath River lamprey (*L. similis*). These species have been identified during various surveys, however, no attempt has been made to extensively survey for lampreys in the Spencer Creek watershed. Redband/rainbow trout in the 12 to 20 inch range (likely migratory) were observed in the mid 1980s migrating downstream near the mouth of Miners Creek in May (Chris Sokel pers. comm. 1994). King et al. (1977) reported observing numerous brook trout in Miners Creek, but did not specify whether redband/rainbow were present. In the summer of 1994 the perennial reach of Miners Creek was surveyed visually and only brook trout were observed.

Lamprey spend the first four to seven years of their life as larvae (ammeocets) that live in stream sediments and filter feed. Lampreys then metamorphose as they migrate downstream to lakes or oceans to become adults. The adult stage can last from 6 to 18 months and is typically spent in oceans, lakes, and rivers, and depending on the species is either parasitic or non parasitic on other fishes. The adults migrate upstream to small tributary streams to spawn. They build a nest in a gravel-bottomed area, spawn and then die. Adult parasitic lampreys feed on blood and body fluids of host fish by attaching with suction-cup mouth and rasping a hole with its muscular toothed tongue.

Klamath River Lamprey. A specimen of this species was collected in Spencer Creek in May 1991 (Logan and Markle 1993) and was an apparent transforming downstream migrant. Nothing is offered in the literature on the life history of this species except that it is parasitic and appears to be closely related systematically and ecologically to the landlocked form of the Pacific lamprey. This species is distributed in both upper Klamath Lake and in the lower Klamath River.

Pacific Lamprey. This is the most widely distributed lamprey in this genus and is anadromous and parasitic in all major Pacific rivers from Baja California to Alaska. The dwarfed, landlocked version of this species, also parasitic, is known in Spencer Creek and throughout most tributaries of the Upper Klamath Lake (Logan and Markle 1993). In Upper Klamath Lake, Pacific lamprey metamorphose in the fall, and feed and migrate downstream to the lake in the Spring. They live in Upper Klamath Lake for 12 to 15 months before ascending tributaries to spawn. The life history of Pacific lampreys in Spencer Creek is assumed to be similar to that in Upper Klamath Lake.

Pit-Klamath Brook Lamprey. The distribution of this species is restricted to the Pit River system in northern California and the upper Klamath basin in Oregon (Moyle 1976). They are ameocetes for at least four years (Moyle 1976), metamorphose in the fall, and are non parasitic non-feeders as adults. Hubbs (1971) describes the principal habitat for the species as cool, clear streams or springs with sandy-muddy bottoms or edges.

Catfish

Brown bullhead. Brown bullheads were transplanted from Upper Klamath Lake in the late 1950s into Buck Lake (Hayes 1994). They occur in portions of mainstem Spencer Creek where water is slow and aquatic vegetation is present (Winema National Forest unpublished notes 1992) and in the canal system and marshes of Buck Lake. Bullhead were observed consistently coincident with spotted frogs at Buck Lake, probably because of a habitat preference by both species for dense aquatic vegetation and warm water (M. Hayes pers. comm. 1994). Brown bullheads are omnivorous bottom feeders that tend to consume a variety of organic matter (Moyle 1976). In this watershed, they may be of concern to the spotted frog population and possibly to endemic molluscs. Because of their opportunistic feeding habits and their close association with the breeding sites of spotted frogs (aquatic vegetation), it is assumed that they would readily feed on the egg masses of the spotted frog (M. Hayes pers. comm. 1994).

Suckers

Klamath Smallscale Sucker. Klamath smallscale suckers are native to the Trinity system, the Rogue system, and the Klamath River below Kamath Falls. The life history and ecology of this species is similar to other Klamath Basin suckers in that they migrate up streams to spawn and rear. Klamath smallscale suckers have slightly slower growth rates and are less lake dependent than other Klamath Basin suckers (Moyle 1976, Buettner and Scoppettone 1990). Klamath smallscale suckers spawn in the spring in Spencer Creek and adults return to Copco Reservoir and the Klamath River in May and June. Mixed schools of juvenile Klamath smallscale suckers, speckled dace, juvenile trout, and chub have been observed in the mainstem of Spencer Creek up to the mouth of Buck Lake. Adults have been observed near the bottom of the cascade one half mile below Buck Lake and canal system of Buck Lake. The majority of the preferred spawning and rearing habitat for Klamath smallscale suckers probably occurs in the low gradient reaches below mile seven (M. Buettner pers. comm. 1994).

Endangered suckers. Lost River and shortnose suckers, both federally endangered, occur in J.C. Boyle reservoir, but have low potential for any significant spawning use in Spencer Creek (M. Buettner pers. comm. 1994). Klamath largescale suckers, a federal candidate for listing under the Endangered Species Act, may also occur in Spencer Creek. The constructed lakes below Klamath Falls have increased the amount of suitable habitat for the three native upper basin sucker species. This has probably extended their distributions and abundance downstream of Klamath Falls (Moyle 1976, Buettner and Scoppettone 1990). They are fairly abundant in J. C. Boyle Reservoir (M. Buettner pers. comm. 1994). The argument that Spencer Creek does not provide good spawning habitat for these suckers is fairly strong. None were reported during Oregon Department of Fish and Wildlife trapping efforts from 1989 to 1992 (J. Fortune pers. comm. 1994).

Sculpins

Marbled Sculpin. Marbled sculpins are native to the Klamath and Pit River drainages and probably occur in most of the perennial flowing stream waters of the Spencer Creek watershed. In general, stream dwelling sculpins like the marbled sculpin are bottom oriented feeders that prey on benthic invertebrates. They occupy a wide variety of habitats from fast riffles to slow pools with muddy bottoms and are adapted to harsh environmental conditions such as high temperatures and high alkalinity (Moyle 1976). Marbled sculpins are one of the three native species shared by both upper basin and lower Klamath River fish faunas.

Fresh water Snails and Clams

The Spencer Creek watershed has not been extensively surveyed for mollusc species. The relative position of the watershed in the Klamath drainage and the high number of endemic snails in the adjacent Jenny Creek watershed (see Frest and Johannes 1995) suggests that there is a high likelihood for rare mollusc in the Spencer Creek watershed. Most of the rare mollusc in the Klamath Basin require cold water spring sources. In Jenny Creek watershed, many of endemic species are associated with large springs complexes (Frest and Johannes 1993). The high volume springs at the southwest periphery of Buck Lake are likely to contain endemic mollusc (T.Frest pers. comm. 1995). Rare freshwater clams are found in most stream reaches of the mainstem of Spencer Creek. Extensive surveys for endemic mollusc in the Spencer Creek watershed are planned for 1995.

Table 7-1. Influences of Timber Harvest and Riparian Area Grazing on the Aquatic Environment in the Spencer Creek Watershed. Changes in the physical/chemical environment, potential changes in aquatic habitat quality, and predicted response of the biological community are listed for each management practice (See text for full discussion)

Management Practice	Potential change in the physical and chemical aquatic environment	Potential change in quality of aquatic habitat	Potential response of the aquatic biological communities	Present Risk to Resource	Location
Timber harvest from streamside areas	Increased incident solar radiation	Increased algae growth, higher concentrations of daytime dissolved oxygen, lower concentrations of nighttime dissolved oxygen	Increased uptake of dissolved nutrients; increased growth rates of fish; increased susceptibility to disease; altered competitive advantage to favor temperature tolerant species; herbivorous and omnivorous fish are favored	High	Lower Spencer Creek
		Higher temperatures			
	Decreased supply of large woody debris	Reduced cover, decreased pool habitat	Increased predation vulnerability; lower winter survival for trout; lower production of juvenile trout; reduced aquatic species diversity; omnivorous and herbivorous fish are favored; decrease in Pacific giant salamander population	High	All perennial streams excluding isolated segments and Miners Creek
		Reduced retention of gravel (spawning and aquatic insect habitat); reduced flow attenuation capability; reduced habitat complexity; decrease in quantity of breeding sites (LWD) for Pacific giant salamander			
	Erosion of streambanks	Loss of stream bank vegetative cover; increased channel width/decreased channel depth	Increased vulnerability to predation; minnow species favored over trout	Moderate	Clearcut areas associated with streams
	Decreased ability to trap fine sediments before reaching streams	Increased fine sediments in gravel beds	Chub and brown bullhead favored, reduced survival of eggs and emergent trout fry; altered marcoinvertebrate communities	Moderate	Varies with slope and level of harvest
	Decreased supply of particulate organic matter	Reduced availability of nutrients to primary consumers (macroinvertebrates)	Reduced production of aquatic insects; reduced fish production	Low	Not applicable
Timber harvest from hillslope and associated roads	Altered stream flow regime (increased stream network, increased snow interception, solar melting)	Increase in peak flow events	Increased use of flood plain habitat for cover and food, reduced winter survival of trout	Low/moderate	Watershed
	Increased number of road crossings on streams	Increased delivery of fine sediments in streams	Reduced production of aquatic insects; reduced fish production/reduced survival of eggs and emergent trout fry; chub and brown bullhead favored.	High	Throughout watershed except wilderness area

Table 7-1. Influences of Timber Harvest and Riparian Area Grazing on the Aquatic Environment in the Spencer Creek Watershed. (Continued)

Management Practice	Potential change in the physical and chemical aquatic environment	Potential change in quality of aquatic habitat	Potential response of the aquatic biological communities	Present Risk to Resource	Location
Grazing in streamside riparian areas	Reduced streamside vegetation	Reduced hiding cover; reduced channel complexity, reduced flow attenuation capability	Increased vulnerability to predation, decreased aquatic species diversity, minnow species favored	Low	Isolated areas
	Streambank erosion from trampling and vegetation loss	Increased channel width; decreased channel depth; increased fine sediments in gravel beds	Reduced production of aquatic insects, reduced fish production; reduced survival of eggs and emergent trout fry, minnows, chub and brown bullhead favored.	Moderate	Spencer Creek in unconfined and accessible reaches
	Decreased supply of particulate organic matter	Reduced availability of nutrients to primary consumers (macroinvertebrates)	Reduced production of aquatic insects, reduced fish production	Low	Not applicable
	Increased incident solar radiation	Increased algae growth; higher concentrations of day time dissolved oxygen; lower concentrations of nighttime dissolved oxygen	Increased uptake of dissolved nutrients; increased growth rates of fish; increased susceptibility to disease; altered competitive advantage to favor temperature tolerant species; herbivorous and omnivorous fish are favored	High	Buck Lake/ Spencer Creek
		High water temperatures		High	Buck Lake/ Spencer Creek
Grazing at Buck Lake pasture	Reduced vegetative cover	Increased algae growth; higher concentrations of day time dissolved oxygen; lower concentrations of nighttime dissolved oxygen	Increased uptake of dissolved nutrients; increased growth rates of fish; increased susceptibility to disease, altered competitive advantage to favor temperature tolerant species; herbivorous and omnivorous fish are favored	High	Buck Lake/ Spencer Creek
		High water temperatures			
	Trampling and bank erosion	Increased input and delivery of fine sediments	Reduced production of aquatic insects, reduced fish production; reduced survival of eggs and emergent trout fry	High	Buck Lake/ Spencer Creek
Draining and channelization of Buck Lake	Loss of wetland function for nutrient and sediment filtering	Increased nutrient levels in Spencer Creek	Potential high algae production	Moderate	Spencer Creek
		Increase in fine sediments delivered to Spencer Creek	Reduced production of aquatic insects, reduced fish production; reduced survival of eggs and emergent trout fry	High	Spencer Creek
	Channel simplification	Simplified habitat structure	Minnows, chub and brown bullhead favored.	Moderate	Buck Lake

Table 7-1. Influences of Timber Harvest and Riparian Area Grazing on the Aquatic Environment in the Spencer Creek Watershed. (Continued)

Management Practice	Potential change in the physical and chemical aquatic environment	Potential change in quality of aquatic habitat	Potential response of the aquatic biological communities	Present Risk to Resource	Location
	High incident solar radiation during irrigation periods	High water temperatures	Increased uptake of dissolved nutrients; increased growthrates of fish; increased susceptibility to disease; altered competitive advantage to favor temperature tolerant species	High	Buck Lake/ Spencer Creek
	Loss of water storage capacity	Early release of seasonal runoff; potentially longer periods of low flows	Lower carrying capacity for aquatic species	Unknown	Spencer Creek/ Buck Lake

Appendix 8
Coordinated Resource Management Plan Information

7/18/95

CRMP Information

This appendix contains the current management objectives for each major land owner taken from the existing Spencer Creek Coordinated Resource Management Plan (CRMP). Much of the impetus for the preparation of the CRMP was to reconcile the impacts of grazing in the area, both on public and private lands, with the other values and uses of the watershed area.

CRMP Grazing Information/ Objectives

The following is the only jointly agreed on "objective" found in the CRMP that is purely livestock grazing oriented. Other objectives oriented towards wildlife, timber, recreation, etc...

"To maintain and/or improve livestock grazing at levels compatible with sustaining other related resources."

The following is the "Livestock Grazing and Forage Production" portion of the CRMP's "Problem List and Possible Causes":

1. Overgrazing by livestock in a few areas, and non-use or very light use in water short area
   a. Lack of cross fences for control of livestock
   b. Shortage of stock watering sources out of streams
2. Lack of alternative watering sites (out of stream) for livestock
   a. Geology and topography limits sources
   b. Lack of funds limits development of available sources
   c. Water right requirements
3. Lower than optimum forage harvest levels on Buck Lake pastures
   a. Irrigation program (schedule and amount of water applied)
   b. Pasture grazing program (schedule and degree of use)
   c. Nutrient (fertilizer) program
4. Livestock drift out of grazing allotments
   a. Lack of fenced boundaries
   b. Lack of natural barriers along boundaries
5. Livestock losses (mortality) on roads from vehicles, and hazards to motorists from livestock on main roads
   a. High speed traffic on paved roads
   b. Livestock crossing unfenced roads or traveling down roads

Within the actual "Resource Management System" section of the CRMP, there are various management objectives, recommendations and project proposals. Except for the Watershed and Stream Aquatic Resources sections below, only livestock-specific information is listed in this appendix; management objectives, recommendations and project proposals for other resources can be found in the CRMP. All information included in this appendix is taken verbatim from the CRMP.

Watershed

WEYCO section 19 (Stream reach 3) near the mouth of Spencer Creek has excessive livestock concentrations and needs fenced. Rancher and WEYCO will evaluate alternatives for dealing with this problem (1994). Buck Lake will be cross fenced by rancher (1994-98) which will aid restoration of natural cover on canals. About 1/4 mile of USFS will be fenced for temporary livestock exclusion at Spencer Creek exit from Buck Lake. Tunnel Creek BLM (north of road) will be fenced and managed as a separate pasture - BLM, Rancher.

Stream Aquatic Resources

Banks and Corridor Vegetation
Grazing: Existing riparian livestock exclosures will be maintained to allow full vegetative development without grazing in critical locations. The grazing system for livestock will focus on maintaining or improving riparian cover and ecological condition.

Riparian exclosure fences planned on WEYCO (?1995-6) by rancher, WEYCO:
   a. Spencer Creek, Reach 3 below Simmers Place
   b. Clover Creek at Dead Porcupine Spring
   c. Lower Clover Creek at Goshawk Spring (with outside stock water development).

Riparian exclosure fence is planned by FS at mouth of Buck Lake (1995) for temporary livestock exclusion to allow for full growth of aspen and herbaceous cover adjacent to creek. This will build stream base level by improving filtering of sediment from creek.

Livestock Grazing

1. **Planned Grazing System:** The present grazing system (see Grazing system chart and allotment map in CRMP appendix) will continue until the FS-BLM Watershed Analysis is completed.

   A. Buck Mountain Allotment - rested (non-use) for the present; future use is uncertain.

   B. Grubb Spring Allotment - no cross fencing; distribution is accomplished by riding, to the extent possible; a single cross fence along Clover Creek Road from USFS to Keno subdivision is proposed by rancher to allow a seasonal rotation and improve management.

   C. USFS - no existing cross fencing; distribution is accomplished by riding, to the extend possible; a two herd, seven pasture rotation is proposed in the 1993 FS range analysis; a second alternative is to merge the Buck Lake allotment with one of the proposed FS rotations. Final decision of these proposals will wait until the Watershed Analysis is complete (1995).

   D. Buck Lake BLM Allotment - this pasture has no rotation or changes in seasonal use. It is proposed that this pasture be grouped with one of the proposed FS rotations (probably the Burton Butte herd) to allow for improved management of the forage resources (see "C" above).

2. **Range Readiness Criteria**: Turnout on FS/BLM/Weyco will be adjusted (as necessary) from target dates based on the following factors which affect the forage supply or soil resource: 1) snow cover, 2) excessively wet soil, and 3) cold temperatures which retard forage growth.

3. **Degree of Use for Key Species:** Grazing use standards (percent of current annual growth) for key species will be:

   Uplands: (50%-FS/BLM)
   - Idaho Fescue
   - Brome
   - Bluegrass
   - Ross Sedge
   - Western Needlegrass

   Meadows: (60%-FS;50%-BLM)
   - Tufted Hairgrass
   - Kentucky Bluegrass
   - Sedge
   - Reed Canarygrass

Use standards will be the target for average degree of use for each pasture in the primary (key) use areas. FS will monitor use on key areas each year during the grazing season to judge move dates. BLM will do a utilization survey (map) on both allotments in fall, 1994, and in one more year in the near future (2 out of next 5 years).

4. **Forage Quality/Supplemental Feeding** no supplemental feeding except late in season at Buck Lake, as needed before shipping (because of early snow).

5. **Forage Inventories**: None planned

6. **Stocking Rates**:No change needed or planned from historic rates.

Within the "Resource Mgt. System for Irrigated and Sub-irrigated pasture" (i.e. Buck Lake private) is the following section:

1. **Pasture Seeding/Planting**: About 15 acres in Dust Bowl pasture after fencing is completed; test plantings of shrubs/trees on ditch banks may be considered after fencing is completed.

2. **Fertilization**: None planned or being considered (may not be economical without testing to verify).

3. **Irrigation System**:Will be improved over next 5-6 years (1994-99); SCS will do a system analysis and engineering design for improving turnouts, water control structures, crossings (Summer, 1994). Irrigation Water Management will be practiced through a water spreading system based on available water from springs and stream runoff.

4. **Drainage**: None planned - excessive drainage from previous ditching is part of the current problem.

5. **Stockwater Development**: None - Adequate water from ditch system.

6. **Planned Grazing System**: To be developed. About 10 miles of fencing is planned (both electric and traditional) with design suitable for use on lakebed conditions and deep snow. A system of rotation grazing will be practiced as fencing is installed (1995-99).

7. **Criteria for Judging Safe Degree of Use**: 2-3 inch minimum stubble on preferred forage species during growing season.

8. **Noxious and Poisonous Plant Control**: No needs or concerns.

9. **Wildlife Habitat**:: See Wildlife Section in CRMP.

10. **Conversion of Other Land to Irrigated Pasture**: None planned.

Current Grazing/Livestock Management Objectives

This section will cover the current grazing related management objectives for each major land owner. This is included because the key question, in part, asks "...how utilization levels compare to target levels in allotment and/or land management plans and in the CRMP...". The Spencer Creek Coordinated Resource Management Plan (CRMP) is basically a summarized version of some of the USFS, BLM, and WEYCO objectives or concerns expressed during the CRMP process as well as some of the private land owners.

Bureau of Land Management

The BLM's Klamath Falls Resource Area Resource Management Plan/EIS (BLM 1994) has varying maximum allowable use standards for grazing on BLM lands (see Tables 8-1 and 8-2).

Table 8-1. Utilization Standards - Upland Areas

Plant Category	Spring	Summer	Fall	Season-long
Perennial grasses & grasslike	50%	50%	60%	50%
Perennial & biennial forbs	50%	50%	60%	50%
Shrubs, half shrubs & trees	30%	50%	50%	45%
Annual grasses and forbs	No annuals are expected to be key species			

Table 8-2. Utilization Standards in Riparian- Wetland Areas

	Proper Functioning Condition		Functional - At Risk or Non-functioning	
	Herbaceous	Woody	Herbaceous	Woody
Riparian Areas with Management	50%	50%	0-40%	0-35%
Riparian Areas without Management	40%	30%	0-30%	0-25%

(The BLM's Riparian Condition rating is discussed in Chapter 4.)

Weyerhaeuser Company

The Weyerhaeuser Company has a list of "Grazing Guidelines" that are attached to the grazing leases for Lester Hinton and Charley Livestock Company. Among other guidelines within the Hinton lease, are the following objectives:

"Optimum Riparian forage use is defined as uniform cropping of 40% of available forage in nonrest pastures."

"Livestock will be initially distributed throughout the lease areas so as to avoid any heavy concentration."

"Uniform use of vegetation will be the key measure of successful grazing."

"Spencer Creek riparian area will be protected through CRMP actions and herd control by riding."

Along with other grazing related guidelines, within the Charley Livestock Weyerhaeuser lease is the following utilization objective:

"Optimum forage use is defined as uniform cropping of 60% of available forage."

U.S. Forest Service

Within the "Range" section of the 1993 Winema Forest Plan, the utilization objectives are defined in tables specific to "Suitable Range (except Riparian)" and for "Riparian Forage Utilization". See Tables 8-3 and 8-4.

Table 8-3. Suitable Range (Except Riparian) Allowable Use of Available Forage[1]

Range Resource Management Level	Maximum Annual Utilization %[2] Forest Sat. Cond.	Forest Unsat. Cond.	Grassland Sat. Cond.	Grassland Unsat. Cond.	Shrublands Sat. Cond.	Shrublands Unsat. Cond.
Livestock use managed within current grazing capacity by riding, herding, and salting and cost effective improvements used only to maintain stewardship of range.	40	0-30	50	0-30	40	0-25
Livestock managed to achieve full utilization of allocated forage. Management systems designed to obtain distribution and to maintain plan vigor include fencing and water development.	45	0-35	55	0-35	45	0-30
Livestock managed to optimize forage production and utilization. Cost-effective culture practices improving supply forage use, and livestock distribution may be combined with fencing and water development to implement complex grazing systems.	50	0-40	60	40	50	0-35

[1] This will be incorporated in annual operating plans and allotment management plans. Allotment management plans may include utilization standards which are either lower or rarely higher when associated with intensive grazing systems and specific vegetation management objectives that will meet resource objectives. Includes cumulative annual use by big game and livestock.

[2] Utilization based on percent removed by weight for grass, grasslike, and forbs.

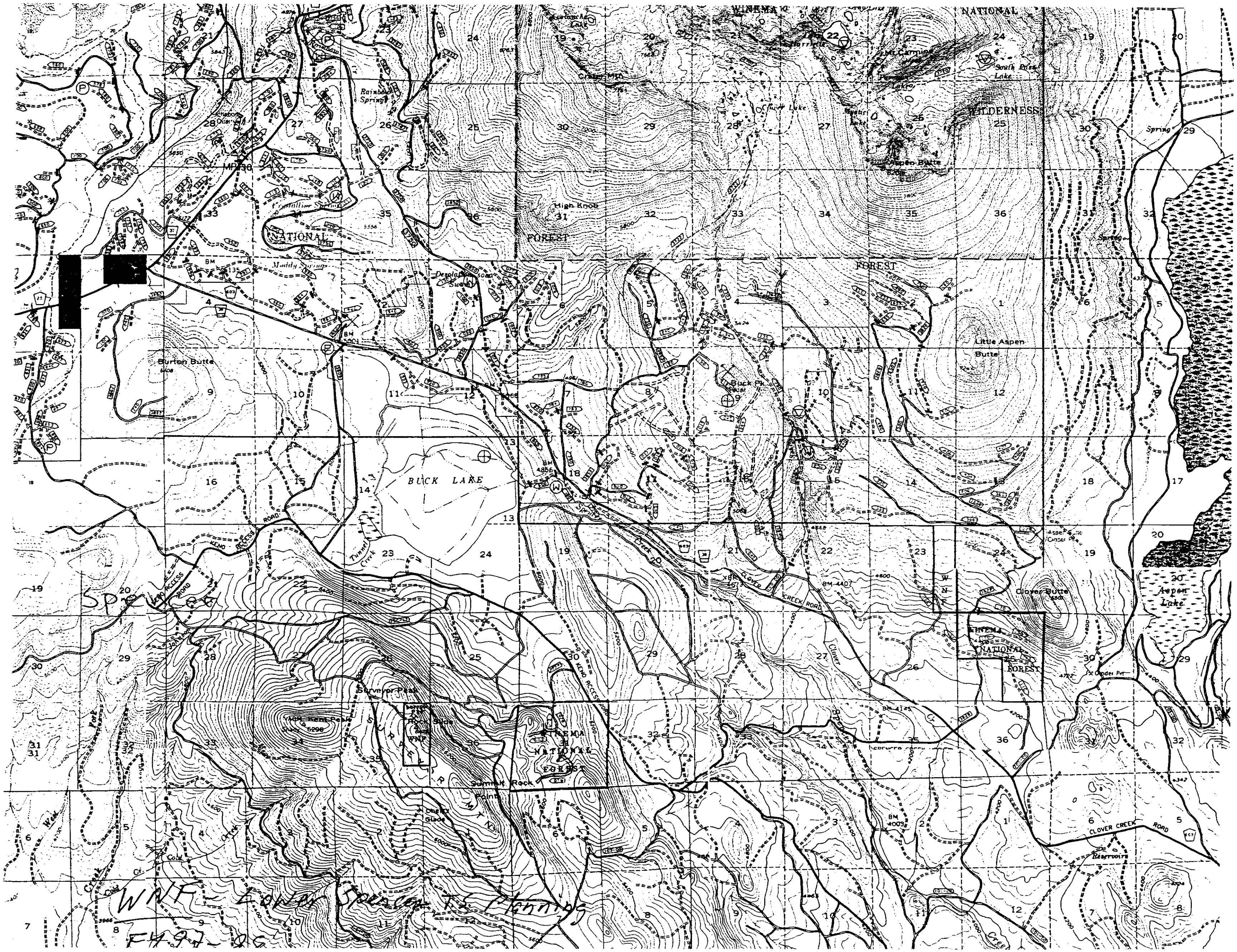
Table 8-4. Riparian Forage Utilization Allowable Use of Available Forage[1]

Range Resource Management Level	Maximum Annual Utilization %[2] Grass/Grasslike[2]		Shrubs[3]	
	Sat. Cond.	Unsat. Cond.	Sat. Cond.	Unsat. Cond.
Livestock use managed within current grazing capacity by riding, herding, and salting and cost effective improvements used only to maintain stewardship of range.	40	0-30	30	0-25
Livestock managed to achieve full utilization of allocated forage. Management systems designed to obtain distribution and to maintain plan vigor include fencing and water development.	45	0-35	40	0-30
Livestock managed to optimize forage production and utilization. Cost-effective culture practices improving supply forage use, and livestock distribution may be combined with fencing and water development to implement complex grazing systems.	50	0-40	50	0-35

[1] This will be incorporated in annual operating plans and allotment management plans. Allotment management plans may include utilization standards which are either lower or rarely higher when associated with intensive grazing systems and specific vegetation management objectives that will meet resource objectives. Includes cumulative annual use by big game and livestock.

[2] Utilization based on percent removed by weight.

[3] Utilization based on incidence of use, weight, and/or twig length. Example: if 50 leaders out of 100 are browsed, utilization is 50 percent


WINEMA NATIONAL
WILDERNESS
South Rock Lake
Rainbow Spring
High Knob
Aspen Butte
NATIONAL
FOREST
Burton Butte
Little Aspen Butte
Buck Pk.
BUCK LAKE
Tunnel Creek
KENO ACCESS ROAD
Spencer
Clover Butte
WINEMA NATIONAL FOREST
CLOVER CREEK ROAD
Aspen Lake
Surveyor Peak
Summit Rock
Spring
Cold Cr.
Creek
WNF - Lower Spencer T.S. Planning
F497-96

United States Department of Agriculture

Forest Service

Klamath Ranger District
1936 California Avenue
Klamath Falls, OR 97601

File Code: 1950

Date: July 25, 1997

Dear Friends:

I wrote to you in June of this year concerning a proposal to salvage approximately 10 acres of white fir forest that had blown down west of Buck Lake in the Spencer Creek watershed (T38S, R5E, Section 11 SWSW). Based on our analysis and the comments already received, I am now ready to authorize the removal and sale of approximately 300 thousand board feet of timber.

I plan to sign a Decision Memo on August 29 so we may proceed with our proposal, unless major concerns or issues are raised between now and then. If you would like further information, please contact Sarah Malaby at 541-885-3421. Thank you for your participation in this project.

Sincerely,

ROBERT W. SHULL
District Ranger

*Comments received in response to this solicitation, including names and addresses of those who comment, will be considered part of the public record on this proposed action and will be available for public inspection. Comments submitted anonymously will be accepted and considered; however, those who only submit anonymous comments will not have standing to appeal the subsequent decision under 36 CFR Part 215. Additionally, pursuant to 7 CFR 1.27(d), any person may request the agency to withhold a submission from the public record by showing how the Freedom of Information Act (FOIA) permits such confidentiality. Persons requesting such confidentiality should be aware that, under the FOIA, confidentiality may be granted in only very limited circumstances, such as to protect trade secrets. The Forest Service will inform the requester of the agency's decision regarding the request for confidentiality, and where the request is denied, the agency will return the submission and notify the requester that the comments may be resubmitted with or without name and address within 10 days.