BIG ELK WATERSHED ANALYSIS

August 1995
Alsea Ranger District
Siuslaw National Forest

This analysis was done by staff of the Alsea Ranger District,
Siuslaw National Forest
18591 Alsea Highway
Alsea, OR 97324
(503) 487-5811

Big Elk Watershed Analysis Team

Margaret Bailey, Team Leader
Barb Ellis, Hydrologist
Martha Jensen, Wildlife Biologist
Curt Ralston, Fisheries Biologist
Diane Rainsford, GIS Analyst

Support

Karen Austin, Wildlife Ecologist
Jessica Dole, Landscape Architect
Dwayne Guthrie, Ecology and Historical info
Stu Johnston and Tom Turpin, Silviculturists
Cynthia Leonard, Public Affairs Specialist
Bob Nowak, Area Steward
Rebecca Ries, Landscape Architect
Clark Tieke, North Fork Watershed Analysis Team Leader, BLM

Original data for this analysis was compiled from multiple sources and may not meet the U.S. National Mapping Standards of the Office of Management and Budget. For specific data source dates and scales, or for additional digital information, contact the Forest Supervisor, Siuslaw National Forest, 4077 Research Way, Corvallis, OR 97333. The maps in this document have no warranties to their content or accuracy.

TABLE OF CONTENTS

I. INTRODUCTION

The focus of a watershed analysis is to meet the Aquatic Conservation Strategy Objectives as outlined in the Northwest Forest Plan (USDA 1994, B-10). An agency must manage the riparian-dependent resources to maintain the existing conditions or implement actions to restore conditions. The baseline from which to assess maintaining or restoring the condition is developed through a watershed analysis (USDA 1994).

The objective of the Big Elk Watershed Analysis document is to serve the managers and district personnel today as well as in the future. The document is intended to provide a description of the analysis process, explain the rationale and supporting information behind any management recommendations, and provide objectives, guidelines, or constraints for future planning and project implementation.

Analysis Area

The Big Elk watershed Analysis Area includes two watersheds totaling about 62,000 acres in the southern third of the Yaquina River basin of the central Oregon Coast Range (Figure 1). Big Elk Creek, the largest tributary, drains an area of about 57,000 acres. Mill Creek is an adjacent, 5200 acre watershed flowing directly into Yaquina Bay (Figure 2). Throughout this document, Big Elk watershed refers to both Big Elk and Mill Creeks. The aquatic analysis attempted to include the whole watershed, but due to lack of data north of the Siuslaw National Forest boundary, the terrestrial analysis focused on the southern two-thirds of the Big Elk watershed, hereafter known as the Big Elk Analysis Area (Figure 3). This area covers about 37,000 acres and includes 8 subwatersheds (Figure 4). It is the same area that was covered in the Big Elk Integrated Resource Analysis (see Prior Planning Processes below).

Analysis Process

The watershed analysis process used for Big Elk was the six step process outlined in the federal guide, Ecosystem Analysis at the Watershed Scale: The Revised Federal Guide for Watershed Analysis, version 2.1 (March, 1995), including the draft terrestrial addendum. The process consists of :

1) Characterizing the watershed
2) Identifying issues and key questions,
3) Identifying the current conditions,

4) Describing the reference conditions,
5) Analyzing the trends between current and reference conditions, and
6) Compiling recommendations for management.

Because a watershed is a complex association of a number of physical and biological conditions, the organization of the analysis process was divided into three domains: the aquatic, terrestrial, and socioeconomic systems. The analysis was completed by domain and the document is organized in the same manner. Issues and key questions were developed for each domain. The intent was to focus the analysis on the most critical elements within the watershed.

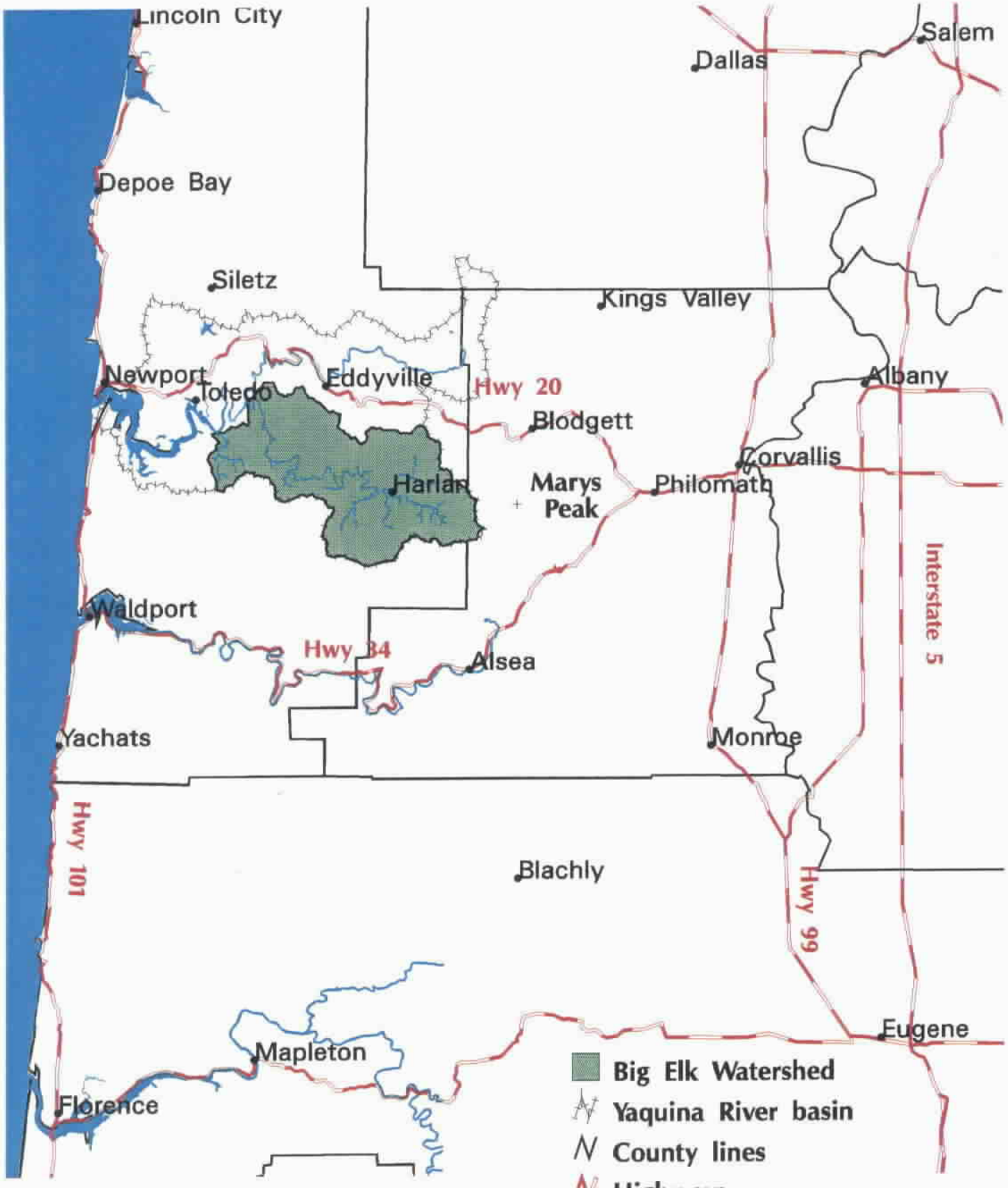
Prior Planning Processes

Previous to the current watershed analysis process, a team of district resource specialists completed an Integrated Resource Analysis (IRA) on federally owned lands in the Big Elk watershed. This process was completed in 1993 and followed the "Forest Landscape Analysis and Design" process developed by Diaz and Apostol (1992). The planning team identified three general areas of patterns and activities and called these emphasis areas . The emphasis areas included human use, Habitat Conservation Areas, and HCA corridor. The IRA served as a foundation for the Big Elk Watershed Analysis, which used much of the information gathered during the IRA.

The watershed analysis used a different process than that of the IRA, but the end results of both analyses provided many of the same recommendations for potential resource management areas. The primary difference between the two planning processes is that the watershed analysis includes both the aquatic and terrestrial systems whereas the IRA focused more heavily on the terrestrial systems. The watershed analysis process also requires that issues and key questions be identified up front to help focus the analysis.

Two other watershed analysis efforts are taking place adjacent to the Big Elk watershed. The BLM is currently working in the North Fork of the Alsea River. The Drift Creek of the Alsea watershed analysis is scheduled by the Waldport district to begin in the fall of this year (see Figure 5).

Big Elk / Mill Creek Watersheds
Oregon Coast Range



Big Elk Watershed Streams

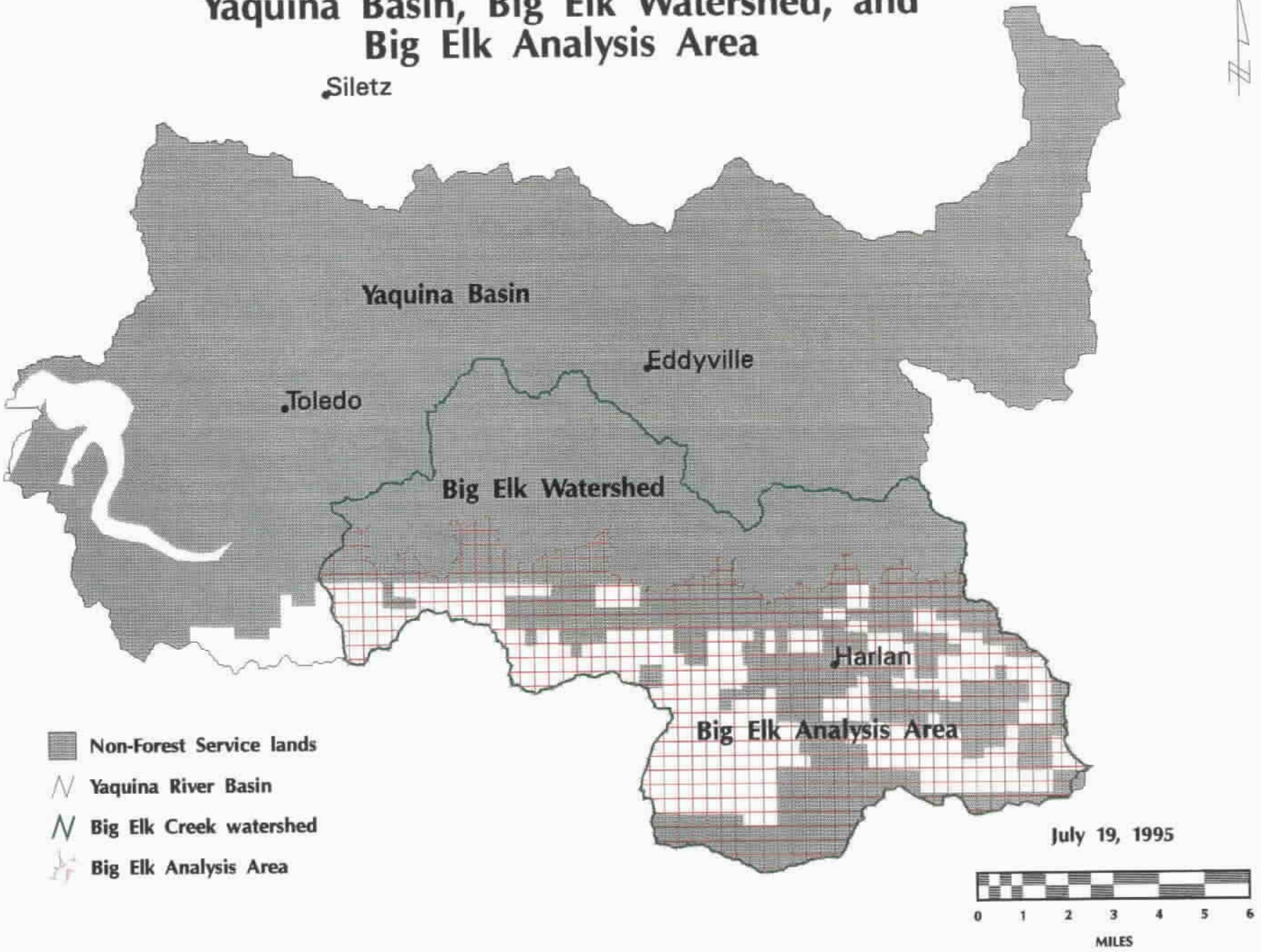
Note: Area north of the SNF boundary shows a lower stream density than what really exists. Streams for this area were generated from Digital Elevation Models and intermittents are generally missing.

August 07, 1995

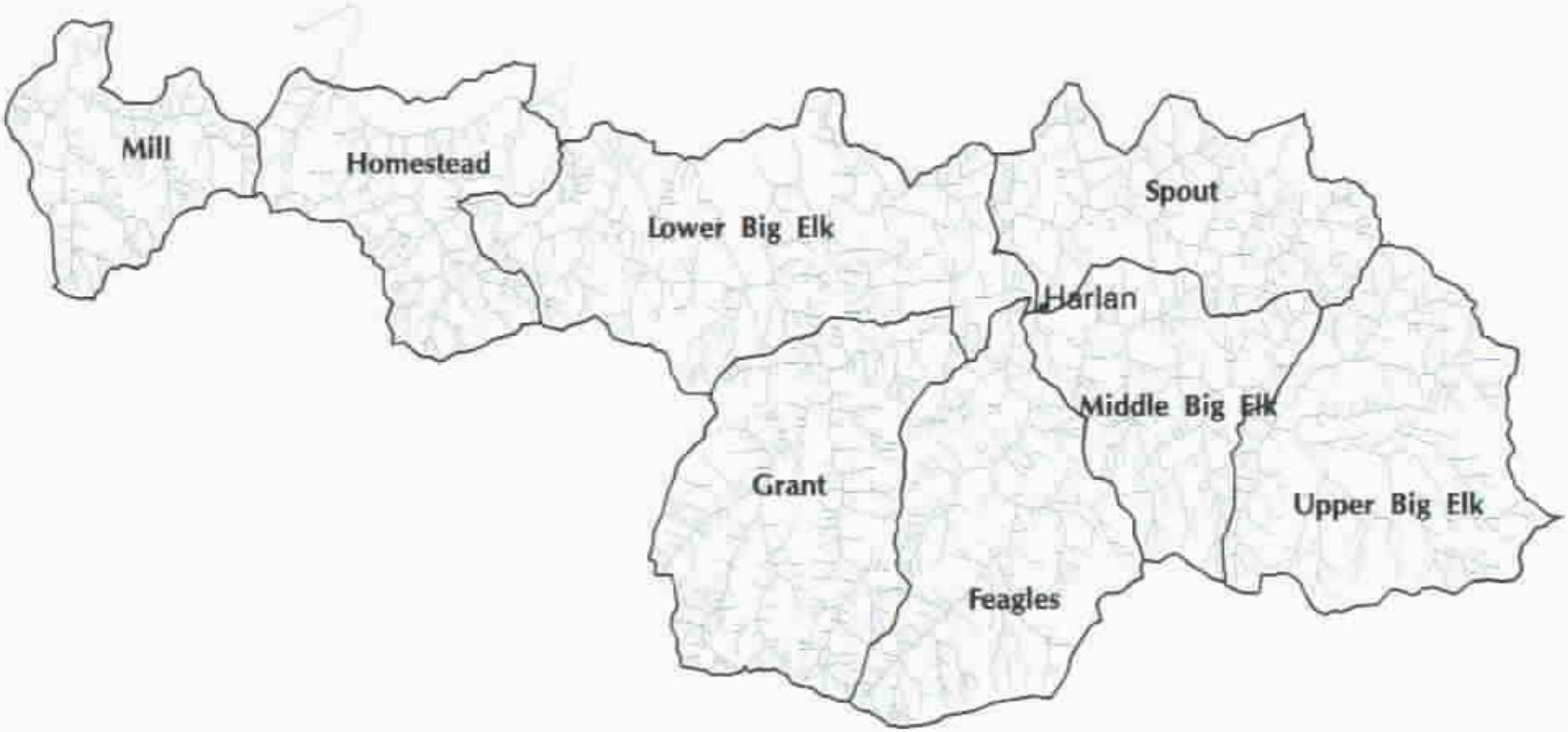
0 1 2 3 4

MILES

Yaquina Basin, Big Elk Watershed, and Big Elk Analysis Area



Big Elk Analysis Area
Subwatersheds



June 22, 1995

0 1 2 3 4

MILES

Figure 4

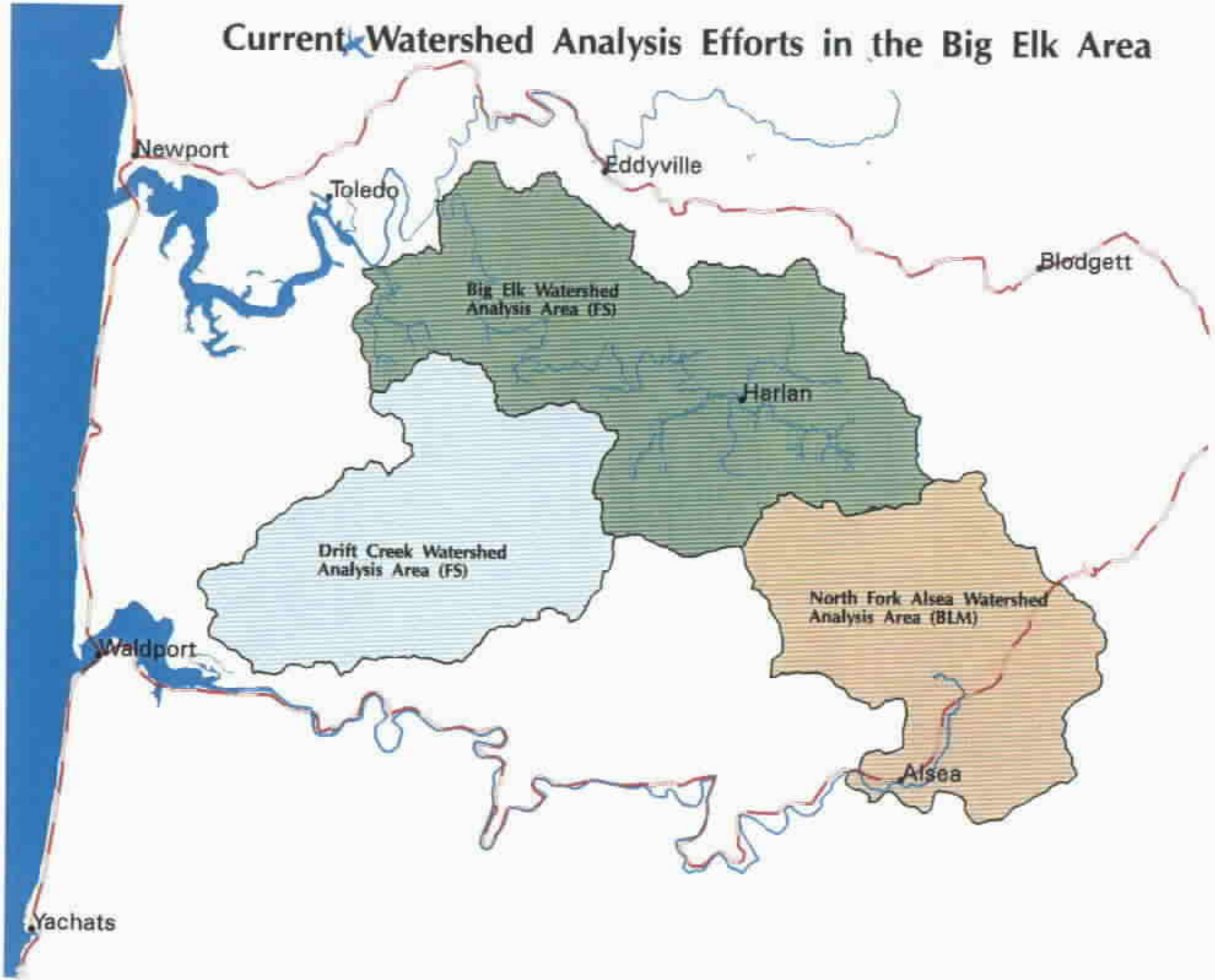

Current Watershed Analysis Efforts in the Big Elk Area
Newport
Toledo
Eddyville
Blodgett
Big Elk Watershed Analysis Area (FS)
Harlan
Drift Creek Watershed Analysis Area (FS)
North Fork Alsea Watershed Analysis Area (BLM)
Waldport
Alsea
Yachats

Figure 5.

II. WATERSHED ANALYSIS PROCESS

This section is organized by the six steps of the process. Each step is subdivided into domains and discussion within the domain is focused on specific issues and key questions.

STEP 1: CHARACTERIZATION

In the Oregon Coast Range, geology controls basin landform and river morphology. Bedrock consists of basalt that was once part of the ocean floor and layers of sedimentary rocks that cover it. Most of the Yaquina River basin, and nearly all of the Big Elk watershed, is underlain by the Tyee Sandstone Formation. This formation is moderately to highly erodable. Intrusions of younger volcanic rocks, more resistant to erosion, are scattered in the headwaters of the Yaquina basin, especially in the northeastern area and around Marys Peak to the southeast in the Big Elk watershed. This landscape is highly dissected, with higher elevations and steeper slopes to the south and southeast. Most of the lands with the highest risk for landslides in the Yaquina Basin are located in the southeast portion of the Big Elk watershed.

The remainder of the Big Elk watershed and Yaquina Basin have a relatively gentler topography due to the nature of the coastal uplift. Subduction of the Pacific Ocean floor under the western edge of the North American continent has caused the whole Coast Range to uplift with an eastward tilt. In addition, the northern part of the Coast Range is tilting south and the southern part is tilting north placing the Yaquina and Siletz River basins in the "hinge zone" between these two areas (Rhea 1994). The crest of the Coast Range is at its lowest point in this zone. The lower average elevation of the Yaquina River basin relative to the rest of the Coast Range influences climate, river morphology, and disturbance patterns. The basin receives less rainfall than the Siletz or Alsea River Basins and delivers less annual discharge (State Water Resource Board 1965). Unlike other rivers in the Coast Range, the Yaquina and Siletz river valleys become broad and unconfined as one moves downstream resulting in milder stream gradients and higher sinuosity. The interaction of low stream flows and low gradients reduces the ability of stream channels to quickly transport sediments delivered from the steeper, more unstable lands in the Big Elk watershed (ODFW 1991).

Human Domain

The gentle topography and mild climate of the area attracted early homesteaders and has resulted in one of the longest histories of European-american settlement in the Coast Range. The ownership of the Yaquina River basin is still highly fragmented and most of the basin is currently owned by private parties and industrial timber interests (Figure 6). Humans have

profoundly influenced the patterns of disturbance, plant communities, and habitat capability of other aquatic and terrestrial species inhabiting the Big Elk watershed.

Within the analysis area lie the small communites of Elk City and Harlan. These communities are a result of a long history of agricultural and commodity use of the valley and forested slopes. The valley floor provided flat ground for grazing livestock, building homes, access to water, and travel routes into and out of the valley. Approximately 100 residents still make their home in Harlan and another 300 to 400 residents live within or near the community of Elk City.

Recreational use of the area consists primarily of dispersed activities such as hunting, fishing, and recreational travel. Several sites within the analysis area are well known as favorite spots for hunting camps. Landing sites from logging activities tend to attract people as well. These areas usually provide level sites for camping and unobstructed views. The Forest Service provided one developed campground on Big Elk Creek just west of Harlan. This site has now been turned over to the community of Harlan to manage.

Aquatic Domain

Over 450 miles of perennial and intermittent stream channels are located within the Big Elk watershed, with over 110 miles of these being salmon and trout habitat (Figure 7). Large wetlands, ponds, or lakes are not a major feature in this watershed. Small, 1-5 acre wetlands do occur in stream channel floodplains above beaver dams. A dam at the confluence of Mill and East Fork Mill Creeks impounds a reservoir for the city of Toledo. A fish ladder provides fish passage over this dam. The Yaquina River has the fourth largest coastal estuary on the Oregon Coast, which provides important habitat for humans, waterfowl, over 80 species of fish, and countless species of invertebrates including 32 species of bivalves and crustaceans (ODFW 1991). Big Elk Creek, below Grant Creek, provides streambank angling for the Yaquina Basin sport fishery.

Fall chinook, coho, and chum salmon, winter steelhead, and sea-run cutthroat trout stocks inhabit the Yaquina River Basin and the Big Elk Watershed. Only the fall chinook stock is considered healthy (Huntington *et. al* 1994). Other salmon and trout stocks are in decline coast-wide (Siuslaw National Forest 1993). Coho salmon will be listed as a threatened species under the Endangered Species Act and steelhead trout is currently being reviewed for listing. The status of cutthroat trout stocks is in the Big Elk watershed is unknown but may be more stable than other coastal basins. The Big Elk watershed is not a major producer of salmon or trout relative to other coastal basins (Nickelson *et al* 1992) but some Big Elk watershed stocks are important. The Mill Creek chum salmon population is currently stable unlike other coastal chum stocks. The Yaquina River Basin is near the southern end of the range of chum salmon. In addition, winter steelhead returns in Mill Creek are predominantly natural fish (ODFW 1995) unlike returns in Big Elk Creek and other coastal river basins.

Yaquina Basin Ownership

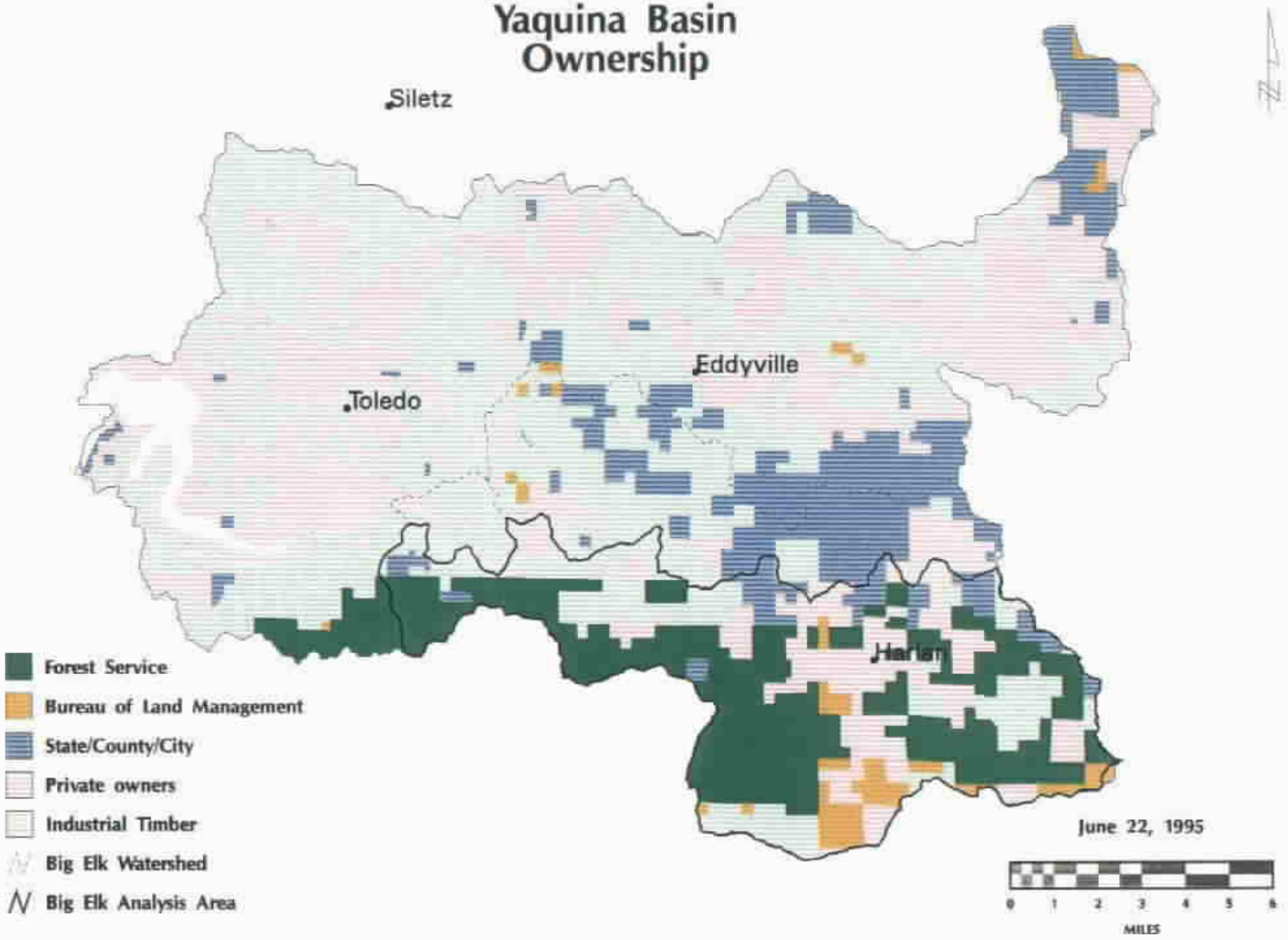


Figure 6

Big Elk Watershed
Stream Gradient and Confinement

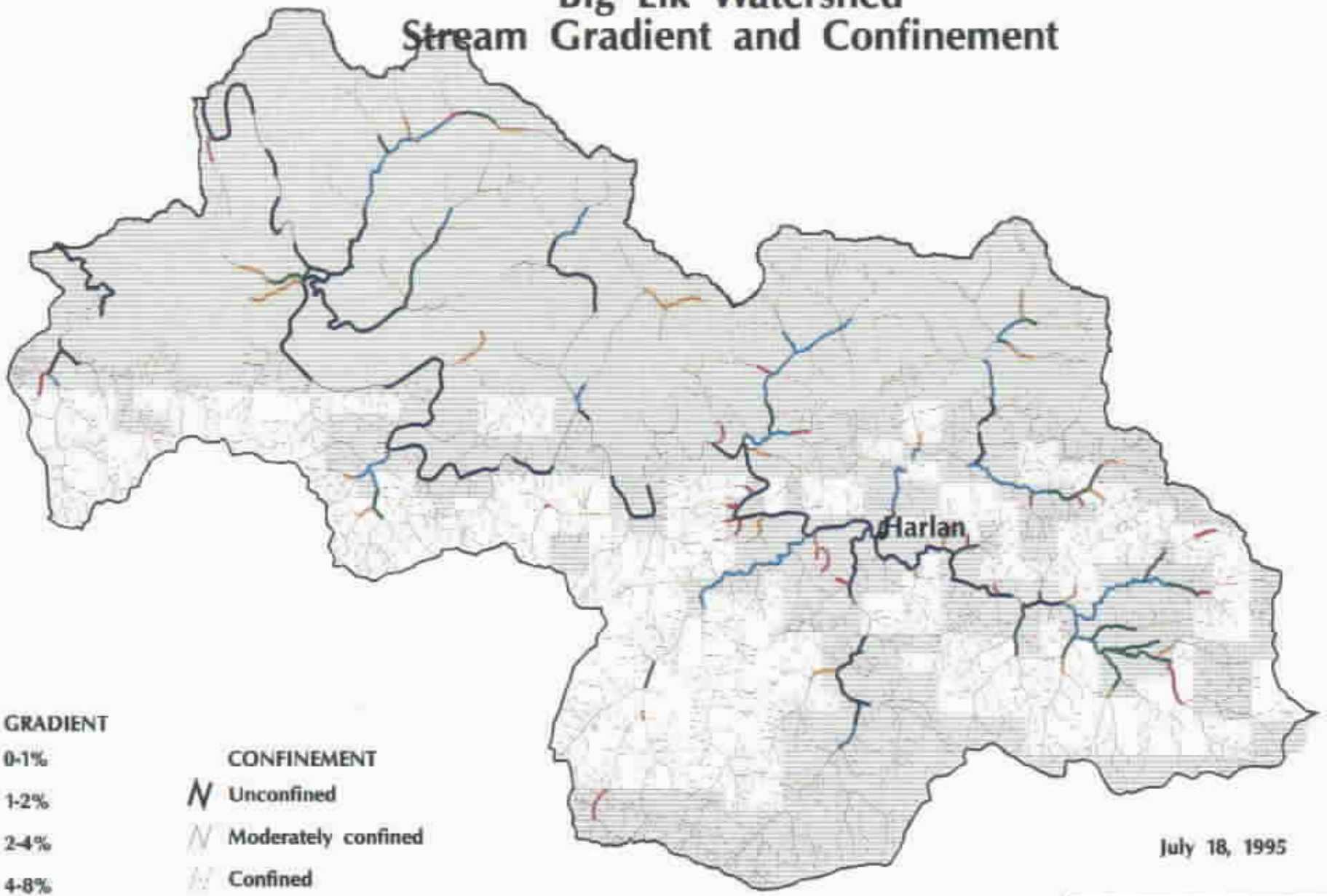


Figure 7.

Habitat degradation is an important, but not unique, factor in the Big Elk watershed. Aquatic habitat diversity in the watershed has been reduced. Hardwood trees or pasture land dominate most riparian areas along low-gradient streams. Water quality of Big Elk Creek is moderately impaired. Hatchery fish interactions are an additional factor for viability of coho salmon and winter steelhead in the Big Elk watershed. The exception is upper Mill Creek watershed, which has been designated a Key Watershed based on stable salmonid stocks, relatively good fish habitat, and the presence of the Toledo municipal watershed (USDA 1994).

Terrestrial Domain

The long settlement history of the Coast Range has resulted in vegetation patterns which have been formed and maintained by human activity for a long time. Early settlers claimed the valleys of the Big Elk drainage for agriculture and livestock grazing while industrial timber management was practiced in the foothills. These activities are shaping the vegetation patterns to this day and strongly influence how the terrestrial and aquatic systems function. Pastures and early seral openings comprise a high proportion of the landscape, while mature conifer stands are confined to the upper portions of the drainages on federal lands. Hardwoods and hardwood mixed stands are very prevelant in the Big Elk drainage and resemble conditions found on the Hebo Ranger District. Approximately 34% of the landscape is in young conifer plantations between 8 and 40 years old, reflecting the active timber management history in the area.

The remaining mature conifer stands within the Big Elk watershed serve as a critical link for species associated with this habitat type and provides connectivity between the federal lands around Marys Peak and the remainder of the Siuslaw National Forest and with lands administered by the Bureau of Land Management to the north and south. The Yaquina Basin was identified as the Forests' second highest priority watershed for restoration of mature conifer habitat (Interim Late-Successional Reserve Assessment for R0268, May 1995). Restoration of mature conifer habitat is vital in this drainage to prevent the genetic isolation of species in the Marys Peak and Corvallis watershed block.

The Big Elk landscape supports seasonal and resident populations of over 200 terrestrial vertebrate species. Due to the history of disturbance in the area, this drainage has a high proportion of non-native plant and animal species. European pasture grasses, along with noxious and unwanted brush species, are common introduced plants. Non-native gamebirds are released regularily by ODFW adjacent to the analysis area and have established populations in the area.

Elk are common in the eastern and western portions of the analysis area. Breeding and demographic studies for songbirds over the past 5 years indicate that the Homestead Creek site in the Big Elk drainage has one of the highest species diversity of neotropical migratory songbirds of the 6 areas surveyed on the forest (including Marys Peak). However, populations of songbirds are declining due to habitat loss and predation and competition. The analysis area

also has the highest known concentrations of *Poa laxiflora* (loose-flowered bluegrass) on the Siuslaw National Forest. This grass is stongly associated with hardwood-dominated riparian areas and disturbance, both common features of this landscape. One of only 12 known active bald eagle nest sites on the forest is located in Grant Creek, in the center of the analysis area.

STEP 2: ISSUES AND KEY QUESTIONS

Human Domain

Issue: Human uses of, and values about, the watershed

Although little is known about how Native American peoples used the Big Elk area historically, the Siletz still reside in and use the Yaquina Bay area. European settlement started in the late 1800's within the Big Elk drainage and human use of the area has and will continue to affect the biological and physical elements of the landscape. Under current land allocations portions of the landscape is dedicated to the extraction of resources such as wood fiber, special forest products, firewood and other commercial uses.

With a projected growth of the Willamette Valley population in the next few years, the demands for and values of the National Forest lands for dispersed recreation and other values is increasing. Cultural and traditional ties, residential use and travel routes through the landscape and contributions of the landscape to visual qualities and the overall standard of living for the area are just some of the current issues.

Key questions:

1. What are the historic and current human uses of the watershed and trend of those uses in the future?
2. What are the key human uses (off-site and direct) in the watershed and the future trend of these uses?
3. What man-made infrastructure and facilities (campgrounds, roads, powerlines) are located within the watershed and what is the trend of their use?
4. What aquatic, and terrestrial plant and animal species are important to people and what is the trend for the future use of these resources? What are the demands and management goals for those species? What is the watershed's potential to meet the demand and /or management goal for those species and values given existing land allocations and management constraints?
5. What are the environmental quality concerns of people for this watershed?
6. Are there anticipated demographic and social trends that will change the human pressures on the watershed?
7. What is the trend in human value of the overall environmental quality or specific site quality in the watershed? What ability does the watershed have to provide for those uses, and what is its role in supplying them?

Issue: Long-term Management of Range Allotments

There are 2 grazing allotments (Grant Ridge, Upper Big Elk) which are held by three permittees within the analysis area. These allotments cover approximately 60% of the National Forest lands within the Big Elk watershed. These allotments do not have current management plans developed or selected per the National Environmental Policy Act (NEPA 1969). At issue are whether or not livestock grazing on federal lands meets or can be compatible with direction outlined in the Northwest Forest Plan for aquatic conservation.

Key questions:

1. Are the range allotments currently in compliance with direction outlined in the Northwest Forest Plan?
2. How will modification or cancellation of the grazing permits affect the permittees?

Aquatic Domain

Issue: Water Quality in the Big Elk watershed

Adequate amounts of cool, clean water is critical for humans and aquatic communities in the Big Elk watershed. The water quality of Big Elk Creek is moderately impaired (DEQ 1988). High stream temperatures and low streamflow during the summer season may be limiting factors for many aquatic species, especially rearing salmonids. The upper Mill Creek watershed is the municipal watershed for the city of Toledo. The city uses the Mill Creek reservoir as a water source during the winter season and water quality needs to be maintained. Any management activities scheduled for the Mill Creek watershed must not impair water quality or yield.

Key Questions:

1. What is the current condition of water quality in the Mill Creek Watershed?
2. What types, if any, of management activities are compatible with maintaining water quality and quantity standards?
3. What types, if any, of restoration projects are needed in this watershed?

Issue: Viability of aquatic and aquatic dependent species (fish, invertebrates, amphibians).

The decline of the ecological health of aquatic ecosystems in the Pacific Northwest is a primary issue in the NW Forest Plan (USDA 1994). Hundreds of stocks of salmon are at risk of extinction in the Pacific Northwest (Nehlsen 1991; USDA 1994); several are already listed under the Endangered Species Act and others are proposed for listing. Amphibians and invertebrates

are also declining at broad scales (Williams and Neves 1992; Walls *et a.* 1992). Yaquina River basin wild salmon and trout stocks are either at risk of extinction or are moderately stable populations in a larger regional metapopulation that is at risk. Only the northern Oregon coast fall chinook stocks, including the Yaquina Basin, are considered healthy (ODFW 1995; Huntington *et al* 1994). The viability of tailed frogs and red-legged frogs is also of concern (Marshall *et al* 1992) and their status in the Yaquina River basin is unknown. Likewise, the status and distribution of macroinvertebrate species in the basin is largely unknown.

This Big Elk Watershed Analysis assessed aquatic habitat condition, aquatic species distribution, and, to a lesser degree, hatchery-wild fish interactions at the watershed scale. Anadromous fishes in the Big Elk watershed range over much larger scales and processes at larger scales affect watershed population viability but these factors were not analyzed. Pearcy (1992) discusses the effects of ocean conditions on salmonid survival and Nickelson *et al* (1992) reviews ocean harvest of salmonid species from Oregon coastal basins. Assessment of aquatic habitat condition was limited to key life-history stages: spawning or breeding and summer and winter rearing. Factors influenced by federal land management or policies were emphasized.

Key questions:

1. What are the key elements (disturbances and processes) interacting with the life-stage habitats?
    a). How does sediment and large wood routing through the watershed affect these habitats?
    b). What are the natural disturbances and processes affecting the habitats?
    c). How do human activities affect habitats or natural processes? Are there known problem areas?
2. What is the condition and trend of key life-stage habitats: spawning, summer rearing, and winter rearing habitats?
3. What is the condition of riparian habitat (bank stability, canopy closure, vegetative community, recruitment of large wood)?
4. Are any of these habitats significant (highly productive, high quality, creating "hotspots" or refugia)?
5. What is the of distribution of aquatic species in the Big Elk watershed?
6. Are there barriers to connectivity of populations in the watershed, or basin or entire range?
7. Are life-stage habitats connected in time and space?
8. What are the key elements (disturbances and processes) interacting with the distribution of aquatic species?
    a). How have human activities altered these patterns historically and in future trends (indirect effects)?
9. Are introduced species or hatchery-produced fish affecting aquatic species viability?

Terrestrial Domain

Issue: Connectivity of Mature Forest Habitat

This issue deals with the amount, distribution and quality of late-successional forest habitat across the landscape. The long history of human activities in the area has resulted in a heavily fragmented landscape with a severe shortage of mature forest stands. Providing connectivity through this landscape for late-successional forest-dependent species is mandated under current direction and is essential to preventing isolation of species in the Marys Peak area. The Big Elk/Yaquina drainage was identified as the second highest forest priority for restoration of mature forest.

Key Questions:

1. Does the landscape provide connectivity for late-successional forest related species?
2. What is the current condition of the Late-Successional and Riparian Reserve and how will management activities within the reserves affect connectivity and terrestrial and riparian processes and functions?
3. Are modifications of the LSR or Riparian Reserve boundaries warranted to improve the overall conditions of the reserves?
5. Are there specific areas outside of the reserve designations which serve an important function for connectivity (i.e. to BLM lands)?
6. Are at least 15% of the federal lands within the watershed in mature conifer or late-successional forest (S&G on p. C44 of the ROD)?

Issue: Maintaining Terrestrial Ecosystem Structure and Function

Human-caused fires, agriculture and timber management activities have shifted the vegetation over the past 140 years on the landscape from large blocks of mature conifer forests to a mosaic of young plantations and small patches of hardwood-mix stands. This landscape pattern favors edge species and introduced non-native plants and animals and limits the habitat quality for much of the native flora and fauna.

Key Questions:

1. What is the current condition of listed species and species of concern (TES, C-3) within the watershed and how can management activities improve habitat conditions for these species?
2. How has human activity in the drainage affected the amount and distribution of early seral habitat in the drainage and what is the trend for this and other habitat types in the future?
3. What are the contributions of special habitats as identified in the ROD and are species associated with these habitats at risk in the Big Elk watershed?

4. How is landscape fragmentation and the introduction of non-native plant and animals (including fish) affecting the native flora and fauna in the watershed?
5. What ecological function do non-federal lands serve in the watershed?

Issue: Long-Term Management of Elk Habitat and Potential Damage to Private Lands

Since a large portion of the Big Elk watershed is privately owned, there is a concern that a reduction in clearcut practices on federal lands could lead to an increase in elk damage on private lands. This issue was raised by the Oregon Department of Fish and Wildlife and will be covered under the Ecosystem Structure and Function issue, rather than being treated separately. Given the limited amount of federal lands within the drainage and the direction outlined in the Northwest Forest Plan, management activities on federal lands would have a limited effect on the distribution of elk on the landscape.

STEP 3: REFERENCE CONDITIONS

The Big Elk watershed reference condition considers community organization and ecosystem processes prior to a regional scale wildfire disturbance circa 1850 and the subsequent immigration of human settlers. The reference condition should include the range of ecosystem structure and processes required to maintain ecosystem sustainability (USDA 1995). Ecosystems are sustainable because plant and animal communities are resistant to disturbances. A diverse ecosystem provides refugia at many spatial and temporal scales during disturbances (Seddell *et al* 1990) and most plant and animal communities are "preadapted" to episodic disturbances (Poff and Ward 1990). After a disturbance event, life history strategies of plant and animal communities and the recolonization of disturbed areas from refugia move the ecosystem back to some reference condition. Important reference condition disturbances in the Big Elk watershed are wildfire, windthrow, flood, drought, and landslides. Generally, large-scale reference disturbance events are episodic followed by long periods of recovery.

Human Domain

Human Uses and Values

People began living in permanent villages at Tahkentich and at Yaquina Head (Exploring Oregon's Past, BLM) between 4,000 and 5,000 years ago. In Theodore Talbot's account of his expedition to the Alsea River and adjacent country in 1849 he reports that the main part of the Coast Range was not inhabited (Oregon Historical Quarterly, 1935). Lieutenant Talbot found heavy stands of timber along the lower Yaquina, Alsea, Siletz, and Salmon Rivers extending from the seashore inland as far as he could see. The Indians at Alsea and Yaquina Bays told him there were no trails up either river, because the forest was impenetrable. Due to the topography of the Coast Range, the Yaquina River would have provided a natural travel route between the coast and the Willamette Valley. Perhaps following periods of fire, travel became easier and more exploration was done between the coast and the interior valleys. Unlike the tribes in the Willamette Valley, the coastal tribes did not use fire to clear large tracts of land for hunting or travel. The rich coastal zone and Willamette Valley probably provided their inhabitants with most everything necessary for survival and the need to use the interior forest was minimal.

It is not known how or to what extent Native Americans used the Big Elk valley, but in Frank Grant's account of his family he reports that when Elija Grant came to Grant Creek in 1871 "There was a single Indian living on the flat where a wheat field exists today".

Settlers did not begin arriving in the Big Elk Valley until after the circa 1850 fire.

Aquatic Domain

Stream channels in the Big Elk watershed were stratified by stream gradient and valley confinement classes (Figure 7) (Washington Forest Practices Board, 1993). This stratification identified stream reaches with similar processes especially regarding the movement of sediment, woody debris and water. Stream gradient, relative to drainage area, is an indicator of stream power, the dominant control on sediment transport and channel morphology. Stream order (not displayed) is an adequate indicator of drainage area. The steep, perennial headwater streams are first order channels flowing together to form incrementally larger order channels of greater drainage area. Mill Creek and most major tributaries of Big Elk Creek are fourth order channels. Big Elk Creek downstream of Grant Creek is a fifth order stream representing the largest drainage area in the watershed.

Channel confinement is the ratio of the valley floor width to the bankful channel width. Confinement controls potential channel response to changes in flow and sediment inputs, and also reflects the long-term history of climatic and geologic events in the watershed. Most stream channels in the Big Elk watershed unconfined by valley hillslopes are entrenched (i.e. constrained) by stream-side terraces of varying heights which narrow the active floodplain and flood-prone area. Highly entrenched reaches, common in the mainstem of Big Elk Creek, respond more like confined channels except during very large flood events. Unconfined *and* unentrenched channels, uncommon in the Big Elk watershed, are usually associated with second or third order channel confluences and areas of extended beaver impoundments. Stratifying the Big Elk watershed by stream confinement, gradient, and order was used throughout steps three through six.

Water quality

Reference condition for water quality is cool, clean water. MacDonald and others (1991) present an appropriate reference range of physical and chemical elements. Water quality guidelines are presented in the Siuslaw National Forest Land and Resource Management Plan (1990). The reference stream temperature range for the Big Elk watersheds is 10-15 C.

Aquatic species viability

Key reference disturbances interacting with aquatic habitats are flood, drought, and landslides; wildfire and windthrow are discussed in the terrestrial domain. Streambed substrates and large wood are important habitat elements interacting with channel processes to create aquatic habitats. Reference conditions for these disturbances, habitat elements and the key life-stage habitats are discussed in this step.

Flood and drought. There is no information on Big Elk Creek stream flows. Streamflow tends to follow precipitation patterns and consequently summer flows are very low and winter storm events produce rapid but short increases and decreases in flow. Snow is common, though

transitory, in the higher elevations of the Big Elk Watershed and a relatively minor component of the yearly precipitation. Rain-on-snow events are occur and have been associated with the larger flood events. Comparison of stream flow data from the upper Yaquina River and the Alsea River indicate that frequency of flood and drought events are similar and probably adequately represent the flood or drought frequency in Big Elk Creek (Figure 8). Timing of floods in Mill Creek between 1961 and 1973 are also similar to the Alsea River. Streamflows relative to area in Big Elk Creek may be greater than in the Yaquina River because precipitation is greater in the southeastern portion of the Big Elk watershed.

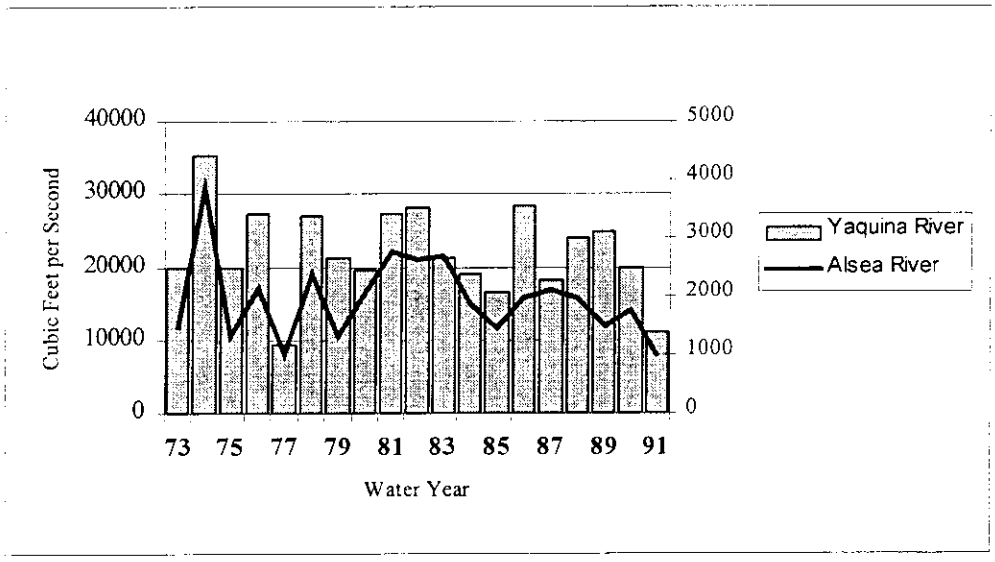
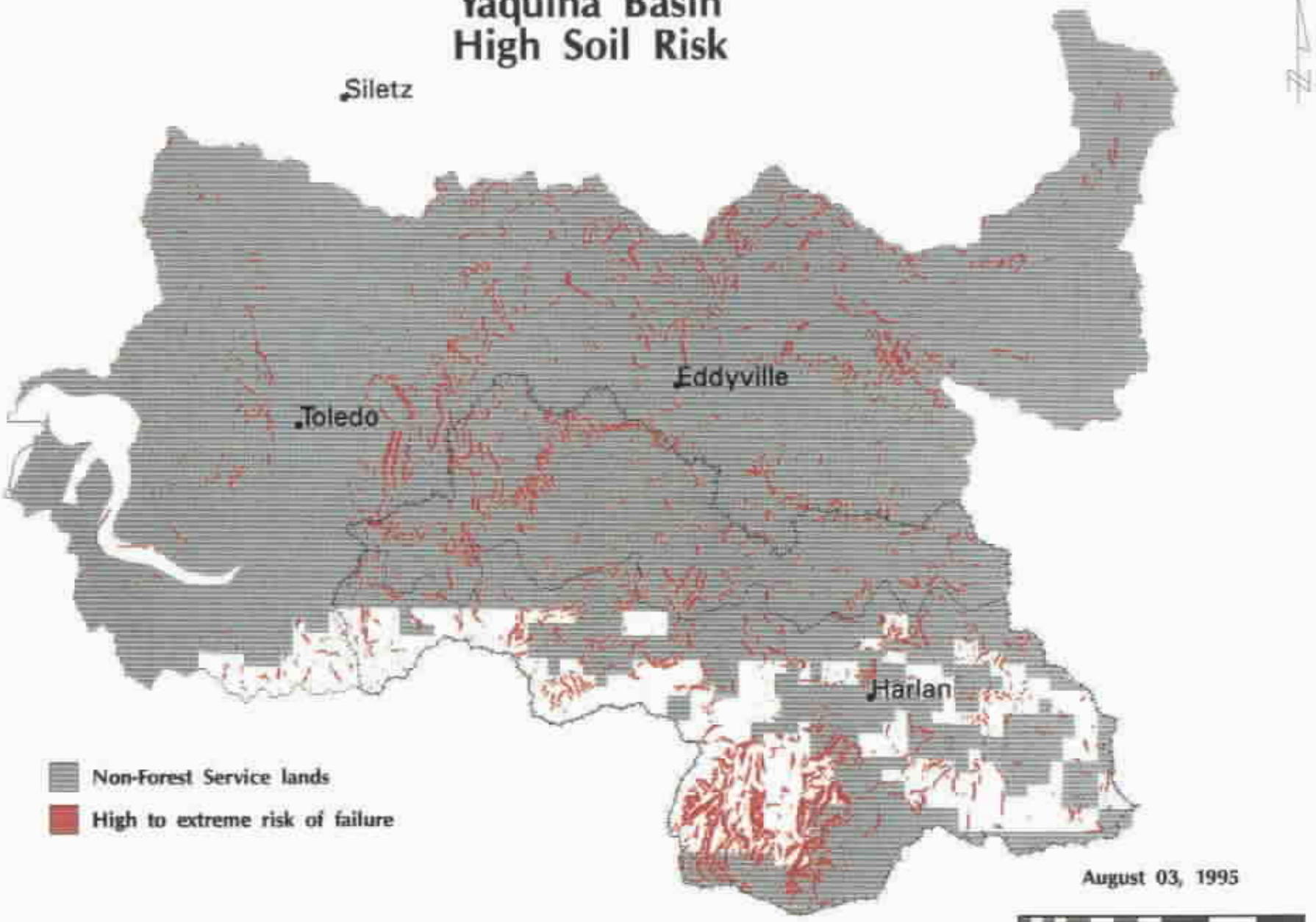


Figure 8. Maximum daily streamflow for the Yaquina River Chitwood gauge (right axis) and Alsea River tidewater gauge (left axis) for water years between 1973 and 1991.

Landslides. Two types of landslides are common in the Coast Range. Deep-seated rotational slumps occur infrequently with a millennial time scale. Debris torrents are common on steep, highly dissected slopes and usually originate in the headwalls of first order streams. At the reach scale the debris torrents frequency is many centuries but more frequent at the watershed scale. Debris torrents are the most common sediment supply mechanism in the Big Elk watershed. Torrents are more common during years of high rainfall when soils become saturated.

Figure 9 shows that most of the area at high or extreme risk of landslides is in the Grant, Savage and Feagles Creek subwatersheds. This categorization is based on bedrock geology and topography. Within the whole Big Elk watershed, almost 11% of the land is categorized as high or extreme risk for landslides. However, on National Forest lands, 14% is categorized as high or extreme. Thus, a disproportionately high amount of debris torrent prone lands are within the National Forest. These subwatersheds are located in Landtype Association 3E (Landtype Association of the Coast Range Province, in progress and Maxwell 1981) include reference characterized by steeper slopes, higher relief and less floodplain development along the streams. By inference, these areas have a greater *potential* for sediment production, however, sediment production is also a function of land use patterns. When covered with vegetation, these steep

Yaquina Basin
High Soil Risk



Big Elk Watershed
Potential Aquatic Habitat

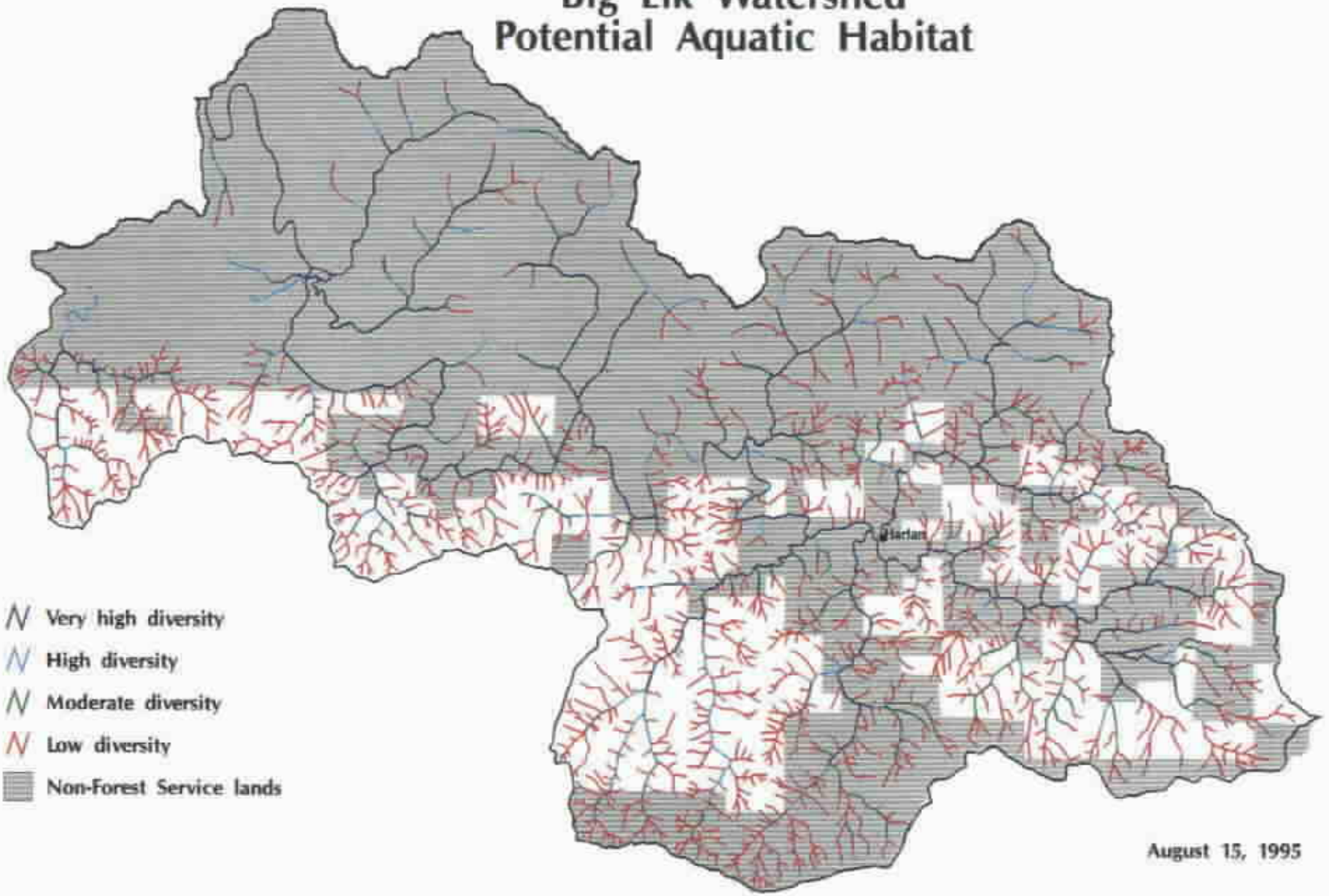


Figure 11.

slopes are less likely to fail. The remaining subwatersheds in the Big Elk watershed (Mill, Homestead, Lower/Middle Big Elk, Spout) are located in landtype Association 3D (Landtype Association of the Coast Range Province, in progress and Maxwell 1981) and have lower relief.

Streambed Substrate. There is no information on reference condition of substrates for the Big Elk watershed. Substrates should reflect sediment supply and routing through the watershed streams (see Montgomery and Buffington 1993). Sediment supply is dependent on the frequency of debris torrents. Routing is dependent on gradient and confinement, drainage area (stream power), and abundance of large wood (see Table 1). From Figure 7, steep gradient channels should be dominated by disorganized cobble and boulder substrates. Some of these channels would have bedrock stream bottoms resulting from past debris torrent events. In 4-8% gradient reference streams the cobble and boulders are organized into step-pools. Gravel is located at the tailout of some pools but more commonly stored upstream of log jams. Gravels and cobbles would be dominant, forming pool-riffle channels where the gradient is lower (0 - 4%). The reference substrate condition of the fifth order Big Elk Creek would be a mix of bedload sediments interspersed with bedrock. The attrition of gravel is probably high in the Big Elk sandstones, so fine sediment, sand and silt are more prevalent in the lower basin. Adams and Beschta (1980) found the amount of fines ranged from 10-30% in Oregon coast range streams with minimal human disturbance. Fine sediments would be stored in beaver pond areas located in low gradient, unconfined channels. Waves of smaller sized sediments also would pass through the watershed from upper basin episodic debris torrents. This would provide alternating substrate conditions. Velocity of the waves would be slow, on the order of decades based on the overall low gradient of the watershed. Rates of 1-10 miles per decade have been reported for streams in the Pacific Northwest (Perkins 1994; Madej 1994).

Large Wood. Large wood is a critical element in the Big Elk reference condition, interacting with aquatic habitats and sediment routing. (See Meehan 1991; Gregory *et al* 1991; Nakamura and Swanson 1993; and Pearsons *et al* 1992). There is no historical information on abundance or distribution of large wood for the Big Elk watershed. PACFISH (USDA and USDI, 1994) provides a estimated value of 80 large logs per mile at least 24 inches in diameter and 50 feet in length. Short reaches in Savage Creek, a Big Elk tributary, where human disturbance was low have greater than 100 pieces per mile (moderately confined 4-8% gradient channels). In the Oregon Coast Range, 80 pieces per mile may represent a low reference value but may be an adequate interim guide at the watershed scale. Table 1 presents reference conditions of large wood by channel type. Reference frequencies of large wood are shown at the bottom of Table 2.

Table 1. Reference characteristics of large wood and effects to sediment routing and channel morphology in the Big Elk Creek Watershed (from Stack and Beschta 1989; Nakamura and Swanson 1992; Bilby and Ward 1989; Cederholm *et al* 1984; Montgomery and Buffington 1993; and Leidholt-Bruner *et al* 1992). For larger stream orders, retention of large woody increases with channel confinement.

	<4% gradient 5th order channels	**<4% gradient 3-4 order channels**	**4-8% gradient 2-3 order channels**	**Steep (>8%) 1st order channels**
Examples	Lower Big Elk Creek	Feagles Creek, Deer Creek, Mill Creek	upper Grant Creek, Savage Creek	all headwater channels
LWD condition	Scattered long, large diameter conifer logs collecting other LWD in complex jams at channel bends, high water mark, or nick points (areas of channel roughness or gradient breaks).	Frequent jams of conifer and hardwood logs with high size diversity. Some random pieces of larger logs.	Randomly spaced pieces common collecting other pieces of wood. Log jams infrequent, usually at tributary junctions.	Large wood bridging channel or poked into channel. Smaller broken pieces lodged in channel with infrequent small jams.
LWD recruitment	Wood distributed by floods and infrequent debris torrents from 1-2 order channels. Large logs from streambank failure.	large wood from streambank failure, tree mortality, and debris torrents. Wood also distributed by flood.	Windthrow and tree mortality common sources. Debris torrents deliver large wood and distributed by dam-break floods.	Windthrow, tree mortality and landslides on lower hillslopes.
Sediment routing	Sediment deposited temporarily at jams.	Large wood controls sediment storage and routing.	Sediment storage above log jams.	Storage of fine sediments above small jams.
Channel morphology	LWD jams form large scour pools. Secondary channels formed in wider valleys.	LWD commonly forms scour pools and some plunge pools. Channel interacts with floodplain and terraces at flood flows. Beavers build dams above LWD.	Large logs interact with cobble and boulders to form step-pools. Channels widen around log jams creating terraces.	Some channel widening.

Aquatic habitats. Reference condition of aquatic habitats are presented in Table 2. Table 3 displays requirements of key life-stage habitats for fish in the Big Elk watershed. The abundance and quality of spawning gravel substrates are dependent on sediment supply routing through the watershed. The frequency and area of pools is dependent on stream gradient and drainage area (Stack and Beschta 1989; Schwartz 1991). Figure 10 displays the PACFISH (USDA and USDI 1994) estimates for pool frequency. Pool area increases with increasing stream order but frequency decreases. Large wood can increase pool frequency in smaller (second to fourth) order channels especially in 2-4% gradient alluvial channels (Montgomery and Buffington 1993). Large wood along with sediment routing controls pool depth and the abundance of cover. Beaver ponds can also increase pool area in low gradient small order streams (Stack and Beschta 1989; Leidholt-Bruner *et al* 1992). Stream gradient and stream width are important factors for beaver pond construction (Beier and Barrett 1987). Beavers are most common in smaller order, low gradient (0-4%) streams (Suzuki 1992).

Table 2. Reference condition rating chart for selected life-stage habitats of salmon and trout (based on Washington Forest Practices Board 1993; USDA and USDI 1994; Reeves *et al* 1989; USDA 1994; USDA *et al* 1994).

Habitat	Reference Condition	Near Reference Condition	Outside reference Condition
Spawning Gravel	Abundant spawning Gravel (>25% of substrate in reach is gravel). Sand is not dominant or subdominant in stream reach.	Gravels present (15-25% of substrate in reach is gravel) and sand is not dominant or subdominant. If gravel is abundant then sand may be subdominant in some habitat units in reach.	Gravels infrequent or absent (<15% of substrate in reach is gravel) or gravel present (or abundant) but embedded with sand substrate or sand dominant in reach.
Summer Rearing	Pool frequency at or greater than PACFISH estimates (Figure 11) and more than 20% of the pools are deep[1] with large wood cover.	Pool frequency within 50% of PACFISH estimates and at least 20% of the pools are deep.	Low pool frequency or shallow pools.
Winter Rearing[2]	At least 40% of stream area with deep (>3 feet) off-channel and quiet water habitat with large wood cover.	15-39% of stream area with deep off-channel and quiet water habitats.	Little quiet water habitat or habitats are shallow.
Large Wood[3] Frequency	More than 80 large pieces per mile	40-79 large pieces per mile	less than 40 large pieces per mile

1. Deep pools have a maximum depth of at least 3 feet for streams with an average stream width greater than 10 feet (wetted width). For streams less than 10 feet wide, Maximum depth of deep pools is at least 1.5 feet.
2. Winter rearing for coho salmon and cutthroat trout. Winter rearing includes beaver ponds, secondary channels, and dammed pools. Estimates are interim values.
3. Large wood is at least 24 inches in diameter and 50 feet long.

Table 3. Habitat requirements for key life history stages of aquatic vertebrates in the Big Elk Watershed Fish habitat information based on ODFW (1991); ODFW (1995); Meehan (1991); Nickelson et al (1992); Wydoski and Whitney (1979); and Trotter (1989).

	Spawning or Breeding Habitat	Spring Rearing Habitat	Summer Rearing Habitat	Winter Rearing Habitat
fall chinook salmon	Abundant gravel in 4-5th order, low gradient (0-2%) streams.	Stream margin and backwater areas.	Mainstem pools and deep riffles then migration to Yaquina Bay.	No freshwater winter rearing.
chum salmon	Abundant gravel in 3-5 order, low gradient (0-2%) streams near tidewater zones.	Yaquina Bay	Migrate to ocean.	No freshwater winter rearing.
coho salmon	Abundant, clean gravel in 2-4 order, in low gradient (0-4%) upper basin streams.	Stream margin and quiet-water areas.	Pools with woody cover.	Beaver pond and quiet-water secondary channels with hiding cover.[1]
cutthroat trout	Clean, gravel in 2-3 order, moderate to steep gradient (2-20%) stream tributaries.	Stream margin and quiet-water areas.	Pools with cover and in Yaquina Bay.[2]	Beaver pond and quiet-water secondary channels with hiding cover.[1]
winter steelhead	Abundant, clean gravel in 3-5 order, moderate gradient (0-8%) streams.	Stream margin and quiet-water areas.	Riffles and some pools with wood.	Clean cobble and boulder substrates or large wood complexes in pools and riffles.
lamprey	Clean gravel in 2-5 order, low gradient (0-4%) streams.	Backwater sand and silty areas for up to 6 years.	Backwater sand and silty areas for up to 6 years.	Backwater sand and silty areas for up to 6 years.
speckled dace	Clean gravel and cobble in 4-5 order, low gradient (0-4%) streams.	Stream margin and quiet-water areas.	riffles and pools	Clean cobble and boulder substrates in pools and riffles.
sculpin[3]	Cobbles and boulders or large wood in 2-5 order streams (<20% gradient).	Stream bottom substrates in pools and riffles.	Gravel to boulder substrates in pools and riffles.	Gravel to boulder substrates in pools and riffles.
threespine stickleback	Sand and vegetation in 4-5 order streams near tidewater zones.	Tidewater zones with aquatic vegetation and LWD.	Tidewater zones with aquatic vegetation and LWD.	Tidewater zones with aquatic vegetation and LWD.

[1] Coho salmon and cutthroat trout migrate to winter refuges during fall freshets.

[2] Some cutthroat trout migrate in the spring to the Yaquina Bay estuary or larger order mainstem habitats then return to upstream pool habitats in the fall.

[3] Coastrange, prickly, and reticulate sculpin are common species in the Big Elk Creek Watershed.

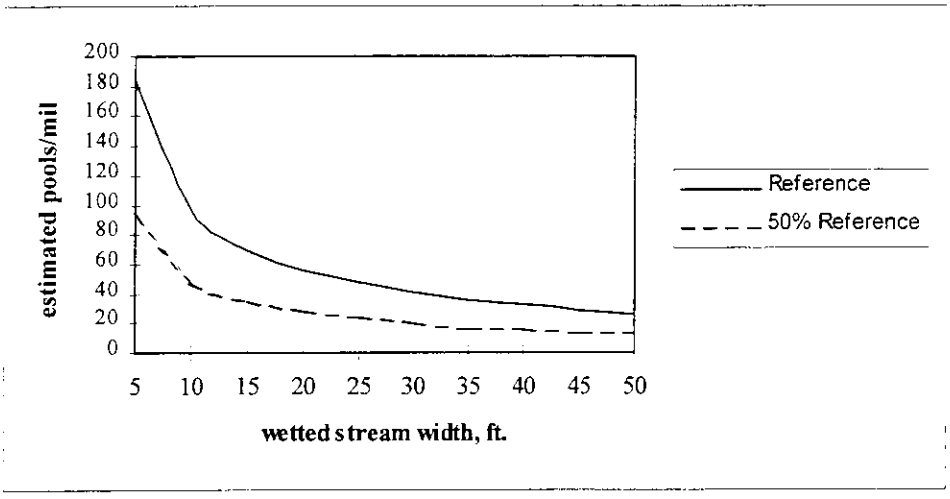


Figure 10. PACFISH estimates of pool frequency (USDA and USDI 1994).

Riparian Habitat. Riparian habitat includes bank stability, canopy closure, riparian vegetation, and the potential recruitment of large wood into the stream channel (see USDI 1993). Table 4 displays reference condition of some of the riparian attributes. To estimate reference riparian plant communities, streams were stratified by stream gradient and channel confinement into five channel types that were assumed to display similar riparian vegetation reference characteristics. Refer to the Big Elk IRA (Siuslaw National Forest, 1993) for additional information.

1. *Unconfined channels with stream gradients less than 4%:*
These channels have a wider riparian zone, less contact with the hillslopes, and more potential for wetland habitat than other channel types. Disturbance regimes include frequent flooding, as well as debris torrent deposition from side tributaries . This channel type has the most potential for beaver use. As a result, vegetation is a diverse mix of species and age classes. Shrub or grass-forb cover is high and a diverse age mix of hardwood trees is possible. Conifers are present on higher terraces above the flood prone area. Wetland species are prevalent especially in areas of beaver activity.

The characteristics of this channel type are on a continuum with the moderately confined, low gradient streams. Differences between the unconfined and moderately confined channels lessen as the stream channel becomes more entrenched.

2. *Moderately confined with gradients less than 4%:*
Moderately confined channels are similar to the unconfined, low gradient channels. Stream channels are well connected with the floodplain but channel has more interaction with hillslopes. Beaver activity is still common and wetlands are prevalent at the confluence of larger tributaries. Moderately confined channels continue a continuum with confined channels as entrenchment increases.

Moderately confined channels continue a continuum with confined channels as entrenchment increases.

3. *Confined channels with gradients less than 8%:*
The riparian zone is dominated by hillslope processes, as the break in slope tends to be close to the stream channel. Conifer are more dominant than hardwoods.

4. *Unconfined and moderately confined channels with gradient 4-8%:*
These stream channels serve as transport corridors and temporary storage areas for wood and sediment. Primary disturbances are debris torrent deposition and flooding. Debris jams temporarily dam the creek, and create depositional areas and flats. As the stream cuts around the jams, it downcuts through the deposited sediment and creates small terraces. There is a diversity of terraces ages, and as a result, individual terraces may have similar species and age classes, but the overall stream reach has diverse vegetation . Beaver activity is uncommon.

5. *All channels with gradients greater than 8%:*
Riparian vegetation is influenced by hillslope processes, such as fire, and is very similar to the vegetation outside of the riparian zone. The primary disturbance is debris torrents, which usually scour the channel down to bedrock. Areas that have had relatively recent debris torrents are dominated by alder.

Table 4. Estimated reference conditions for key riparian habitat elements (based on Washington Forest Practices Board 1993; USDI 1993; Gregory *et al* 1991).

	Reference Condition	Near Reference Condition	Outside reference Condition
Sreambank Stability	At least 80% of stream banks are well armored and not eroding.	50-80% of stream banks are well armored.	More than half of stream banks are eroding or unstable.
Canopy Closure	At least 60% for 1st-4th order streams. At least 30% for 5th order streams.	30-60% for 1st-4th order streams. 20-30% for 5th order streams	Less than 30% for 1st-4th order. Less than 20% for 5th order.
Large Wood Recruitment[1]	More than 50% of riparian vegetation is conifer trees and the majority are mature.	20-50% of riparian vegetation is conifer trees and some is mature.	Less than 20% of riparian vegetation is conifer trees.

1. Interim estimates.

Species Distribution and Connectivity. Historic distribution of aquatic species is unknown. Figure 11 displays potential aquatic habitat based on stream gradient and channel confinement. Low gradient, moderate to unconfined pool-riffle channels have the greatest potential for diverse aquatic habitats and could have supported a larger mix of species. Fewer

species would inhabit steep gradient, confined cascade channels at the other end of the spectrum (refer to Table 3).

Generally, Chinook salmon utilized lower Mill Creek, the mainstem of Big Elk Creek and the lower end of the larger tributaries. Chum salmon had a similar distribution. Anecdotal information from the 1949 Oregon Fish Commission report for Big Elk mentions that large numbers of chum spawned in Big Elk Creek up as far as Grant Creek.

Coho spawned and reared in upper Mill Creek and all the lower gradient tributaries in the watershed. Aquatic habitats were connected and fish movement occurred during all seasons except at extremely low flow years only limited by natural barriers. Table 5 shows that the majority of potentially diverse aquatic habitat is in private ownership.

Table 5. Potential Fish Habitat Classification by Ownership

	Very High Species Diversity	High Species Diversity	Moderate Species Diversity	Low Species Diversity
Siuslaw NF	5.2 miles (7%)	11.4 miles (35%)	14.3 miles (33%)	142.3 miles (49%)
BLM	0.25 miles (0%)	0.36 miles (1%)	1.9 miles (4%)	17.2 miles (5%)
State	1.4 miles (2%)	0.9 miles (3%)	1.4 miles (3%)	13 miles (5%)
Private land	68.0 miles (91%)	19.7 miles (61%)	26.5 miles (60%)	116 miles (40%)
Total	74.8 miles (100%)	32.4 miles (100%)	43.2 miles (100%)	288.5 miles (100%)

Terrestrial Domain

Connectivity of Mature Forest Habitat

Based on the accounts of early explorers and the fire history of the area, it is generally accepted that the analysis area, and most of the remainder of the Coast Range, was primarily late-successional forests in the early 1800's. Openings were confined to the higher elevations, such as the tops of Marys Peak and Grass Mountain, the coastal strip and river valleys, where flood events and wetlands kept the forests from encroaching. The fire history in the Coast Range Province indicates that fire return intervals are infrequent (300-350 years) and stands would have remained in a late-successional condition for long periods before another disturbance event set them back again. Vegetation patch sizes were huge (>100,000 ac) and forest edges limited.

Based on the topography, soils and coastal influence, the fire regime in the Yaquina drainage is believed to be slightly different than for the southern portion of the forest. Fires in this area are thought to have been smaller and less intense than the huge stand-replacement fires seen to the south.

Given these conditions, plant and animal species evolved and were adapted to a forested environment which experienced infrequent change. Species which favor early seral and edge conditions, such as elk, were numerous in the wetlands and oak-savannas of the Willamette Valley. Stable populations of elk also occurred in the Coast Range prior to the 1850 fire (ODFW, 1992) and were an important trade and food item for the early settlers. Populations of species associated with late seral forest habitats were large, more stable and less isolated than they are today, since larger portions of their overall range would have been in these habitat conditions in any given time. Species linked to special habitats, such as wetlands, cliffs or coastal areas, were localized.

Maintaining Terrestrial Ecosystem Structure and Function

Vegetation plots and stand exams conducted within mature and late-successional stands in the Douglas-fir/western hemlock plant association of the Oregon Coast Range define a range of live trees, snags and logs which are found in these stands (Table 6). Information for late successional forests was compiled from BLM plots taken in 17 stands ranging in age from 200 to 500 years old and plots centered around spotted owl nest sites on the Siuslaw National Forest. Data for the mature conifer stands was compiled from stand exams done in 1994 in the Big Elk area, 1987 vegetation resource survey, and 1990 vegetation structure exams.

Table 6. Stand Components for Mature Conifer and Late-Successional Forest

Stand Component	**Mature Conifer Stands approx. 100-200 yrs**	**Late-Successional Stands approx. 200-500 yrs**
Overstory Conifer Trees/ac (> 25" dbh)	28/ac (range 30-50) > 25" dbh	Total 38/ac (range 15-50/ac)
Codominant Conifer Trees/ac	15/ac (range 15-30/ac)	Multi-layer understory
Hardwoods	15/ac (range 0-25/ac)	12/ac (range 0-15/ac)
Large Snags/ac (> 21" dbh and > 20' tall)	3/ac (range 0-4/ac)	6/ac (range 4-10/ac)
Large Logs/ac (>24" dbh and > 20' long)	10/ac (range 3-15/ac)	15/ac (range 10-30/ac)
Total Logs/ac (all sizes)	182/ac	128/ac

BLM plot data did not separate canopy layers. All of the stands had a strong understory of trees less than 8" dbh (60-500 seedlings/ac) in addition to the overall tree per acre count (>8" dbh).

Old growth stands change from being Douglas-fir dominated to western hemlock and western redcedar dominated at around 300 years of age. Reference conditions most closely approximate the late-successional conditions, while the mature conifer stands depict the current condition of many of the natural stands on the landscape.

STEP 4: CURRENT CONDITIONS

Human Domain

Human Uses and Values

Settlement of the Big Elk Valley began with the westward movement of pioneers during the mid-19th century. As land became more scarce in the fertile Willamette Valley, settlers began searching for homesteads in the interior valleys of the Coast Range. The Big Elk Creek valley was particularly attractive to early settlers, in part because of the circa 1850 fire that created lush, open grasslands perfect for livestock raising.

During the latter part of the 1880s, only a few settlers were living in the Mill Creek area. Much of this township is still unsurveyed because of the rough terrain. In a published report, early surveyors characterized this area as one of the best timber producing areas within the Forest (Land Classification of the Siuslaw National Forest, OR 1917). Big Elk and Savage Creeks were home to approximately 28 settlers and a county road provided access along the creek. The earliest homestead on record is 1895, but the 1917 report states that settlement occurred at least a decade before this date. Dairying was the chief industry. Due to the big fires of the past most of the old growth trees had been destroyed. Only in the higher elevations was Douglas-fir well established. The predominant tree on the landscape was alder, but vine maple, salmonberry, thimbleberry, hazel, salal, and fern were abundant.

Fire was used extensively as a land-clearing tool by the settlers. Settlers cleared the best lands of any remnants of conifer or hardwood trees, built homes, cultivated floodplains, and introduced non-native grass species and livestock. Open conditions were maintained with frequent use of fire that consumed any woody debris which would replenish the soils. Large human-caused fires were reported in and around the analysis area in 1868, 1902 and 1931. Numerous smaller fires were also set repeatedly near the community of Harlan and in the eastern half of the Big Elk analysis area to promote grazing conditions for angora sheep (Grant 1990). Many areas were burned three or more times between 1850 and 1950. Historic panorama photos taken at Chinquapin, Hilltop and Marys Peak lookouts in the 1930s show most of the analysis area as open grasslands with scattered patches of young trees. This more frequent fire regime was not a part of the evolution of this particular ecosystem.

Figures 12 and 13 show the changes in vegetation patch types and distribution within the Big Elk analysis area since the settlement fires in the '30's and in 1956, prior to intensive logging. These maps were created from data collected by county and Forest Service surveyors. Scale and accuracy of these two mapping efforts are unknown and thus cannot be compared to more accurate data from photo interpretation or satellites. The maps do, however, give a general visual picture of the changes in patch sizes and distribution on the landscape.

Currently, there are about 100 inhabitants living in the Harlan Valley area. The valley floor is still in agricultural production. Livestock grazing is concentrated in riparian areas. Most of the private forest lands as well as much of the federal lands are in an early seral condition.

Special Use Permits. Currently there are two special use permits for water transportation systems in the analysis area. One permit is at the Big Elk Guard Station. The other permit allows withdrawal of water from Big Elk Creek for agricultural purposes and also allows withdrawal from a tributary for potable water use. There is one special use permit for a TV antenna for reception. Currently there are no research projects within the area. The Oregon Military Department will occasionally conduct training in the area.

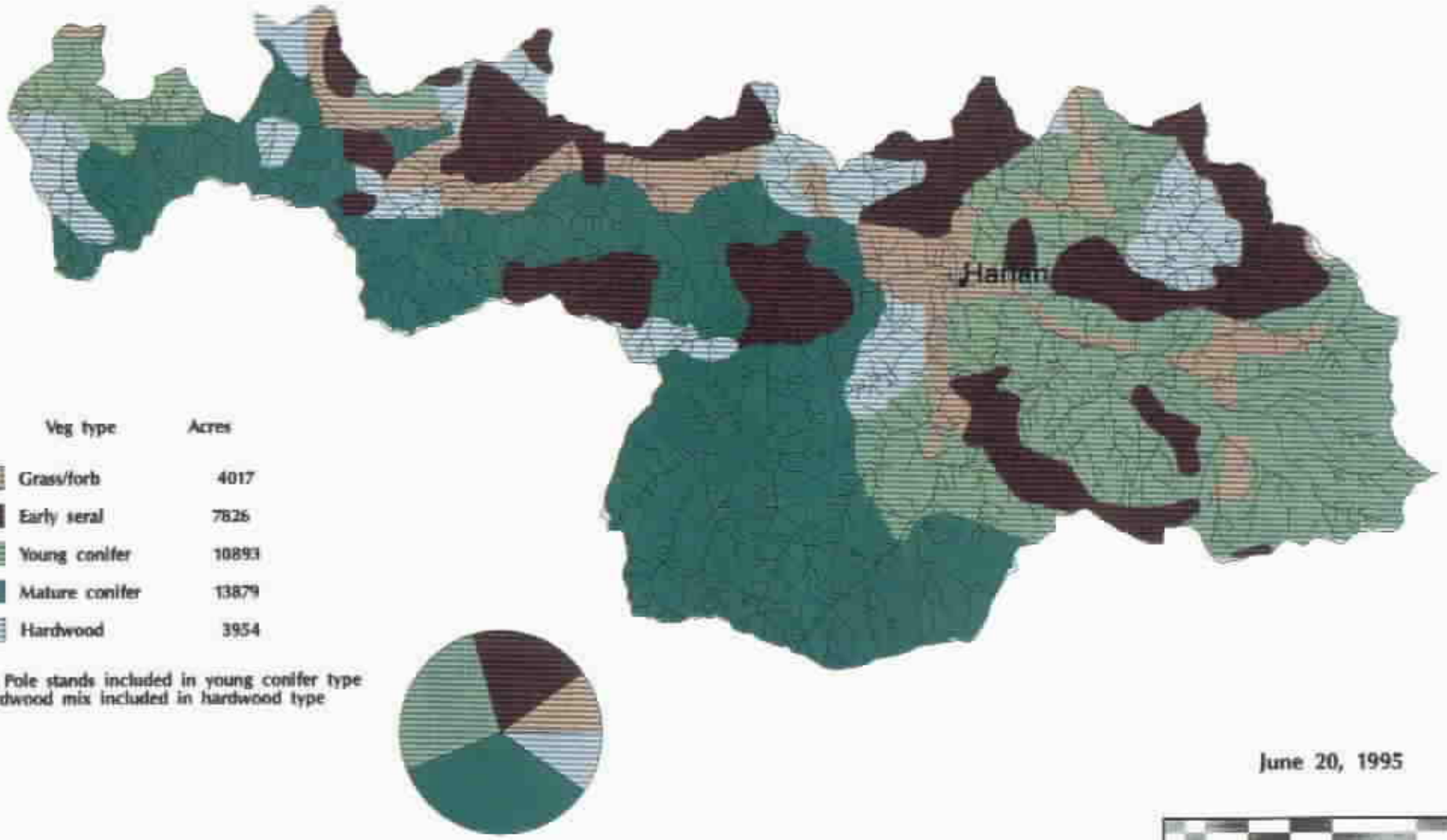
Commercial Uses. The Big Elk landscape has been intensively managed for timber for more than 30 years. Both federal and private ownerships have clearcut harvested within their ownerships. Following World War II, timber harvested increased on Federal ownerships to help meet the demand for the post war housing boom. There were two peak periods for harvesting timber on federal lands within the Big Elk watershed. The first peak occurred from 1965 to 1970 with a total of 1356 acres harvested. The second peak occurred from 1985 through 1990 with a total of 1162 acres harvested. Since the moratorium on logging federal lands began in 1992, activity on Industrial Timber lands has increased to meet the continuing demand for forest products.

Special forest product permit use in the analysis area is fairly low. Use consists primarily of firewood and free use permits for ornamentals such as ferns.

Roads. Roads traverse 182 miles of the analysis area and portions of some are located within the riparian area. Average road density is 2.92 miles per square mile for the analysis area. Average road densities by subwatershed in the analysis area are shown in Figure 33. The watershed analysis did not evaluate the road system or make recommendations for road closures beyond what had already been completed for the IRA process. However, as part of the 1995 road maintenance program, all forest roads in the analysis area with the exception of those having easements or rights of way are scheduled for waterbarring. Forest road 3109-112 (Grant Creek subwatershed) will have fill and culvert removal work completed. This road accesses Forest Service lands only and is currently abandoned. Table 1 in Appendix B includes a list of the roads in the Big Elk analysis area to be waterbarred in 1995.

Recreation. Recreation use in the analysis area is primarily dispersed and seasonal in nature. Probably the most significant recreational use of the area is during the annual deer and elk hunts. Several well known sites exist in the area that are used for camps during hunting season. Fishing is also an important activity in the area. There are a number of places along Big Elk Creek that provide access for bank fishing, a rare opportunity in the Coast Range. Fishing is also

Big Elk Analysis Area
1934 Vegetation



Veg type	Acres
Grass/forb	4017
Early seral	7826
Young conifer	10893
Mature conifer	13879
Hardwood	3954

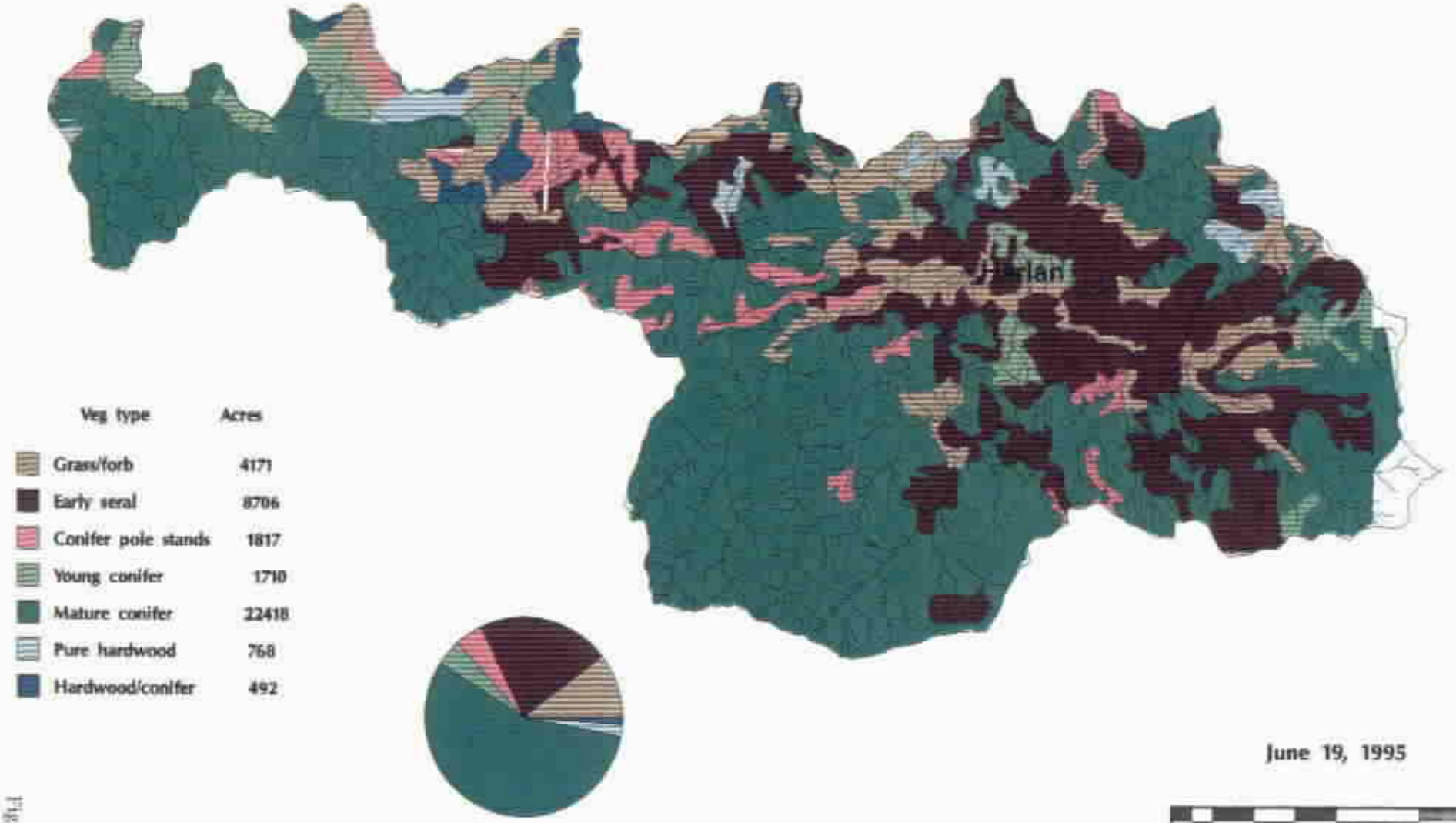
Note: Pole stands included in young conifer type
Hardwood mix included in hardwood type

June 20, 1995

0 1 2 3 4
MILES

Figure 12

Big Elk Analysis Area
1955 Vegetation



June 19, 1995

0 1 2 3 4
MILES

Figure 13

allowed below the Grant Creek Bridge (at the confluence of Grant Creek with Big Elk Creek) on Big Elk Creek and in the reservoir on Mill Creek.

The Big Elk Campground west of Harlan is the only developed recreational facility within the area. The campground has pit toilets and potable water. Big Elk Creek provides access for picnicking and water play during the summer months. In 1994, the Forest Service turned management of the campground over to the community of Harlan.

Marys Peak serves as a destination point for many motorists on scenic drives. Motorists can continue their travel via Forest Road 30 (Dicks Ridge Road) into the Harlan Valley. Once in the valley a motorist has options to travel in all four directions. The analysis area serves as a hub for travel in all four directions. County Rd. 547 (Burnt Woods Road) provides access to Highway 20; the coast can be reached via FS road 31 or County Road 538. Forest road 62 is a main thoroughfare south to Highway 34 at the base of Marys Peak. Forest road 3119 provides access to Highway 34 at Fall Creek.

The fragmented nature of the vegetation may actually serve to make the area more scenic. Rapidly growing trees obscure views from roads and trails in less than fifteen years creating an intimate landscape experience. In contrast, the agricultural use of the broad valley bottoms creates an open, somewhat expansive atmosphere. After the rather confining experience of driving through the forest, the openness of the valley is a welcome relief. In traveling the major circulation routes of the watershed, the most satisfying experience stems from moving through alternating patches of overarching mature forests and wide open early seral stages. Diversity is important (Ries 1995).

The proposed Corvallis-to-the-Sea Trail includes a route which will travel the Dicks Ridge road down to Forest Road 3012 and loop back to Marys Peak via BLM roads.

Culturally Motivated Uses. Following the 1930's Resettlement Act, many of the homesteads were returned to federal ownership. Today, they are valued for their cultural heritage. These areas remind us of the struggles and hardships previous generations endured in their quest to settle the West. The Alsea District has conducted interpretive programs on these cultural sites that have been very popular.

For some people, the analysis area represents a tie to their past. Many of the local residents are descendants of early homesteading families and may return occasionally to the old homestead site to visit. This tie to the land can be a very emotional or spiritual experience. Guthrie (personal comm. 1995) stated that several years ago he came across an older couple who had come to pay one last visit to the homestead on which the husband had been born. District personnel relate incidents of local families who annually return to areas within Big Elk to harvest fruit from the orchards in the old homesteads. The forest also provides a rich bounty of blackberries, salmonberries, and thimbleberries that can easily be picked from the road.

Tribal Cultural Resources. There has been no contact with any tribe regarding the cultural uses of the Big Elk analysis area. Most of what is known about the area regarding tribal use is from cultural resource personnel, search of records, and information gathered from the Cummins/Tenmile Watershed report. Contact with the Confederated Tribes of Siletz is being established through proper channels for any scoping that may be necessary for compliance with potential projects requiring the National Environmental Policy Act (NEPA) process.

The 1855 Coast Range Reservation Act originally extended from Cape Lookout in the north to the Siltcoos River in the south (Cummins/Tenmile 1995), including the Big Elk analysis area. Approximately 3,000 Native Americans from 24 different tribes were originally brought to the reservation (A History of the Siuslaw National Forest, Oregon 1959). Whether any of these people actually used the Big Elk Valley is not known.

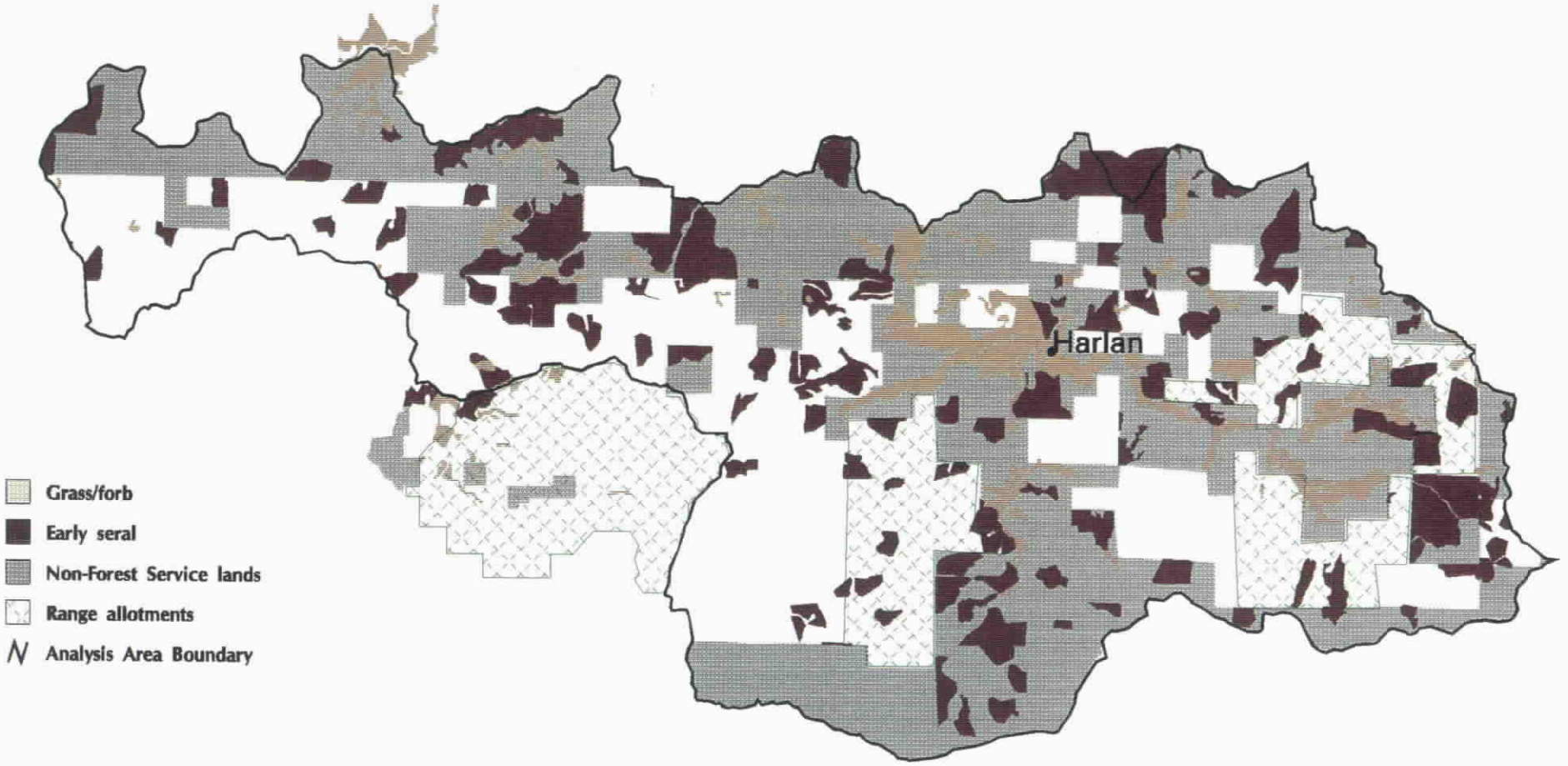
Residents. For the residents of the watershed it is the daily experience of a familiar landscape. In the lives of most individuals, familiar landscapes quietly hover in the balance between conscious and sub-conscious awareness. Familiar landscapes are accepted as a normal part of one's life and it is the abrupt changes or extraordinary circumstances which ultimately get attention. For the residents of Harlan, this landscape forms the backdrop and fiber of their lives in this basin. However, because residents and landowners of this community earn at least a portion of their income from the timber and agricultural resources of the watershed, land-use decisions would be made largely on the basis of economic reasoning. Although individual personal values may range from preservation to capitalization, the community might sacrifice non-economic landscape values for the sake of an income (Ries 1995). Others realize that with each successive generation there is a decline in the abundance of the resources. Many of the residents do not want to see any changes to the status quo, but there is also a constituency that are open to some type of development. In addition, the local communities are not isolated from the effects of off-site pressure to control land use, such as the Northwest Forest Plan. Finding common ground and working together among themselves may be their best opportunity to influence land use in the analysis area.

Management of Range Allotments

Currently there is only one active range permit within the Big Elk watershed analysis area (see Figure 14). This permit allows grazing of cattle in the eastern portion of the area in the Spout, Middle and Upper Big Elk subwatersheds (T12S, R8W., Sec. 12, 11, 10, 15, 13, 24, 23, 22, and 26 Lincoln Co.) in what is known as the Upper Big Elk Allotment #12-03-R34. This is a term permit that was renewed in May of 1992 for a ten year period, expiring Dec. 31, 2002. One other range allotment is located in the Grant Creek subwatershed but is inactive until an Allotment Management Plan and Environmental Assessment can be completed.

The Upper Big Elk allotment encompasses Crawford Canyon (locally known as Linton Canyon), and the headwaters of Sugarbowl Creek in Sections 12 and 13. Both Crawford and Sugarbowl creeks drain directly into Big Elk Creek. The permittee was informed of the need to

Big Elk Analysis Area
Range Allotments and Forage



August 03, 1995

0 1 2 3 4

MILES

Figure 14.

change past grazing practices to meet the Aquatic Conservation Strategy (letter dated March 29, 1995). It is not known if any of the suggested habitat protection measures were implemented or how effective they are. Modifying the permit to meet the aquatic conservation strategy would require the permittee to manage their livestock more intensively and consistently than is currently practiced.

There is a general decline in available forage within the allotments. The clearcut units within the allotment range from 5 to 16 years old. These units are expected to continue to develop toward canopy closure, reducing the amount of forage even further. As the amount of available forage within harvest units declines, livestock use concentrates in the riparian areas, permanent meadows and along roadsides.

Aquatic Domain

Water Quality

The Oregon Department of Environmental Quality (1988) has identified moderate to severe water pollution problems in the Yaquina basin and the Big Elk watershed. Specific problems cited included turbidity, sediment, erosion, temperature concerns, and in the case of the lower Yaquina River, bacteria, viruses and chemical pollution. These conditions affect aquatic species and human use of Big Elk Creek. Probable causes of disturbance in the Big Elk Creek watershed were high stream temperatures, road locations and traffic, vegetation removal, and channnelization and drainage of wetlands. Since 1988, more stream survey and temperature data has been collected, and generally confirms the original findings. Bank stability, sediments, and stream structure are discussed under Viability of Aquatic Species.

Water temperature data was obtained from either continuous automated monitoring or stream surveys (Figure 15). Six streams were continuously monitoring during the warm months of July through October. Nine streams have temperature data that were collected as part of stream surveys conducted by ODFW in 1992 and the Forest Service between 1978-1993. In addition, historic stream survey data from 1953 were available from ODFW that included spot checks for water temperature. The historic data is limited, however, and does not provide adequate baseline data to determine whether streams temperatures have increased through time.

Stream survey data only provides information for one point in time. If stream temperature are above 15C (60F), the stream probably has a thermal problem. If temperatures are below 15C, however, a potential problem may not be revealed because of the date, time or weather conditions when the data was collected. Appendix A presents stream temperature data including some historic data.

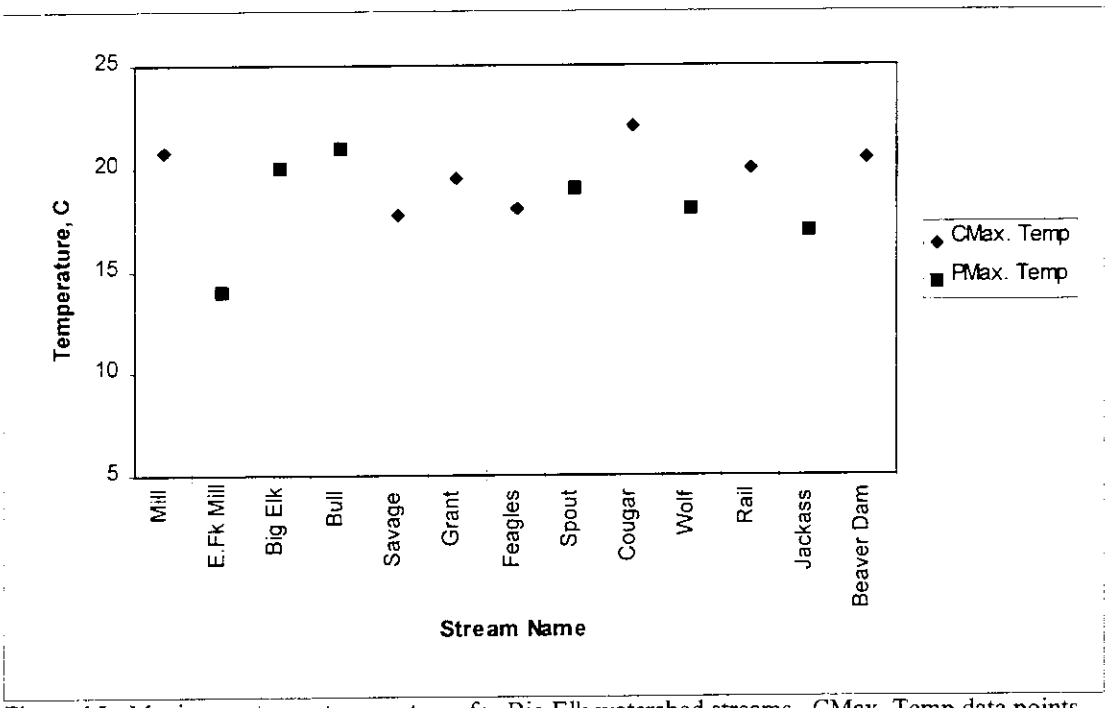


Figure 15. Maximum stream temperatures for Big Elk watershed streams. CMax. Temp data points represent average daily maximum temperatures. PMax. Temp data points are maximum temperatures collected during stream surveys. Mill Creek temperatures are from below Mill Creek Reservoir. Stream temperatures above the reservoir were similar to East Fork Mill Creek.

Most of the streams where data has been collected have temperatures that are above 15C, the upper limit of optimal temperatures for salmonids. The only notable exception is the East Fork of Mill Creek, which flows west and may be shaded by topography. Temperatures above the reservoir on Mill Creek are below 15C, whereas temperatures below the reservoir are warmer than 15C. Both the continuous monitoring record for 1994 and the stream survey data from 1992 show that the mainstem of Big Elk Creek has sustained summer temperatures above 15C. The lower part of Feagles Creek and Grant Creek flow through open pasture land with little shade Reasons for the elevated temperatures in the Big Elk watershed may include the following:

- Loss of canopy cover. Past timber harvest, and clearing land for agriculture may have reduced the shading of streams so that more sunlight is reaching the water.

- Low water flows during the summer months. The drought during the 1980's, and the withdrawal of water from streams for agriculture and domestic use may have caused summer flows to be lower than normal. There would be less water to absorb the heat, and overall water temperatures would be higher.

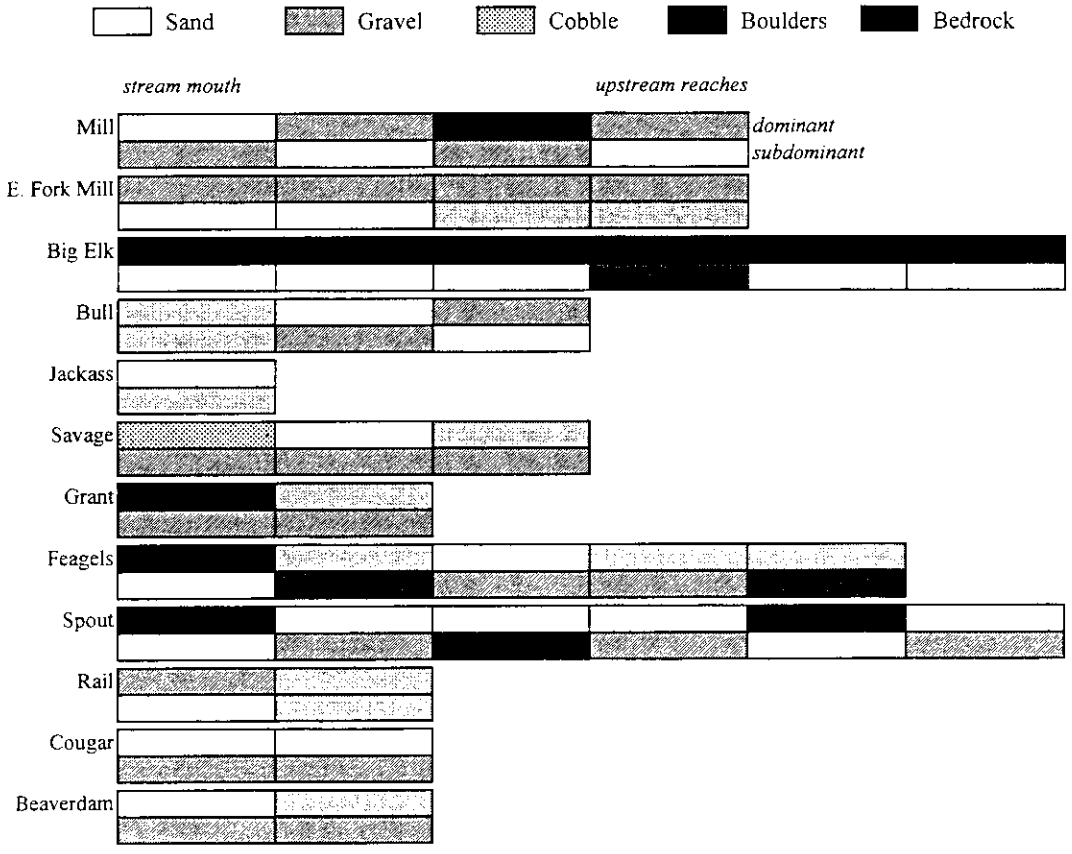
- Conversion of conifer dominated riparian zones to alder dominated zones. Preliminary research in the Cascades suggests that summer flows are lower in streams with riparian zones dominated by alder. It is suggested that alder transpires more water, therefore it

lowers the water table and reduces stream flow (F. Swanson, pers. comm.). Lower stream flows may contribute to warmer temperatures.

Aquatic Species Viability

Substrate. Figure 16 graphically portrays dominant and subdominant substrates by reach for streams surveyed in the Big Elk watershed. Bedrock substrates are most common in larger order streams. Sand is prevalent throughout the watershed. Comparing current condition with survey data from 1949-1955 shows no dramatic changes in streambed substrates. At least one sediment wave of sand has passed through Bull Creek. Substrates in lower Savage Creek coarsened dramatically in the 1960's when road construction deposited large and small boulders into the channel.

Figure 16. Dominant and subdominant substrate types by reach for Big Elk Watershed streams. Dominant substrates are represented by the top cells and subdominant by the bottom cells of each set. Each column represents a stream reach. Upstream is left to right.



Large Wood. Large wood levels are well below reference conditions for most of the Big Elk Creek watershed (Figure 17). Stream reaches with higher levels of large wood are associated with mature timber stands on National Forest lands. Figure 18 shows levels of large wood by stream.

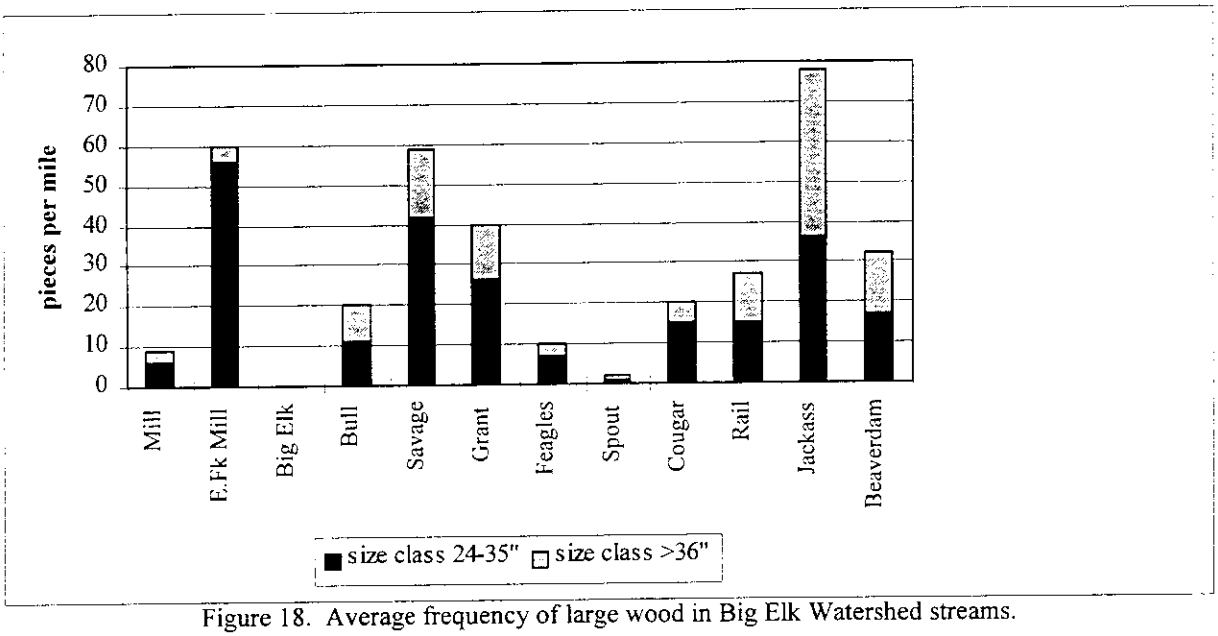


Figure 18. Average frequency of large wood in Big Elk Watershed streams.

Spawning habitat. Figure 19 shows distribution of stream reaches where gravel is present or abundant. Potential spawning habitats are distributed in 3rd and 4th order stream channels throughout the basin. However, the majority of the gravel are poor spawning quality occurring in reaches dominated by sand or silt substrates. The exception is upper Mill Creek. The condition of spawning habitat in lower Grant Creek is assumed to be near reference condition, based on upstream conditions and observations of current stream bank stability. Oregon Department of Fish and Wildlife considered gravels to be in excellent condition in 1979 (USDA 1979). Abundance and quality of spawning gravel in the northern portion of the Big Elk watershed is unknown but condition is assumed to be fair to poor. Recent site visits to Bear and Deer Creeks showed streambed gravel present to abundant with moderate to high levels of fine sediments. Gravel in Wolf Creek is prevalent but sand is the dominant streambed substrate.

Aquatic Habitats. Figures 20 and 21 display rearing habitat conditions for salmonid fishes. Generally summer and winter rearing habitats are outside the reference range. Deep pools with complex woody debris cover are rare throughout the Big Elk watershed. For instance, deep pools are frequent in Big Elk Creek but are nearly devoid of woody debris complexity. Shallow pool depths are most common in the upper basin tributaries. Stream reaches where pool frequency is below reference, such as Feagles, upper Mill and East Fork Mill Creeks, have an adequate proportion of deep pools (>25%).

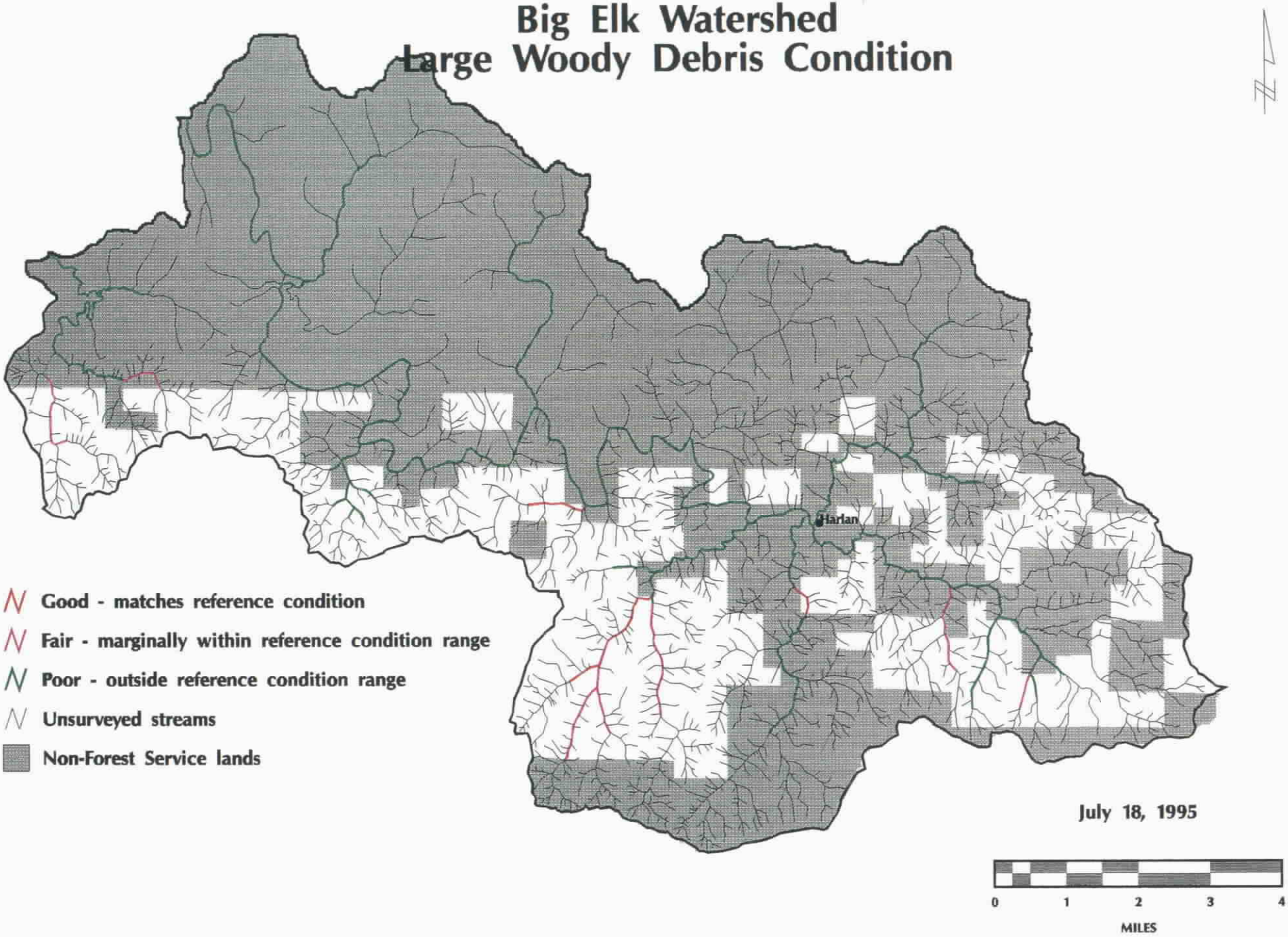

Big Elk Watershed
Large Woody Debris Condition
Harlan
Good - matches reference condition
Fair - marginally within reference condition range
Poor - outside reference condition range
Unsurveyed streams
Non-Forest Service lands
July 18, 1995
0
1
2
3
4
MILES

Figure 17.

Big Elk Watershed
Spawning Area Condition

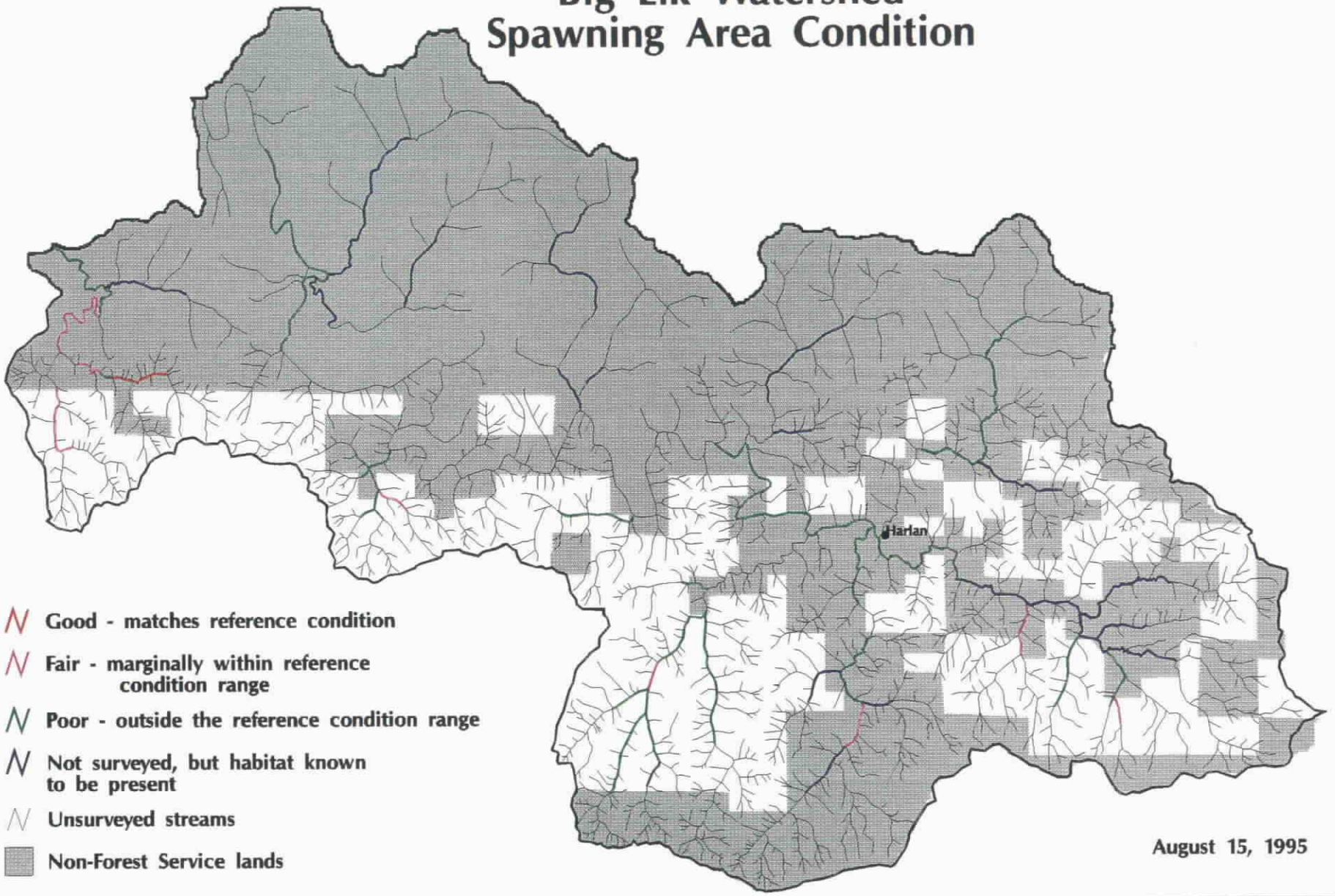


Figure 19.

Big Elk Watershed
Summer Rearing Habitat Condition

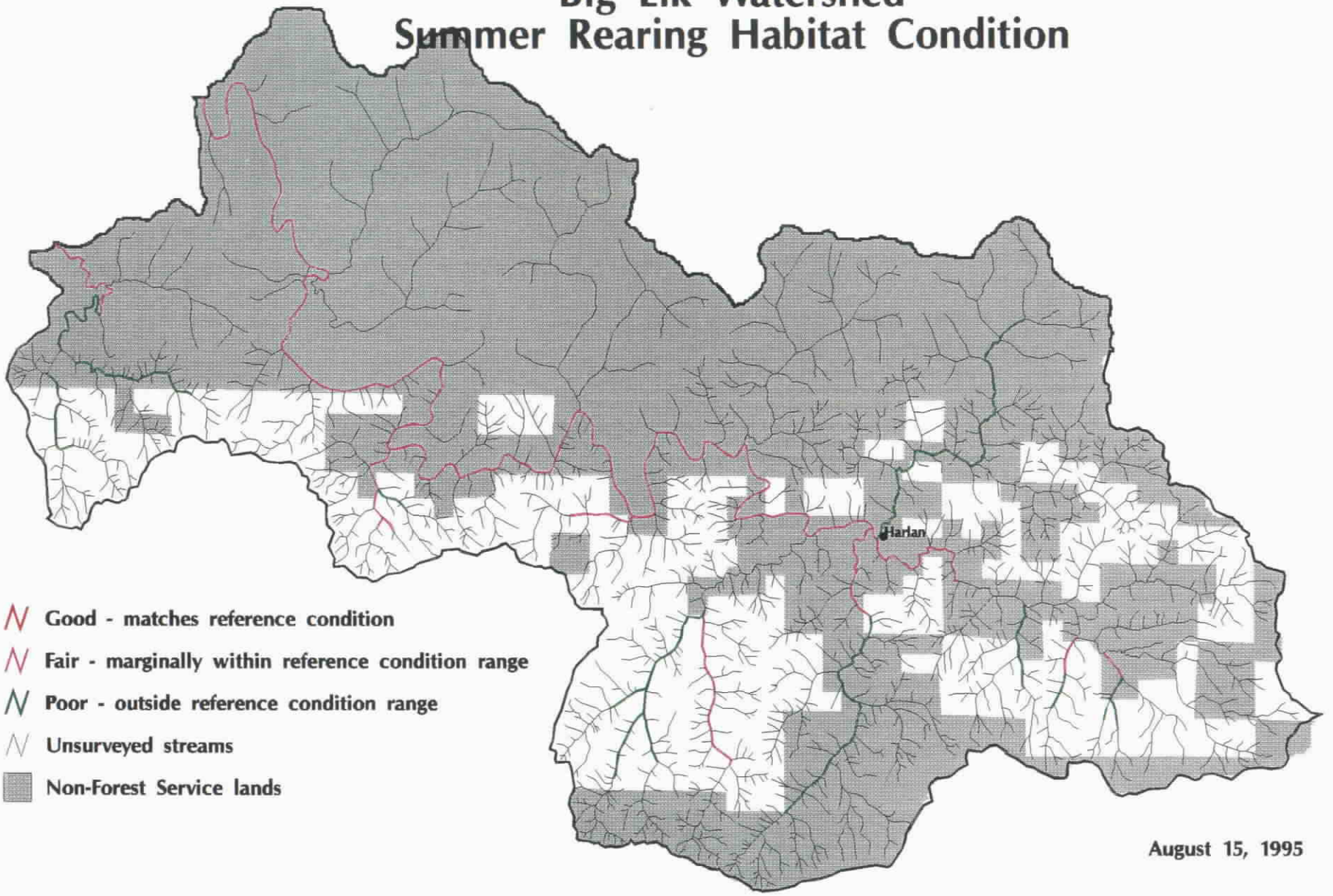


Figure 20.

Big Elk Watershed
Winter Rearing Habitat Condition

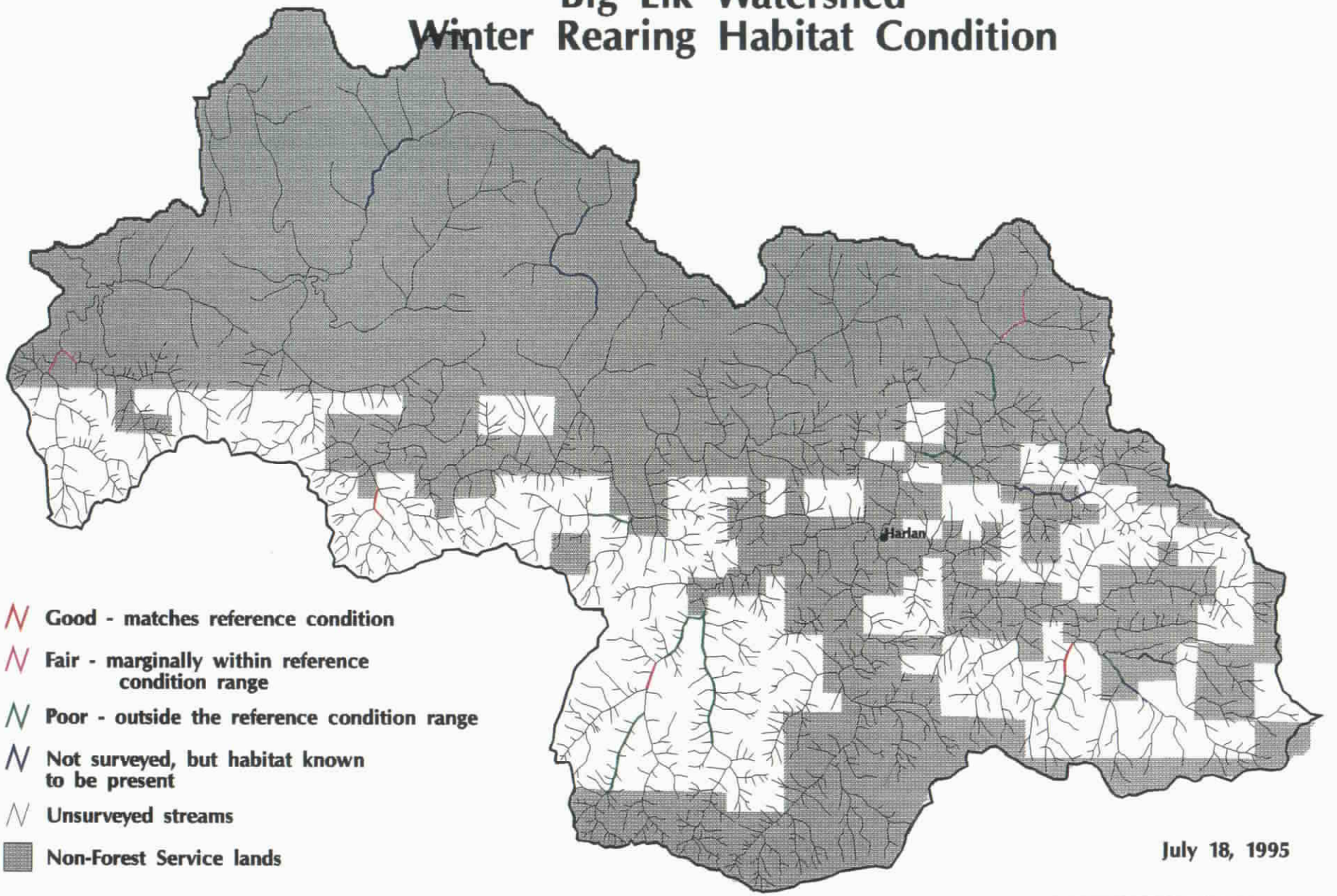


Figure 21.

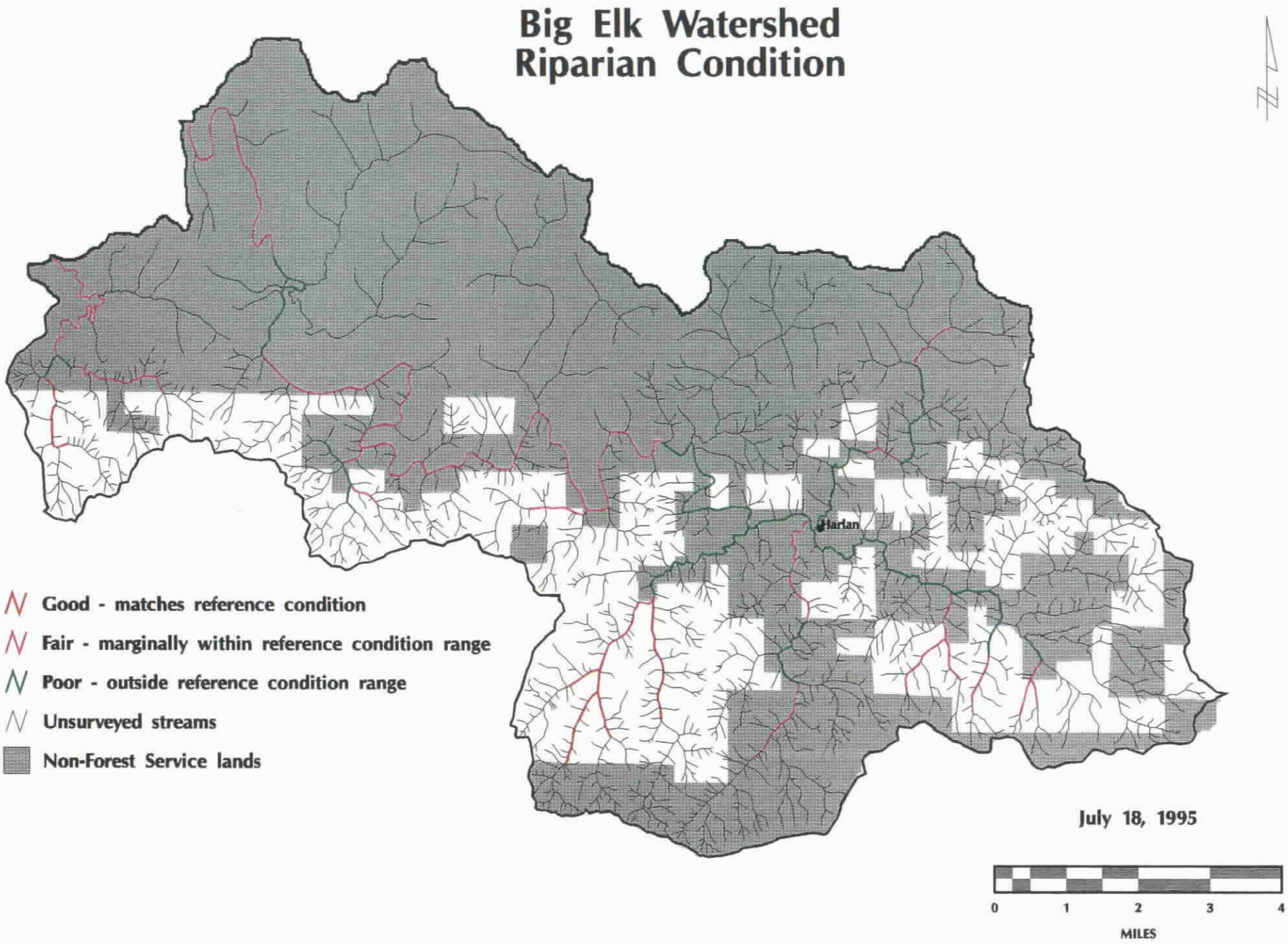

Big Elk Watershed
Riparian Condition
Harlan
Good - matches reference condition
Fair - marginally within reference condition range
Poor - outside reference condition range
Unsurveyed streams
Non-Forest Service lands
July 18, 1995
0
1
2
3
4
MILES

Figure 22.

Conditions in unsurveyed streams, such as Bear and Deer Creeks, appear similar to other 3rd and 4th order streams in the watershed so summer rearing habitat conditions probably are outside the reference range as well. Bear and Deer Creeks contain some winter rearing habitats based on summer site visits. Deer Creek, in particular, may provide a large area of winter rearing habitat. Beaver ponds comprise some of the better summer habitat and the majority of winter habitat. Beaver pond habitats are located in low gradient, unconfined valley forms in 2nd to 4th order streams.

Riparian Habitat. Few riparian areas meet reference condition (Figure 22). Most riparian areas are dominated by hardwoods. The majority of conifers in riparian areas are small diameter, second-growth (see Figure 27). Mill Creek has the largest proportion of mature riparian conifer in the watershed. Riparian areas in the wider, unconfined valleys with human settlement are mostly non-forested (Figure 23) with a low potential for recruitment of conifers into the stream channel. These areas often have open stream canopies and a high proportion of unstable banks. Recent bank erosion occurred along Big Elk Creek following winter floods in 1995. East Fork Mill Creek and lower Savage Creek also have a high proportion of unstable stream banks. Appendix A provides specific riparian habitat information by stream reach.

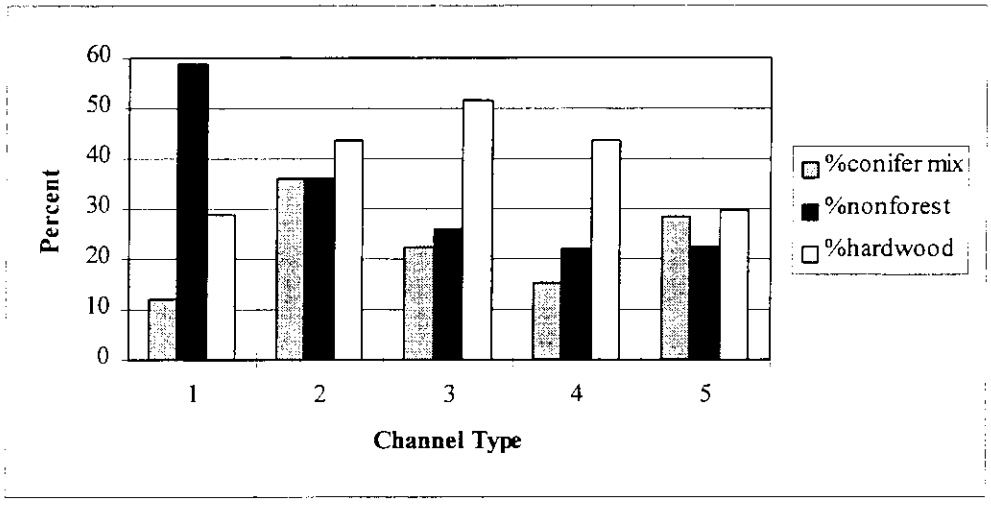


Figure 23. Riparian vegetation by channel type. Low gradient (0-4%) unconfined channels are type 1 and moderately confined channels are type 2. Type 3 channels are confined with a gradient less than 8%. Unconfined and moderately confined, 4-8% gradient, channels are type 4 and channels with a gradient greater than 8% are type 5.

Of the unsurveyed streams -- Beaver, Bear, Deer, and Wolf -- Wolf Creek has the largest proportion of conifer (40%) in the riparian zone. Some pockets of mature timber remain in stream bottoms in upper Deer Creek. Bank stability and canopy closure is variable in all of these streams.

Species distribution and habitat connectivity. Figure 24 shows current known distribution of salmonid species. Chum salmon are no longer present in Big Elk Creek. Upper extent of sculpins and cutthroat is unknown in most streams. Habitat and water quality degradation is limiting distribution of aquatic species from reference distribution. The Mill Creek reservoir may be a partial barrier to downstream migration of smolts.

Terrestrial Domain

The map in Figure 25 shows the current seral stage of the vegetation in the analysis area. Today, approximately 22% of the analysis area is in permanent pastures or was recently clearcut. The agricultural areas are located throughout the central portion of the analysis area. Approximately 34% of the Big Elk watershed is in young plantations, ranging in age from 10 to 50 years old. Many of these areas are currently managed on a 40-60 year rotation for industrial timber production (Yaquina Basin Ownership, Figure 6, pg. 11). Most of the federal lands have also been heavily managed for timber production over the past 40 years, though the harvest units on federal lands are generally smaller and road densities lower than on private timber lands. Another 22% of the area is classified as hardwoods or hardwood-dominated mix stands. Many of these stands are a result of the fire history and past logging practices. The remaining 22% of the landscape, primarily on federal lands, is mature conifer or natural conifer/hardwood mixed stands which are roughly 150 years old . Note that this figure is high, as some large patches, notably a large block in the SE corner of Feagles Cr. between BLM lands and some sales on FS lands, have been logged in the last year and do not show up in the GIS database.

Approximately 20% of the mature conifer stands within the analysis area had commercial thinning activities applied during the 19'70s. Between 30-50% of the overstory and nearly all of the commercially merchantable snags and logs were removed in the thinnings and along road corridors during this time period.

This mixture of ownerships and land management patterns has resulted in the mosaic of vegetation types and patch sizes we see on the landscape today.

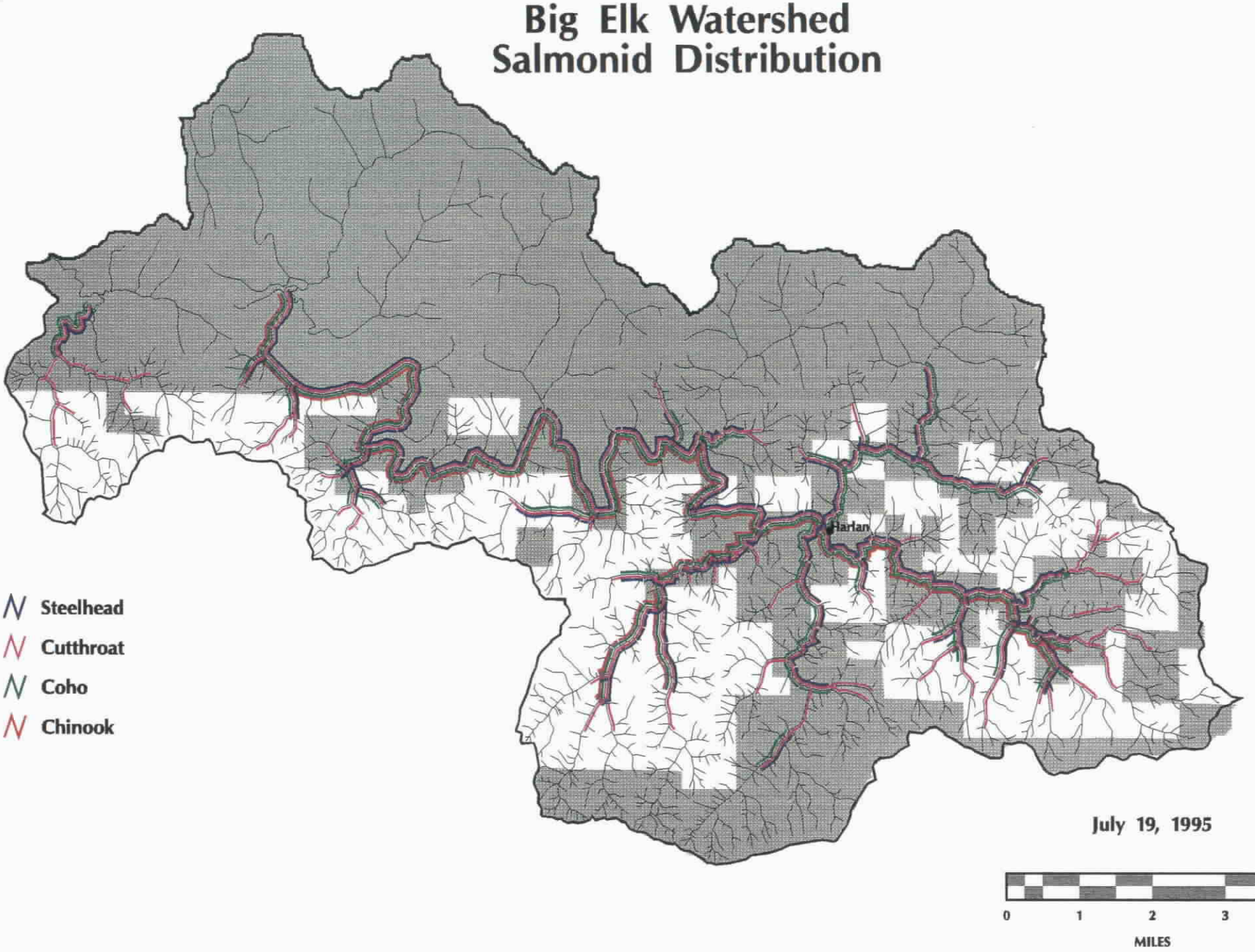
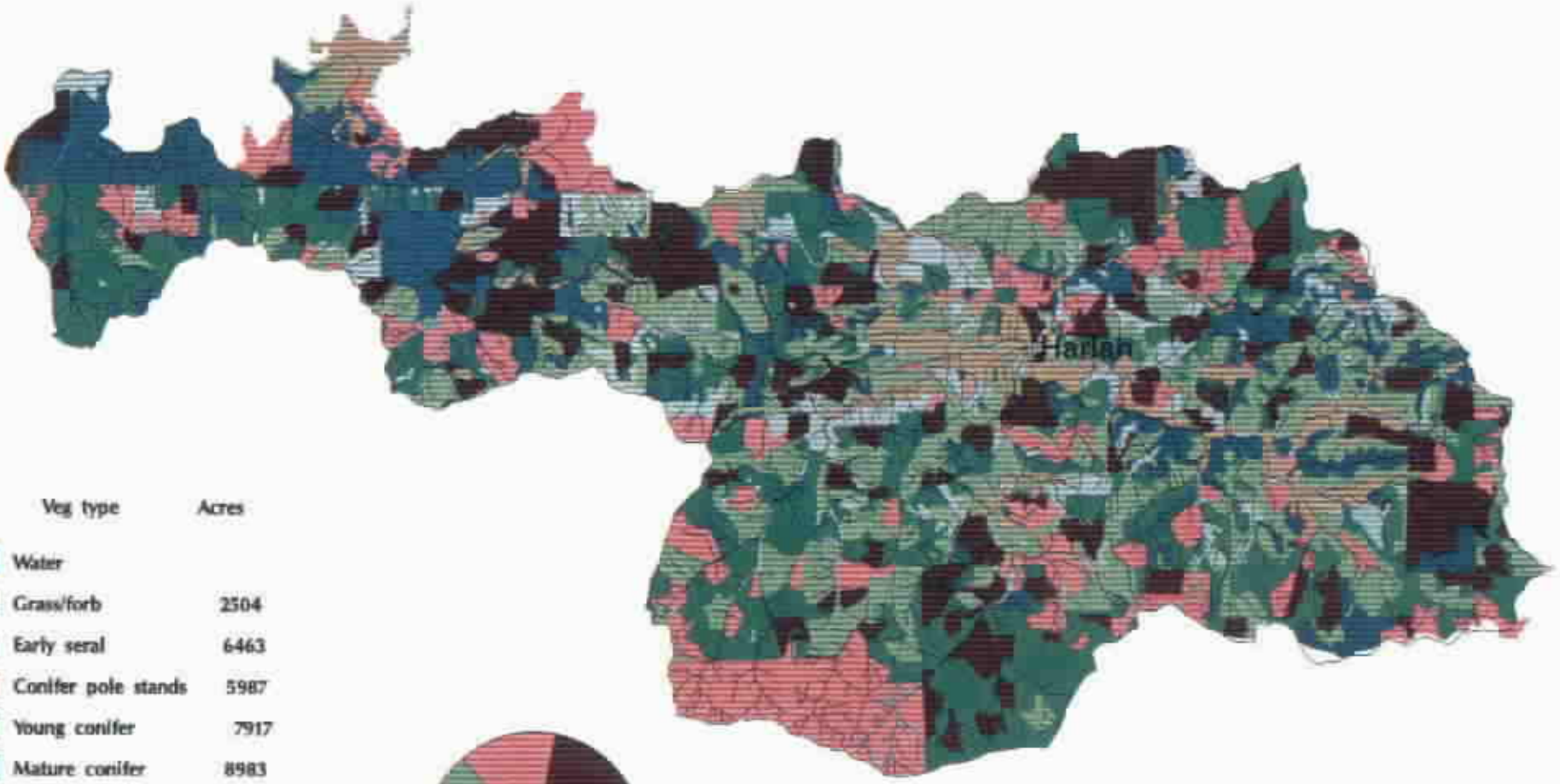

Big Elk Watershed
Salmonid Distribution
Harlan
Steelhead
Cutthroat
Coho
Chinook
July 19, 1995
0
1
2
3
4
MILES

Figure 24.

Big Elk Analysis Area
Current Vegetation



Veg type	Acres
Water	
Grass/forb	2504
Early seral	6463
Conifer pole stands	5987
Young conifer	7917
Mature conifer	8983
Pure hardwood	3232
Hardwood/conifer	5974

June 19, 1995

Figure 25.

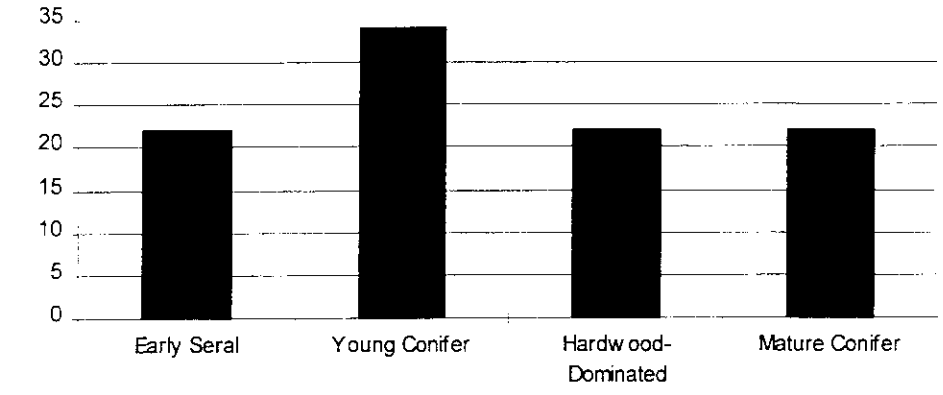


Figure 26: Percent of the land in each seral class for the Big Elk Analysis Area. Data includes all ownerships.

Figure 25 shows the seral breakdowns in the watershed at a finer scale than the breakdowns listed in Figure 26. In the above graph, pasture and recent clearcuts were lumped into the early seral category; young conifer and pole stands were lumped into young conifer and the hardwoods and hardwood-dominated mix stands were grouped into one category.

The following Figure 27 compares the amount of mature conifer stands and early seral habitats for each subwatershed, in order of the amount of mature conifer. Most of the remaining mature conifer stands are in Mill Creek and the upper drainages of Feagles and Grant creeks, while the amount of early seral habitat exceeds mature conifer stands in the majority of the drainages.

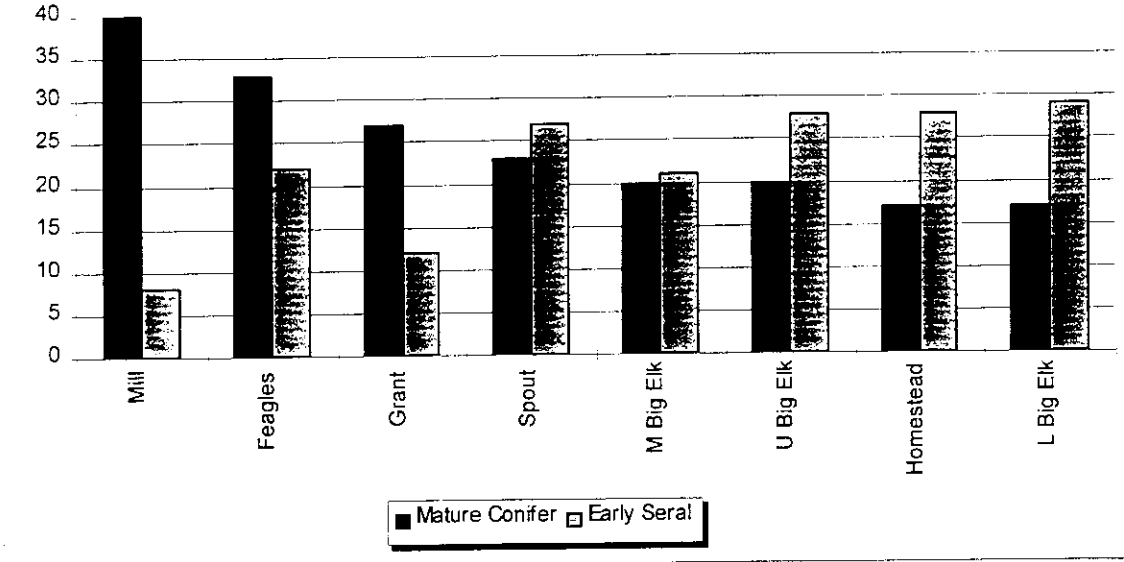


Figure 27: Percent of mature conifer vs. early seral habitats by subwatersheds for the analysis area. Data includes all ownerships.

Stand exams were conducted within natural mature conifer stands in the Big Elk drainage in 1993. The data indicates that mature conifer stands in the Big Elk drainage have an average of 25 hardwoods/ac comprising 30% of the stand component. The stands average around 30 large (>25" dbh) and another 15-20 codominant trees per acre. These stands typically do not have a distinct understory or multi-layer component and the dominant and codominant trees are both part of the overstory..

In general, mature conifer stands in the southern half of the analysis area are very similar to mature conifer stands in other areas of the forest, based on plots taken around the forest in the mid-80s. Stands in the Big Elk drainage may have a slightly higher hardwood component and somewhat smaller average stand diameters than the forest-wide average, possibly a legacy of the fire history in the area.

Snag and log levels are exceedingly low within the analysis area, compared to the rest of the forest. A total of 396 acres of mature conifer stands were surveyed within the analysis area in 1993. A total of only 147 logs and 135 snags were counted, or 0.4 logs and 0.3 snags per acre (range: 0-14 logs/snags per stand sampled). Figures 28 and 29 show the approximate levels of snags and logs seen forestwide in the different seral types. Data were derived from 1987 managed stand survey, 1987 vegetation resource survey, and 1990 vegetation structure exams. Data are for the entire Forest and were compiled from over 1,000 plots. Only snags at least 20' tall and logs at least 20' long were counted. No true late-successional forest habitat was sampled on the Siuslaw National Forest. Owl activity areas are mature conifer stands which may have contained remnant old growth trees.

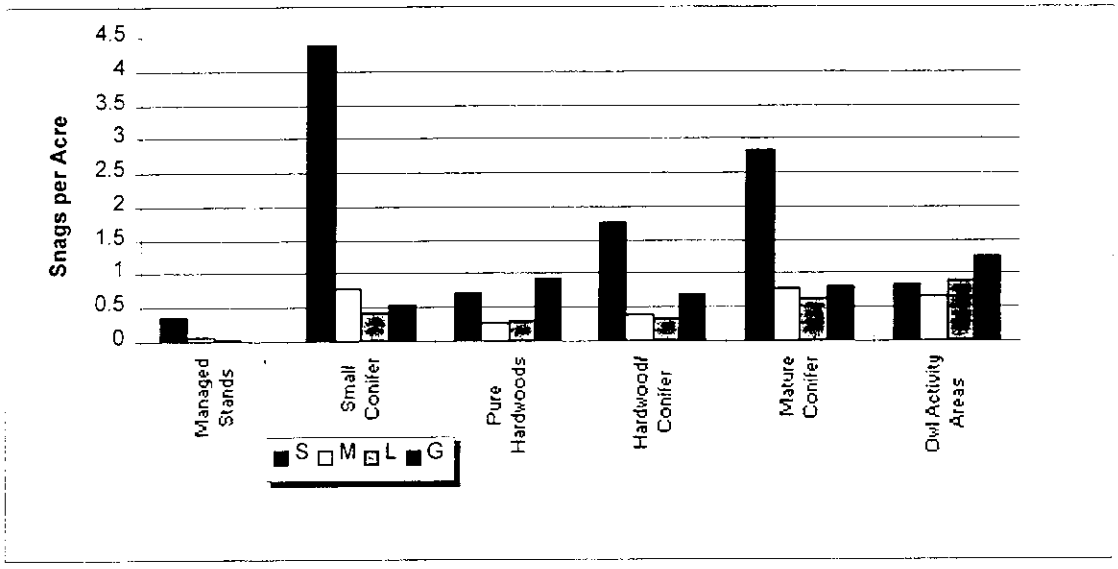


Figure 28 - Snags per acre for seral classes. Sizeclasses: Small (S) = 10-19" dbh, Medium (M) = 20-29" dbh, Large (L) = 30-39" dbh, and Giant (G) = >40" dbh.

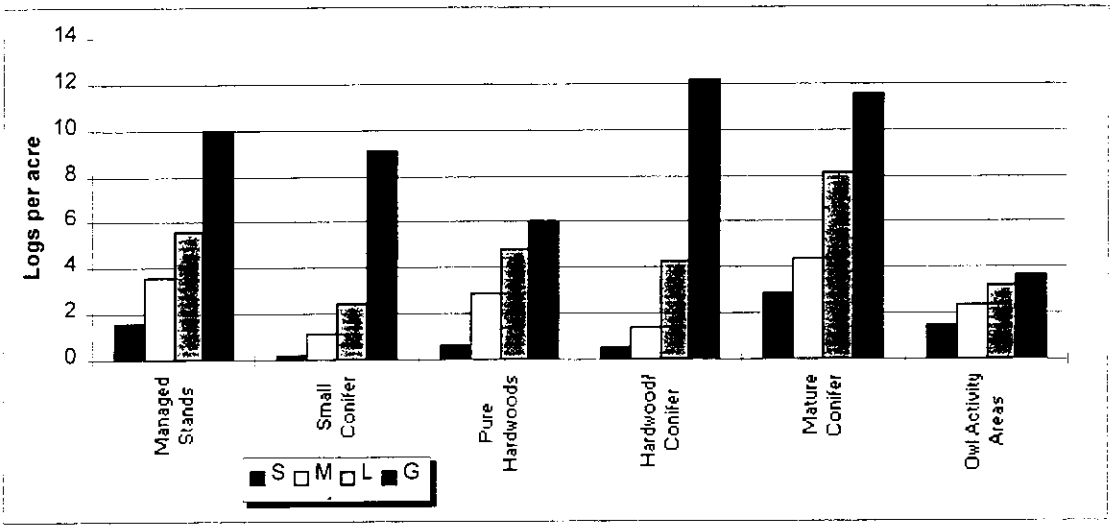


Figure 29 - Logs per acre for seral class. Sizeclasses: Small (S) = 10-19" dbh, Medium (M) = 20-29" dbh, Large (L) = 30-39" dbh, and Giant (G) = >40" dbh.

Connectivity of Mature Forest Habitat

The shift in vegetation patterns on the landscape from large homogeneous patches of mature conifer stands to the mosaic of mixed age groups and small patch sizes (<100 acres) and the acceleration of disturbance regimes on the landscape has dramatically altered the amount, distribution, and quality of the terrestrial and aquatic habitats. Species which once had adjacent

refugia to escape to after major disturbance events, are now restricted to smaller habitat patches and are competing for limited resources.

The edge effect of forest fragmentation further reduces the amount of available interior forest habitat by increasing the risk of predation and competition by edge-associated and non-native species. Forest fragmentation has had a direct negative affect on the survival and reproductive success of spotted owls, marbled murrelets, and neotropical migratory songbirds.

Figures 30 and 31 depict the current condition of mature versus interior forest habitat by subwatershed in the analysis area. Interior forest habitat was determined by evaluating the type and severity of the edge adjacent to the mature stand (Chen, Franklin and Spies, *Ecology*, 1992). Mature stands which were next to clearcuts, pastures or similar openings were buffered in 400 feet (two site tree lengths); mature stands adjacent to young plantations (8-24 yrs) were buffered in 300 feet; stands which were adjacent to older plantations or pure hardwood stands were buffered in 200 feet.

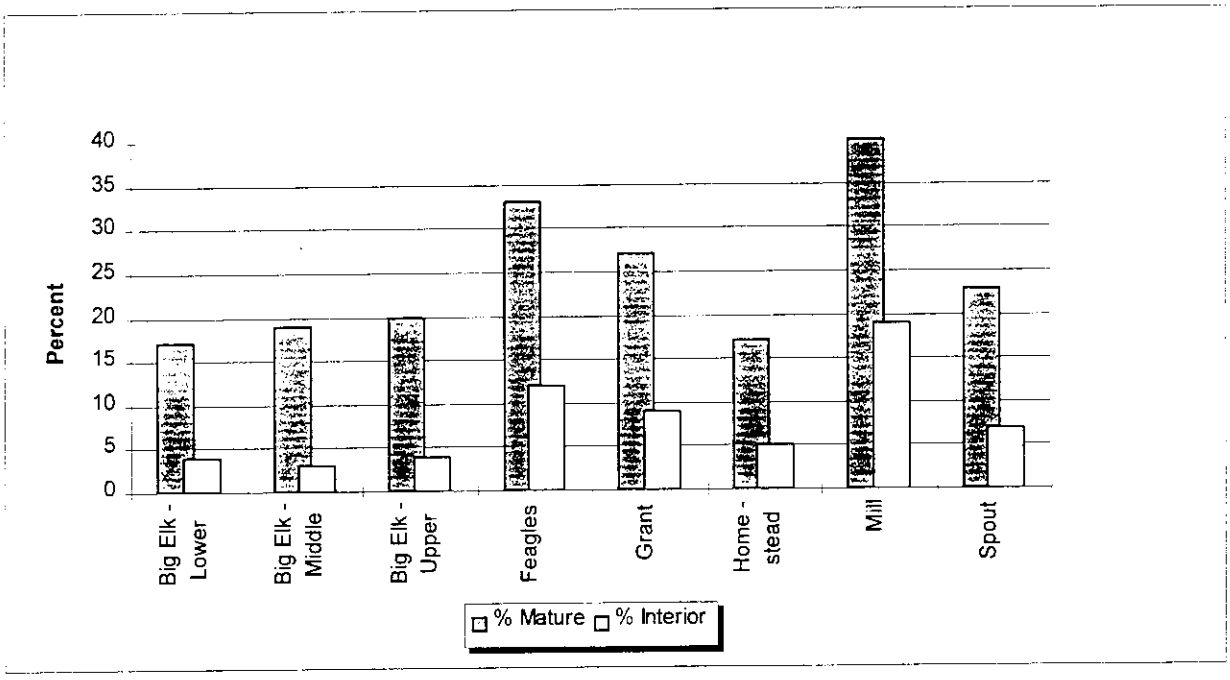
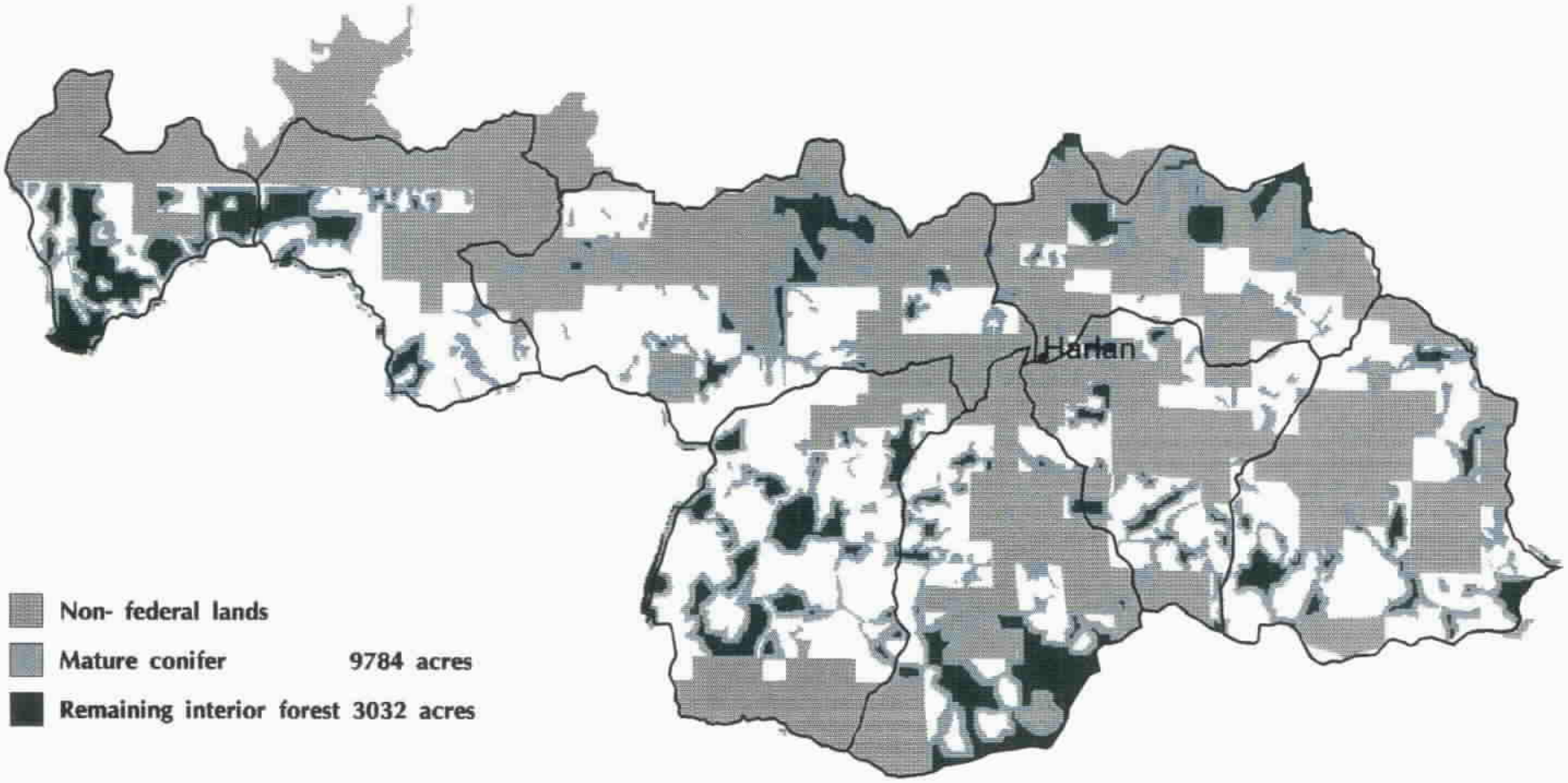


Figure 31 - Mature and interior forest habitat by subwatershed.

Maintaining Terrestrial Ecosystem Structure and Function

Introduced Non-Native Plants and Animals. Forest fragmentation and maintenance of early seral conditions encourages the spread of non-native and invasive plant species, such as Himalayan blackberry, Scotch broom, tansy ragwort and many of the european pasture grasses. The long settlement history of the area has resulted in a landscape in which non-native plants are well established and here to stay. The change in vegetation patterns is also beneficial to non-

Big Elk Analysis Area
Interior Forest



June 22, 1995

0 1 2 3 4

MILES

Figure 30.

native and native wildlife species which were uncommon or absent in this region. Competition and parasitism by european starlings, brown-headed cowbirds and english sparrows, along with predation by feral cats and opossums are causing nation-wide declines in our native songbird populations. Other species were deliberately released by game management agencies. Wild turkeys, and ring-neck and Szechwan pheasants all have established populations in the Big Elk drainage. These introduced species have the potential for carrying and transmitting diseases to native grouse, quail, and other gallinaceous species.

Status of Threatened, Endangered, or Sensitive Species. Survey efforts within the analysis area are limited to recent timber sales and include spotted owl, marbled murrelet, bald eagle, and botanical surveys. Approximately 50% of the analysis area has been surveyed to regional protocol for the spotted owl and bald eagle, while murrelet surveys are limited to stations within and around Randall Salado Units 1, 2, and 3 and stands immediately adjacent to Grant Davis Unit 2, which was logged this spring. Botanical surveys were conducted for most of the analysis area for past timber sales and will cover nearly 100% at the end of the 1995 field season.

One spotted owl activity center is located within the eastern portion of the analysis area in the heavily fragmented Chinquapin area. This pair has been monitored by Forest Service and PNW personnel since 1988. The owls produced young in 1989, 1990 and 1994 but dead fledglings were found at the nest site in 1990 and 1994, indicating a shortage of food and/or predation at the exposed nest site. Nesting was not initiated or failed in 1991, 1992, 1993 and 1995. Based on the history of this pair to date, it is assumed that juvenile survival is at or near zero for this site. It is also believed that this pair may be getting old and is remaining in the area due to high site fidelity and the fact that adjacent suitable habitat (Marys Peak) is occupied. No other known spotted owl sites are located within the analysis area.

Single responses of both male and female spotted owls were recorded during surveys for a number of timber sales throughout the middle of the analysis area in 1989, 1990 and 1991. A pair was located in Traxtel Creek, just outside of the analysis area, in 1992 but was confirmed non-nesting that year and the next. The birds were not located in 1994. Although this pair has better habitat than the Chinquapin pair, they do not seem to have a solid activity center or nest location.

An active bald eagle nest site - one of only 12 on the forest - is located in the Grant Creek area. Although the pair has been seen in the area by the Grants and other residents for a long time, the nest site was not located until 1992. The nest was found along the unit boundary of a timber sale indicating that the pair may have been inadvertently dislocated by this or other nearby sales before being discovered. After locating the nest, conflicts soon arose with a sold timber sale, resulting in the establishment of an official bald eagle management area and the eventual release of the unit.

Although the pair initiated nesting in 1992, they did not fledge any young. The adults constructed a new nest further up the hill in 1993, but nesting efforts failed again that year. They did successfully fledge two young in 1994 at the new nest location, but failed again in 1995.

Limited monitoring efforts indicate that the adults forage in Feagles and lower Grant Creek. They may also forage as far away as the Yaquina Bay estuary. A historic pair which nested near Table Mountain were reported to foraged as far away as the coast.

The Big Elk landscape with its disturbance history and associated hardwood stands, supports the highest concentration of *Poa laxiflora* on the forest. This grass species is strongly associated with riparian hardwood conditions and favors a moderate level of disturbance. A species management plan was completed by the Forest Botanist in April, 1993 and the species was downlisted from sensitive to C3 (more common than thought) the following year. The forest is currently managing the species based on protection populations and buffers outlined in the management plan.

Other Species of Concern. C-3 and species proposed for listing include several species of amphibians and bats, red tree voles, and species which are proposed for listing are regional species of concern which occur within the analysis area. Recent location information has become available for the red tree vole and some of the bats, but data are lacking for most species. In addition to these terrestrial vertebrates, numerous plants, particularly non-vascular plants, and invertebrates, such as freshwater mollusks and forest arthropods, are species which are highlighted in the Northwest Forest Plan as survey and manage species. Many of these latter species probably do not occur within the analysis area, but survey information for these species is lacking.

There are no known special habitats, such as caves or cliffs, within the Big Elk analysis area. Wetlands are limited to beaver activity within the riparian areas and are relatively common in the lower gradient areas of the drainage.

Neotropical Migratory Birds. Neotropical migratory songbirds are defined as those species which overwinter in Mexico and South America and fly north in the summer to breed. All of them rely on a seasonal food supply (insects, nectar, fruit) to raise their young. Surveys indicate that many species of neotropical migrants are declining, particularly those which are associated with mature forest or wetland habitats. Management of these international migrants is complex and habitat loss and the use of agricultural chemicals are some of the major reasons cited for their decline. Songbirds are attracted to hardwood and hardwood mix stands (McGarigal, 1993), since deciduous forests generally support higher concentrations of insects. These stand types are relatively abundant in the analysis area and banding surveys conducted over the past 5 years indicate that the area supports the highest number of birds of the 6 sites sampled.

Guilding Analysis. A species guild analysis was conducted to evaluate the current condition of this drainage and compare the habitat quality to the rest of the forest. A guild is defined as a group of species that use the same set of environmental resources in a similar way. Thus the suitability of a given landscape can be characterized or rated for all species, including those with limited mobility and small home ranges. As stated earlier, results of this analysis confirm that the area is not functioning adequately to support species with large home ranges which require mature forest habitat. Less than 15% of the area was rated as suitable for this

guild. Another guild which rated out poorly includes contrast species. These species, such as elk, require a combination of mature forests adjacent to openings. Contrast species use the forests for security and breeding and forage close to the edge in the openings. Although it may seem contradictory that habitat for this guild rated out poorly, especially when considering how fragmented the landscape is, the amount and distribution of mature forest habitat was again the limiting factor. In contrast, the landscape rated out well for patch species, which utilize a homogeneous patch of habitat and generally have small home ranges, and mosaic species with small and medium home ranges, which use several patches of habitat in aggregate. These guilds include many of the neotropical migratory songbirds, most of the rodents and several reptiles.

Long-Term Management of Elk Habitat

The long-term management of elk habitat is a regional issue due to the commercial and social value of elk as a big game species. In particular, there is a growing concern that browse damage on private lands will increase with a reduction in clearcut practices on federal lands.

According to Oregon Department of Fish and Wildlife (ODFW) reports, the Alsea subunit, which covers most of the Siuslaw National Forest, currently supports approximately 8 elk per square mile. This level is considered the carrying capacity of the habitat. Elk populations have fluctuated greatly since early settlement. Though common when settlers first arrived in the Coast Range, the Roosevelt elk was nearly extirpated in Oregon by market and subsistence hunting between 1850 and 1900. Market hunting was outlawed in 1899 and a combination of transplant efforts and state-wide hunting moratoriums between 1909 to 1938 allowed populations to slowly increase again. Figure 32 shows that populations peaked in the mid-60s and declined sharply again through the 70s and 80s (Oregon's Elk Management Plan, 1992). Ironically, this period of decline coincides with a peak in logging activities and increase in forage on federal lands.

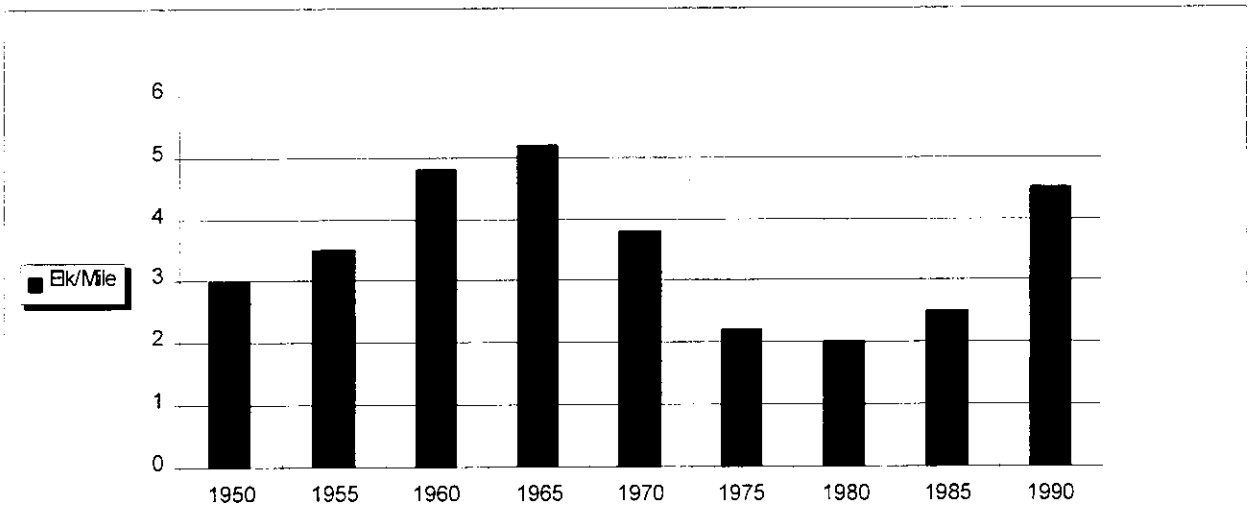


Figure 32 - Roosevelt Elk Populations in Western Oregon over time. This information is from the Oregon Elk Management Plan (July 1992, p. 5).

The increase in road densities and hunter access are considered to be the primary cause of the population decline. Hunter numbers have been declining statewide since the mid-80's and in 1992 elk hunters in Oregon made up approximately 5% of the resident population over the age of 15. Public meetings were held by ODFW in 1991 and are ongoing to come up with solutions to the access problem and other elk management concerns. Reducing road densities is the highest public and agency priority, followed (in order) by concerns over competition for forage between elk and livestock, an overall loss of cover and potential elk damage to private lands.

Based on reports from local hunters, ODFW personnel and signs of elk use in the area, elk populations are concentrated in the eastern (foothills of Marys Peak) and western sections (edge of Gopher and Drift Creeks) of the analysis area, while use is much lower in the central portion of the analysis area. This pattern is closely correlated with road densities (see Figure 33) and human use patterns in these areas, rather than available forage, which is relatively high throughout the area.

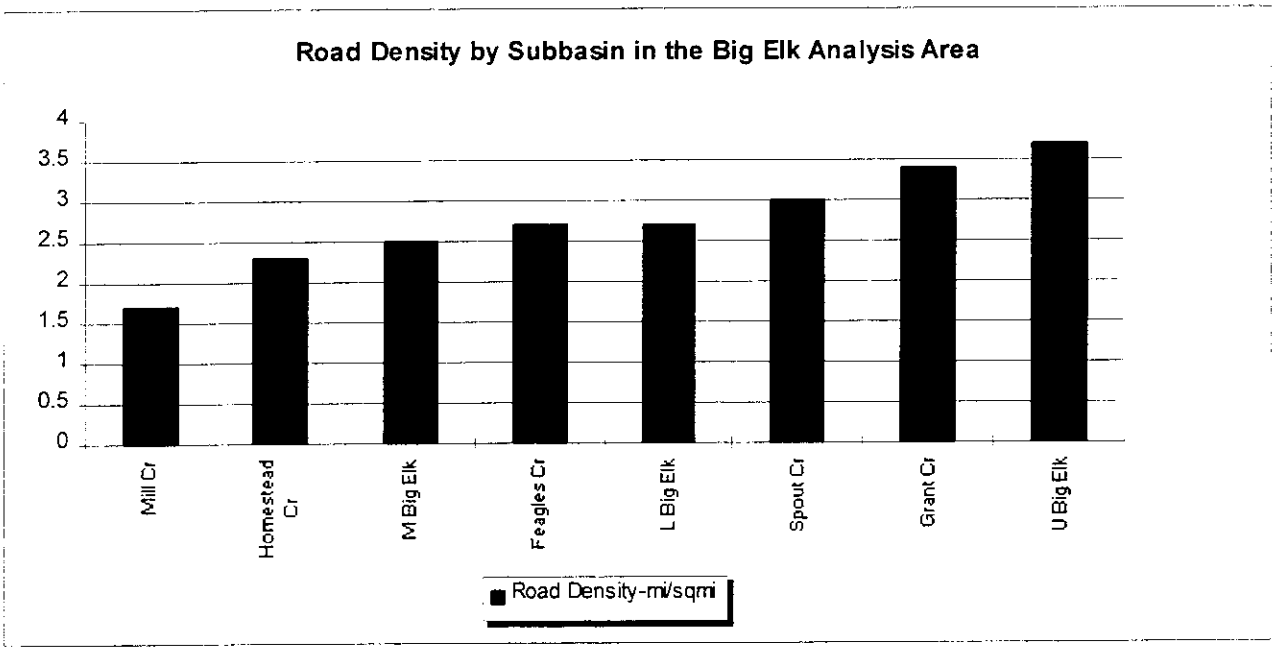


Figure 33 - Road densities in miles per square mile by subwatershed in the analysis area.

The Big Elk drainage was not identified as a high priority elk emphasis area for the Forest (Forest Wide Assessment and Siuslaw Land and Resource Management Plan), based on the amount of private lands within the basin and topography.

STEP 5. TRENDS

This step compares current conditions to reference condition and identifies key watershed elements (processes and disturbances) responsible for current condition and future trends. In general, the Big Elk watershed is responding to a large scale wildfire disturbance in 1850. Human activity has altered or disrupted the reference recovery processes, especially vegetative recovery.

Human Domain

Human Uses and Values

Population Trends. The July 1994 "Population Estimates for Oregon" reports the estimated current population is 3,082,000 people. Oregon's population grew 8.4% since the last U.S. Decennial Census of April 1, 1990. This rate of increase is almost double that of the whole U. S. (4.8%). Oregon's population increase is the result of two factors: natural increase (births minus deaths) and net migration (persons moving to Oregon minus persons leaving Oregon). Natural increase has accounted for only about 70,000 new Oregonians while in-migration has accounted for about 169,600 persons (Wineberg, 1994).

Population distribution by county shows that the eight most highly populated counties are located on the I-5 corridor. These counties, Multnomah, Washington, Clackamas, Marion, Linn, Lane, Douglas, and Jackson, contain 71% of the state's population (Wineberg 1994). The Demographic and Economic Forecasts 1990-2030 (ODOT 1993) state that Oregon's population is expected to increase by 34%, from 2.847 million (1992 population) to 3.809 million in 2012.

Economic Trends. Between 1990 and 2012, Oregon's rate of employment growth is projected to exceed its rate of population growth by 24%. Population and employment will be greatest in western Oregon and metropolitan areas. The differences in rates of growth within Oregon occur as the service sectors of both the state and national economy continue to grow faster than the natural resource-based sectors (ODOT 1993). Local resource-based industries, lumber and wood products, paper, and fishing, have declined due to substitution of technology for labor and declining supply of cheap, natural resources (Forest-wide Assessment, in progress). Agricultural wage and salary employment from 1990 to 2012 is estimated to grow at an annual rate of 1.65%

The Corvallis Gazette-Times (July 12, 1995) reported that the July edition of the Employment Department's "Oregon Labor Trends" is projecting that local employers will add more than 22,000 jobs to their payrolls over the next decade. Employment in the local region, which

includes Benton, Linn, and Lincoln counties will grow faster than employment in Oregon as a whole. The local region will grow to 107,590 jobs by 2005. Most of this growth will be in high-tech jobs, such as software programming and hardware manufacturing. Those jobs, which are mostly in Benton and Linn counties, will increase from 6,700 today to 9,500 in 2005. The salaries for these jobs will range from $5.00/hour for low-skill entry level jobs to $20-25/hour (State of Oregon, Employment Department, Corvallis Office, personal comm., 1995).

Service jobs will grow 46% (from 18,530 to 27,110) adding workers in fields such as health care. Construction is projected to grow 34% (from 3,060 to 4,110). The only industry expected to lose jobs in the region is federal government employment, much of that in U.S. Forest Service jobs (Corvallis Gazette-Times, July 12, 1995).

Many of these high-wage jobs will require college degrees. This will lead to an increase in the overall level of education in the area. The Labor Trends published information on education and income levels by county for the state of Oregon, Table 7 shows these numbers for the local region.

County	% of Adult Population with Bachelor's Degree	Median Family Income
Benton	41.3	35, 559
Lane	22.2	30,763
Lincoln	16.7	27,224
Linn	11.0	29,421

Table 7. Income vs. education for 4 local counties. "Education and Income, Oregon Counties, 1990 Census". October 1994.

The figures indicate that a limited number of individuals in Lincoln and Linn counties will be able to compete for higher paying jobs and that Benton County, probably due to the location of Oregon State University, will have the largest applicant pool.

Socioeconomic Trends. With increased income there is more disposable income available for recreation. The trend will be more towards viewing the forest from a scenic and recreational standpoint than from a utilitarian standpoint. The trend has been to value a forest not for its ability to produce timber but to protect older forests "that have a cathedral value to so many people" (Corvallis Gazette-Times, July 9, 1995). As a result, landscapes having high recreational and scenic value by the public, will not tolerate harvesting practices that destroy the scenic beauty. The non-commercial interests in the forest will continue to limit the amount and kinds of commercial uses that are found acceptable.

In the Forest-Wide Assessment (in progress), the Department of Tourism finds that the public would like more recreation programs combined with education, more guided recreation opportunities, and some business opportunities such as outfitter guiding on federal land (Roberts 1995). Bicycle touring and mountain biking are not adequate to meet future demands (Chamber of Commerce and others 1995). In addition, the types of opportunities provided in the future

may need changed to meet the needs of older recreationists and the more varied population (Dwyer 1994).

Management of Range Alllotments

The trend in application for, and use of, national forest lands for livestock grazing has been a decline. Currently, there is one active range permit in the analysis area. The two other permittees were either denied reissue of their temporary permit pending completion of this analysis or declined to activate their permit. The decline in use is due in part to management restrictions but also to the general decline in forage availability on Forest Service lands. In the past, forage was developed for both elk and livestock grazing following clearcut logging. The four most recent clearcut units in the allotment are five years old at this time. These areas begin to lose nutritional value and palatability at about 8 to 10 years of age, depending on site and growing conditions.

Aquatic Domain

Water Quality

Stream temperatures in the Big Elk watershed do not match the reference condition and are far outside the reference condition for many streams (Figure 15). The future trend in Big Elk Creek, Spout Creek, and Feagles Creek is degraded and worsening. The trend for other tributaries in the watershed is degraded and improving. The exception is upper Mill Creek and East Fork Mill Creek where temperatures match reference condition.

High stream temperatures in the Big Elk watershed result from the interaction of low stream flows, warm summer air temperatures and poor canopy closure. Low summer flows match the reference condition but there is no information on the magnitude of current low flow events. Water withdrawal for irrigation use in Big Elk Creek *may* decrease summer low flows outside a reference range in some years. In addition, extensive timber harvest may cause long-term decreases in low stream flows (Hicks *et al*, 1991) and alder riparian communities may lower water tables and reduce low stream flows (F. Swanson, pers. comm.). Canopy closure relates to riparian vegetation condition discussed in Issue 2. Alterations in riparian vegetation from agriculture and timber harvest activities and historic small-scale wildfires have maintained an open stream canopy throughout the watershed. Summer low flow stream temperatures are highest in Big Elk Creek and cannot recover as channel width increases downstream. Thermal loading in Mill Creek begins in the Mill Creek reservoir from outflow of warmer surface waters.

Sustained stream temperatures above the reference condition decrease summer rearing habitat quality and reduce growth and vigor in salmonid species and macroinvertebrates (Meehan, 1991). Warmer temperatures may also increase distribution of speckled dace and alter

competitive interactions between dace and salmonids (Reever *et al*, 1987). Finally, higher stream temperatures are a barrier for any salmon and trout movement during summer flows.

Aquatic Species Viability

Substrate. Levels of fine sediments in the Big Elk watershed are higher than reference conditions. Sediment routing into watershed streams has increased above reference condition due to watershed-wide human activities. Debris torrent rates in Grant, Savage, and Feagles Creeks (Siuslaw National Forest, 1979) have been far above the reference condition (see Siuslaw National Forest, 1993). Some of this sediment is still stored or being routed through the basin. Road densities in these streams and the upper Big Elk basin are 3-4 miles per square mile (Figure 32). Bank stability is also outside of the reference condition supplying mostly fine sediments into the system. Finally, anecdotal information from Oregon Fish Commission surveys dating 1949-55 describe fine sediment choked streams resulting from logging activity which indicates the long-term nature of the problem. Chronic, rather than episodic, sediment input, coupled with low potential of sediment storage from large woody material may have limited the oscillating (more discrete) nature of sediment routing through the watershed (Benda, 1994) limiting substrate refugia. The future trend for Big Elk, Spout, and Feagles Creeks is degraded and worsening based on poor bank stability. The future trend for other tributaries of streambed substrates is degraded but improving.

The Mill Creek Reservoir dam has interrupted sediment routing through the Mill Creek watershed. Bedrock dominance below the dam probably results from the loss of upstream sediment supply. Future sediment routing in lower Mill Creek must be from adjacent hillslopes comprising a small drainage area. The reservoir also affects timing and magnitude of peak winter flows, limiting the flushing of fine sediments.

Large Woody Debris. Large woody debris levels match or are near to the reference condition in stream reaches with mature timber habitats (Figure 17). Recovery processes in these areas have had minimal disturbance, or, in the case of lower Savage Creek and the second reach of Feagles Creek, large wood has been added to the channel as habitat restoration (in 1990). LWD levels are far below the reference condition for other streams in the Big Elk watershed. Channel clearing and loss of LWD recruitment sources in riparian zones have created the current condition. Logs were rafted down Big Elk Creek between the 1890's to 1940's (Farnell 1981). Logs were also floated down Spout Creek (Parry 1985). There does not seem to be anecdotal evidence about the condition of the creeks during that time. Other coastal waterways were cleared of native LWD and stream bank vegetation to facilitate log transport (Sedell and Luchessa 1981). Early logging in the Big Elk was probably centered around valley bottoms and lower hillslopes.

In the Big Elk watershed, and especially in Big Elk Creek, low levels of LWD limit both long-term and temporary storage of sediments, which affects spawning habitat and macroinvertebrate populations. Low levels of LWD also reduce pool scour which affects the frequency and quality of summer and winter rearing habitat in third and fourth-order streams. In addition, lack of LWD

minimizes interaction with floodplains in unconfined and moderately confined channels resulting in less secondary channel habitat.

Spawning Habitat. As discussed in the Substrate section, amount of fine sediments in streambed substrates, especially gravel, is above reference condition. Abundance of spawning gravel probably meets reference condition (except for lower Big Elk Creek) but the quality is poor. Historical (1949-55) information from Oregon Fish Commission surveys indicate that abundance of gravel has not changed dramatically but quality has depending on local disturbances, usually timber harvest. Spawning habitat in lower Big Elk was no more abundant in 1949. Trends are discussed with substrates. Key spawning areas are shown in Figure 19. Lower Grant Creek is an important Chinook Spawning area. East Fork Mill and the second reach of Savage Creek are important coho spawning areas. Lower Mill Creek is critical for chum salmon spawning.

The extent of impacts of sand and silt sediments on spawning or egg-to-juvenile mortality in the Big Elk watershed is not known. Negative impacts from fines in spawning gravel are well documented and probably affect Big Elk fish stocks. Chinook salmon are less susceptible than cutthroat trout to gravel fines (Meehan 1991) which may partially explain the stability of fall chinook stocks in the Yaquina River basin The future trend of spawning habitat condition is unchanged from current condition. Gravel will continue to be transported into the larger order streams. Gravel quality will be inversely related to trends in human activities

Aquatic Habitats. No summer rearing habitat in the Big Elk watershed meets reference condition of deep, complex pools. High summer temperatures further degrade the condition of summer rearing habitat (Figure 20). Stream power and gradient influence pool frequency, pool area, and depth (Stack and Beschta, 1989). In smaller order streams, LWD can force a higher pool frequency (Nakamura and Swanson, 1992). Beaver dams increase rearing area substantially in fourth order and smaller streams and increase rearing habitat in reaches with low pool frequencies such as in Spout Creek. High bedload conditions may be limiting pool frequencies in Feagles, East Fork Mill and Mill. Bank instability is high in the first two streams and the width-depth ratio is large in upper Mill Creek. LWD levels are also low in these reaches. Spout Creek and Savage Creek have adequate pool areas but shallow depths resulting from high levels of fines.

Quiet-water winter rearing habitat is dependent on beaver populations and channel morphology in the Big Elk watershed. Habitat quality is dependent on complex hiding cover, usually large woody debris, and inversely related to deposition of fine sediments affecting pool depth. Little information is available on the longevity of beaver ponds in the Big Elk watershed. Beaver ponds in Cougar Creek and Savage Creek blew out during a set of 5-10 year floods, significantly reducing the amount of winter habitat in the watershed. Important winter rearing areas exist in Deer Creek, Bear Creek, Savage Creek reach 2, lower Cougar Creek, and Bull Creek.

The large amount of fine sediment in the watershed negatively impacts winter substrate used as refugia by steelhead trout, dace, and sculpins. The best winter habitat for steelhead occurs in the

steeper gradient (4-8%) step-pool channels. Lower gradient channels have more embedded substrates.

The future trend of rearing habitat depends on large woody debris sources, sediment supply and routing into the watershed, and beaver populations. Rearing habitats in National Forest lands are improving. Summer rearing habitat in Big Elk Creek is degraded and worsening based on high stream temperatures.

Riparian Habitat. Human activity plays a dominant role in the riparian habitat condition. Large components of non-forest and hardwood dominated riparian zone is a result of agriculture and timber harvest. Most wide valley bottom areas were converted to grazing and crop lands late in the 19th century. The steeper lands in the southern portion of the watershed were avoided and these areas now provide the small amount of aquatic habitat near reference condition in the Big Elk watershed.

Poor bank stability is caused by unvegetated streambanks commonly associated with livestock grazing areas and recently drained beaver pond areas with fresh sediment terraces. Most areas with poor bank stability do not have a forested riparian canopy. East Mill Creek is an exception.

Recruitment potential for conifer LWD is low in many stream reaches due to valley bottom roads. Over 45 miles of steam channel have a parallel road within the riparian zone (See Big Elk IRA maps) and many of these roads are main travel routes. Agricultural lands also have a low potential. National Forest lands with riparian reserves and industrial forest lands have a good long-term recruitment potential. Many stream reaches in these areas have hardwood dominated riparian areas that will require management.

Riparian habitat influences most aquatic processes, regulates water quality, and provides habitat for many terrestrial organisms (Gregory *et al*, 1991). Recovery of aquatic habitats usually lags behind recovery of riparian and terrestrial systems.

Terrestrial Domain

Figure 34 shows the Northwest Forest Plan Managment Allocations for the analysis area. Approximately 70% of the area was designated as a Late-Successional Reserve. Of the remaining area which is designated as Matrix, approximately 80% lies within the Riparian Reserve network.

Mature conifer stands make up approximately 15% of the analysis area, when considering lands administered by both the Forest Service and Bureau of Land Management. This level is at the threshold for the fifth field watershed, as outlined in the ROD, page C-44.

Big Elk Analysis Area
Forest Plan Management Allocations

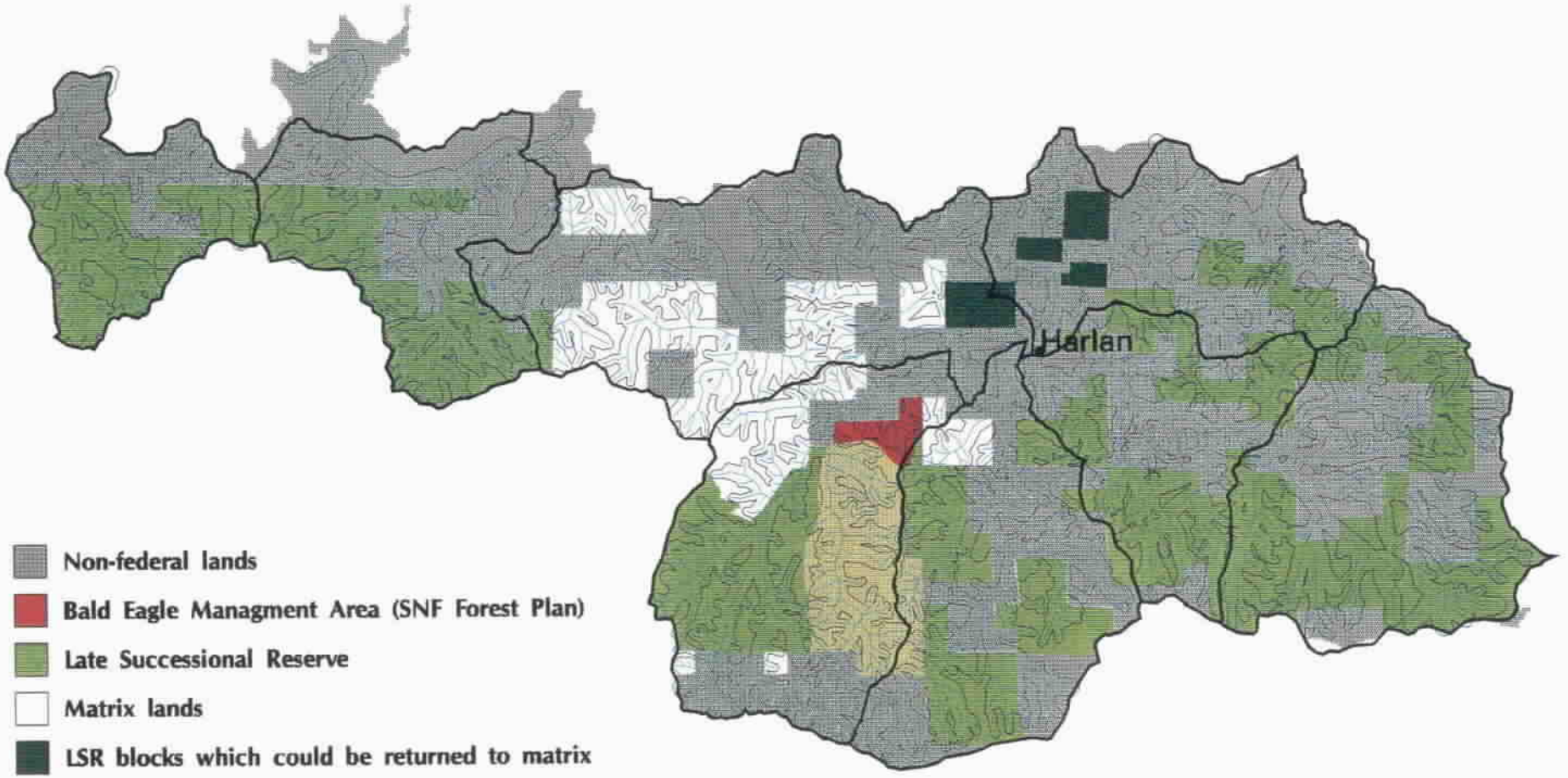


Figure 34.

Approximately 2,000 acres of dispersed patches of mature conifer stands are located outside of the Late-Successional Reserve. These stands currently serve as critical linkages, connecting federal lands in the Marys Peak area to BLM lands and the remainder of the forest. Potential opportunities exist to modify the reserve boundaries to include these areas in the reserve network, while freeing up other isolated patches of reserves to matrix designation (see management recommendation section of this report).

Providing dispersal habitat for terrestrial and riparian species is a one of the primary functions of the Riparian Reserve network and replaces the 50-11-40 analysis for spotted owls. Approximately 15,000 acres (55%) of the stands within the Riparian Reserve currently meet the minimum sizeclass for spotted owl dispersal habitat (11" dbh), while the remainder of the area is in openings or young plantations (see Figure 35). Although the landscape may meet the dispersal needs for spotted owls, the current mix of stands within the Riparian Reserve may not provide adequate dispersal habitat for other species, such as red tree voles or amphibians.

Under current management direction on federal lands approximately 80% of the analysis area will be managed to meet the LSR and Aquatic Conservation Strategy Objectives (USDA 1994, pages C-11 and B-11). This will shift the vegetative patterns from the current condition of small patches of mixed young age classes to larger patches of older forests. Hardwood and hardwood/conifer mix stands will gradually diminish on the landscape to where these stand types will once again be restricted to the stream-influence zone and other disturbance areas. Under current management direction and given the threshold levels of the landscape, clearcut harvesting of mature conifer stands on federal lands is not considered appropriate within the analysis area until the landscape has recovered above the minimum levels.

On privately owned lands, areas which are currently being managed for agriculture will be maintained in an early seral condition while those which are being managed for industrial forestry will likely continue to be intensively managed on 40-60 year harvest rotations. On federal lands, release of the 318 timber sales will cause a further decline in mature conifer stands, while thinning activities are expected to create diversity and increased diameter growth within the plantations.

Openings and early seral habitats will likely remain at or above 20% in this watershed, while the amount of mature conifer stands will begin to increase over time. This gradual change, while trending towards the reference conditions of the Coast Range ecosystem, is expected to remain outside of the natural range of variability for this ecosystem.

Figure 36 depicts the changes in the amounts of mature conifer and early seral habitat types on SNF lands within the Big Elk Watershed Analysis area through time.

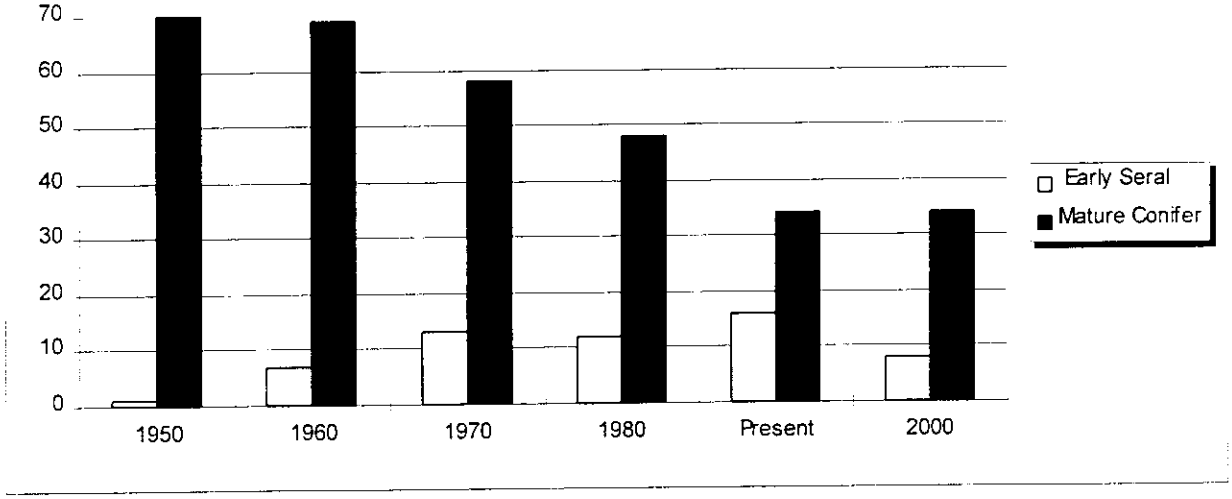


Figure 36. Amount of mature conifer vs. early seral habitat by decade. Data includes only Forest Service lands.

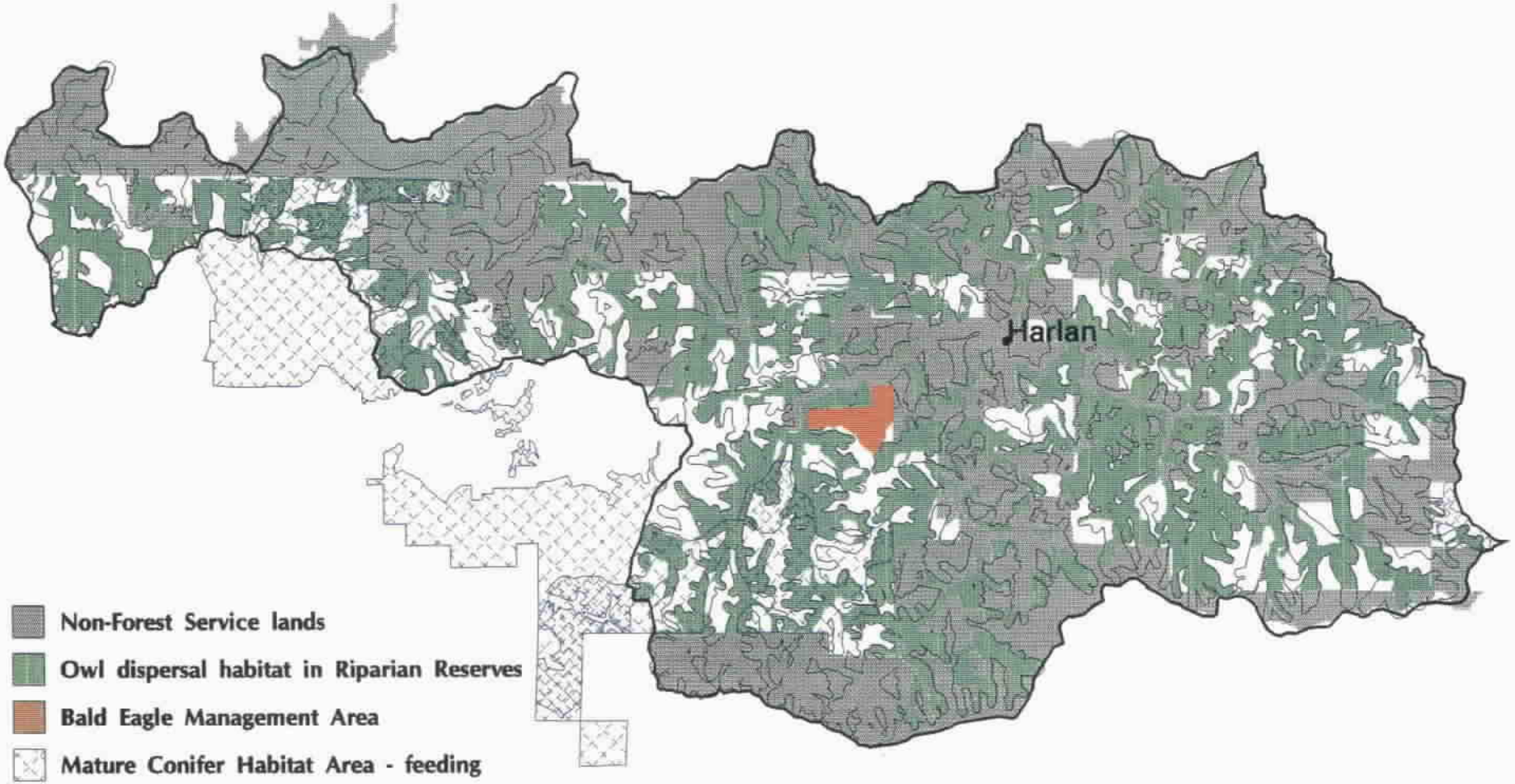
Use of chemical herbicides and pesticides will likely continue on private lands. Government trappers have and likely will continue to remove unwanted beaver, coyotes, bear, and cougar where conflicts with livestock and timber management occurs on private and state lands. Conflicts with elk damage on private agriculture and timber lands may increase, although harassment and hunting pressure may limit this trend.

Due to the ownership patterns in this watershed, the area will likely remain fragmented in the northern and eastern portions, while the southern half of the analysis area will become more consolidated with time.

Due to the continued levels of early seral and hardwood habitat types in this watershed, populations of elk, neotropical migratory birds and other edge-associated species are likely to remain constant. Although there may be an increase in use of private lands by species such as elk, the current use pattern is not expected to change significantly due to the fragmented ownership patterns, distribution of cover, and road access (disturbance). Current trends indicate that elk use patterns in this watershed are more strongly associated with low levels of disturbance rather than with the amount of available forage.

The recovery of mature conifer habitat will improve the dispersal and survival of species which are associated with this habitat type and will result in the long-term recovery of the connectivity function of this landscape.

Big Elk Analysis Area
Wildlife management considerations



June 20, 1995

0 1 2 3 4

MILES

Figure 35.

STEP 6. RECOMMENDATIONS

See Figure 37 for a map of priority areas within the watershed.

Human Domain

Human uses and values

Management Objectives: Provide for human uses and values without compromising the aquatic conservation strategy in the watershed.

Recommendations:
1. Validate the watershed analysis issues through public participation.
2. Continue to develop communication links with communities within and around the watershed to understand their uses and values of the area.
3. Involve the public in reaching a balance between uses and values.
4. Work cooperatively with BLM and others to develop Corvallis-to-the-Sea Trail and other recreation needs.
5. Develop and implement market analysis to determine human uses and values of the watershed in 10-15 years

Data Gaps: What are the current demands for use that are not being met? What are the trends for recreational use of the analysis area based on a projected population increase in the Willamette Valley?

Monitoring Needs: Monitor current use, other than commercial, of the area. Are people using the area in ways other than expected or known?

Management of Range Allotments

Management Objectives: Evaluate current range allotments for compliance with with the Aquatic Conservation Strategy and other Standards and Guidlines outlined in the Presidents Forest Plan.

Recommendations:
1. Develop Allotment Management Analysis and complete NEPA process for all permittees.
2. Survey allotments to determine if they meet current management objectives. Adjust allotment management as needed to meet compliance. Exclude or rotate cattle from areas where resource degradation is a concern.
3. Do not renew or issue new permits without completing NEPA and preparing up to date management plans.

Data Gaps: The anticipated reduction in upland forage opportunities (harvest units) will affect livestock use patterns in the watershed and is expected to concentrate them in riparian areas and openings such as permanent meadows and road corridors. We do not know how this will affect sensitive plants, such as *Poa laxiflora*, since this species can tolerate a certain amount of disturbance. Price fluctuations of livestock may determine the future trends and the need to use public lands for grazing in this watershed.

Monitoring Needs: Determine the shift in livestock use patterns and potential conflicts with riparian restoration and need to meet aquatic conservation strategy objectives. Monitor known *Poa laxiflora* populations to determine effects of livestock grazing on this species.

Aquatic Domain

A recommended strategy for moving aquatic habitat toward a reference condition must consider the diverse ownership in the Big Elk watershed and potentially diverging land management objectives.

Water Quality

Management Objective: Enhancing the recovery of the stream temperature regime is a watershed-wide priority. Rapidly restore canopy closure to greater than 80% on 3rd and 4th order Big Elk Creek tributaries to move summer low flow stream temperatures in upper Big Elk watershed within reference range of 10-15 C (maximum temps should not exceed 17.8 C) (See Park, 1994; Timber-Fish-Wildlife, 1990). This objective meets Aquatic Conservation Strategy Objective 4 to maintain and restore water quality necessary to support healthy aquatic ecosystems.

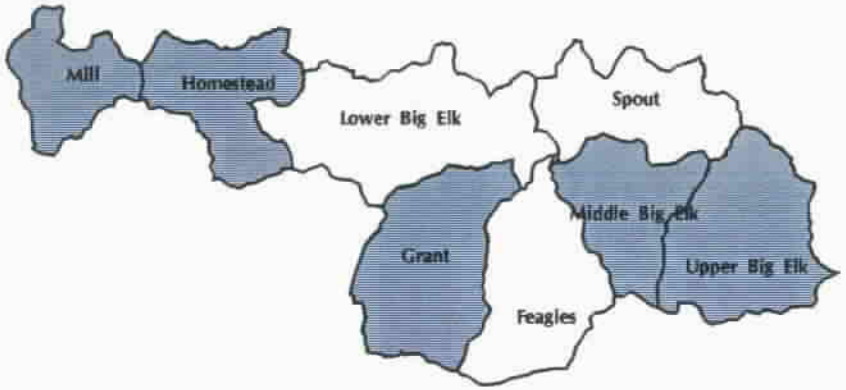
Ecosystem Processes and Functions: Stream temperatures in the Big Elk watershed do not match the reference condition and are far outside the reference condition for many streams. High stream temperatures in the Big Elk watershed result from the interaction of low stream flows, warm summer air temperatures and poor canopy closure. Alterations in riparian vegetation from agriculture and timber harvest activities and historic small-scale wildfires have maintained an open stream canopy throughout the watershed. Sustained stream temperatures above the reference condition decrease summer rearing habitat quality and reduce growth and vigor in salmonid species and macroinvertebrates (Meehan, 1991). In addition, high stream temperatures are a barrier for salmon and trout movement during summer flows.

Recommendations:

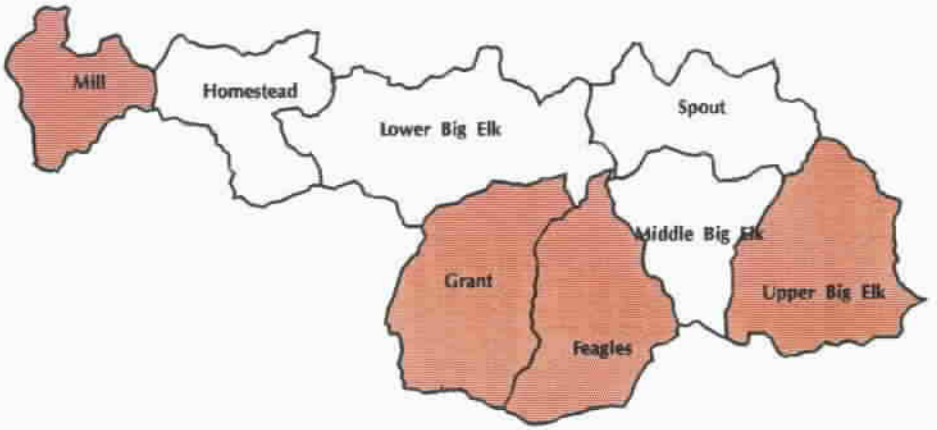
1. Plant hardwoods and conifers on Siuslaw National Forest land riparian areas. Base silvicultural prescriptions on riparian vegetation reference conditions for channel types and temperature modeling from monitoring data. Potential streams include upper Grant Creek, Bull Creek, Cougar Creek, and Beaver Dam Creek.

Big Elk Analysis Area
Priority Areas

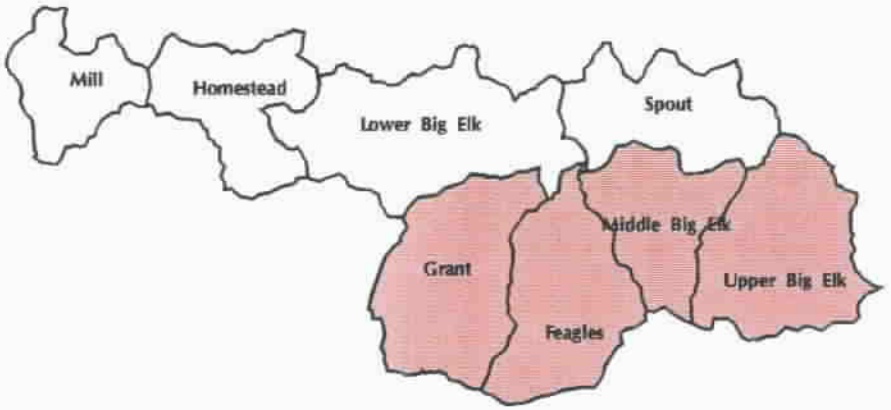
Refugia for Late Successional aquatic and terrestrial species



Road closures and restoration



Cooperation with land owners in restoration projects and connectivity for Late Successional habitat



August 15, 1995

Figure 37.

2. Initiate partnerships with Big Elk residents and other agencies to develop restoration programs on private lands that meet canopy closure objectives and landowner goals. Rapid canopy closure is objective. Potential streams are lower Grant, Feagles, Spout, Big Elk Creek reach 5 and 7, and Wolf Creek.

Data Gaps: Big Elk watershed temperature regime. Big Elk Creek low flow regime. Riparian silviculture prescriptions. Habitat and water quality conditions for northwestern sub-watersheds (Bear, Beaver, Deer, and Wolf Creeks).

Monitoring Needs: Monitor stream temperatures in basin to determine thermal loading sites and potential recovery sites. Monitor low stream flows by setting up a staff gauge on Big Elk Creek. Perform spot checks of other water quality elements such as nutrients and dissolved oxygen. Project implementation and effectiveness monitoring.

Aquatic Species Viability

Substrate.

Management Objective: Enhance the recovery of streambed sand and silt levels to within Oregon Coast Range reference conditions (10-30% fine sediments). This objective meets Aquatic Conservation Strategy Objectives 5 to restore the reference sediment regime and Objective 3 to restore the physical integrity of streambanks and stream bottoms.

Ecosystem Processes and Functions: Levels of fine sediments in the Big Elk watershed are higher than reference conditions. Sediment routing into watershed streams has increased above reference condition due to watershed-wide human activities. Bank stability is also outside of the reference condition supplying fine sediments into the system. The large amount of fine sediment in the watershed negatively impacts winter substrate used as refugia by steelhead trout, dace, and sculpins. Negative impacts from fines in spawning gravel are well documented and probably affect Big Elk fish stocks. Lower Grant Creek is an important Chinook Spawning area. East Fork Mill and the second reach of Savage Creek are important coho spawning areas. Lower Mill is a critical for chum salmon spawning.

The Mill Creek Reservoir dam has interrupted sediment routing through the Mill Creek watershed. Bedrock dominance below the dam probably results from the loss of upstream sediment supply. The reservoir also affects timing and magnitude of peak winter flows limiting the flushing of fine sediments in lower Mill Creek

Recommendations:

1. Decommission unnecessary roads. At a minimum, reduce roads in subwatersheds with current densities greater than 2.5 miles per mile. Remove culverts from closed roads and fix identified road problems. High risk soil sub-watersheds are a priority.

2. Identify unstable stream bank areas on National Forest Lands. Restore banks to reference conditions (80% of streambanks are stable). Combine with other management objectives if applicable.
3. Initiate partnerships with Big Elk residents and other agencies, such as DEQ or Soil Conservation Service, to stabilize stream banks on privately owned lands. A high priority is East Fork Mill Creek which is adjacent to a Key Watershed. Feagles Creek is another degraded area (for example, willow planting in reaches 3 and 4).
4. Culverts in the Upper Big Elk sub-watershed are old and should be upgraded to meet 100-year storm events. Assess Feagles, Grant, and Savage Creeks for inadequately sized culverts.
5. Review impacts from cattle grazing in Cougar Creek (unstable streambanks) and mitigate.
6. Initiate partnerships with county, state, and industrial timber land road maintenance crews to implement Best Management Practices for road maintenance activities.

Data Gaps: Validation of reference condition for amount of fine sediment (see Adams and Beschta, 1980). Trend of spawning gravels in lower Mill Creek. Factors impacting pool frequencies below reference conditions in Mill and East Fork Mill Creeks. Habitat and water quality conditions for northwestern sub-watersheds (Bear, Beaver, Deer, and Wolf Creeks). Lack of macroinvertebrate information.

Monitoring Needs: Monitor abundance and quality of spawning gravels in Reach 1 and 2 of Mill Creek. Monitor Reach 2 of Savage Creek (cross-sections) for aggradation impacts. Project implementation and effectiveness monitoring. Monitor macroinvertebrate populations.

Riparian Habitat

Management Objective: Enhance recovery of riparian zone conifers for long-term recruitment of large woody debris in stream channels and floodplains. See Step 3 for reference conditions. This management objective meets Aquatic Conservation Strategy Objective 8 to restore diversity of plant communities in riparian areas. This management objective is related to the substrate and the water quality objectives.

Ecosystem Processes and Functions: Large components of non-forest and hardwood dominated riparian zone is a result of agriculture and timber harvest. Most wide valley bottom areas were converted to grazing and crop lands late in the 19th century. Recruitment potential for conifer LWD is also low in many stream reaches due to valley bottom roads. Over 45 miles of stream channel has a parallel road within the riparian zone (See Big Elk IRA for road maps) and many of these roads are main travel routes. Riparian habitat influences most aquatic processes, regulates water quality, and provides habitat for many terrestrial organisms (Gregory *et al*, 1991). Recovery of aquatic habitats usually lags behind recovery of riparian and terrestrial systems.

Recommendations:
1. Initiate partnership with City of Toledo, other agencies, and industrial timberland owners to plant conifers in East Fork Mill Creek riparian areas (reaches 1-3).

2. Initiate partnership with private land owners and other agencies to plant conifers in Feagles Creek (reaches 1 and 3) and Big Elk Creek (reach 6) riparian areas.
3. Conversion of Cougar Creek and Rail Creek hardwood areas to conifer stands.
4. Incorporate these objectives into thinning of small pole and pole stands in the Big Elk watershed.

Data Gaps: Factors impacting pool frequencies below reference conditions in Mill and East Fork Mill Creeks. Riparian silviculture prescriptions. Habitat and water quality conditions for northwestern sub-watersheds (Bear, Beaver, Deer, and Wolf Creeks).

Monitoring Needs: Monitor planting survival and growth. Project implementation and effectiveness monitoring.

Large Woody Debris

Management Objective: Enhance recovery of large woody debris reference levels in streams selected as 6th field refugia. This management objective meets Aquatic Conservation Strategy Objectives 1 and 9.

Ecosystem Processes and Functions: LWD levels are far below the reference condition for many streams in the Big Elk watershed. Channel clearing and loss of LWD recruitment sources in riparian zones have created the current condition. Logs were rafted down Big Elk Creek between the 1890's to 1940's (Farnell, 1981). Early logging in the Big Elk was probably centered around valley bottoms and lower hillslopes. In the Big Elk watershed low levels of LWD limit storage (long-term or temporary) of sediments, especially in Big Elk Creek, which affects spawning habitat and macroinvertebrate populations. Low levels also reduce pool scour which affects the frequency and quality of summer and winter rearing habitat in 3-4th order streams, and minimize interaction with floodplains in unconfined and moderately confined channels resulting in less secondary channel habitats.

Recommendations:
1. Initiate partnership demonstration project in Big Elk Creek reach 6 adjacent to Big Elk campground on Siuslaw National Forest and Bureau of Land Management lands. Reintroduce complexes of large logs and smaller woody debris into stream channel and monitor utilization by salmonid species, especially cutthroat, routing of sediments, and changes in macroinvertebrate assemblages.
2. Reintroduce large logs in Cougar Creek and Bull Creeks to improve summer and winter rearing habitat. Addition of large logs (whole trees) to Savage Creek reach 2 may improve overwintering habitat in this key reach.
3. Initiate partnerships with landowners and other agencies to re-introduce large logs into other Big Elk tributaries, such as Deer Creek, to improve rearing habitat for coho salmon.

Data Gaps: Habitat and water quality conditions for northwestern sub-watersheds (Bear, Beaver, Deer, and Wolf Creeks). Macroinvertebrate information. Fine sediment movement in Bull Creek and Savage Creek.

Monitoring Needs: Project implementation and effectiveness monitoring. Channel morphology. Level III monitoring surveys. Macroinvertebrate monitoring.

Aquatic Habitats

Management Objective: Increase amount of winter rearing habitat in the Big Elk watershed through introductions of transplanted beavers.

Ecosystem Processes and Functions: Quiet-water winter rearing habitat is dependent on beaver populations and channel morphology in the Big Elk watershed. Habitat quality is dependent on complex hiding cover, usually large woody debris, and inversely related to deposition of fine sediments affecting pool depth. Little information is available on the longevity of beaver ponds in the Big Elk watershed. Beaver ponds in Cougar Creek and Savage Creek collapsed during a set of floods (5-10 year events) significantly reducing the amount of winter habitat in the watershed. Important winter rearing areas exist in Deer Creek, Bear Creek, Savage Creek reach 2, lower Cougar Creek, and Bull Creek.

Recommendations:
1. Identify potential release sites for beaver in the basin and appropriate population levels. Release transplanted beavers into habitats.
2. Perform a complete literature review. Identify important data gaps.

Data Gaps: Criteria for adequate release sites. Population estimates.

Monitoring Needs: Consider implementing study with transplant releases to address data gaps. Possible topics include impacts to beaver from commercial and pre-commercial thinning; riparian vegetation-beaver interactions, and effects of LWD on beaver dam stability.

Connectivity

Management Objective: Restore connectivity in stream systems.

Recommendations:
1. Review and replace culverts impassable to fish on Beaver Dam Creek and Grant Creek.
2. Monitor production from upper Mill Creek.

Data Gaps: Condition of suspected culverts. Location of culverts in unsurveyed streams. Impacts of the Mill Creek dam on outsmolt migration.

Monitoring Needs: Monitor channel morphology changes. Project implementation and effectiveness monitoring.

Hatchery Interactions

Management Objective: Maintain wild coho and steelhead fish stocks in Big Elk watershed.

Ecosystem Processes and Functions: Wild coho salmon stocks are very depressed. Past hatchery releases of coho into Yaquina Bay from the private OreAqua facility resulted in extensive straying of coho adults into adjacent basins including Big Elk Creek and Mill Creek. Reactivation of the facility and new releases of hatchery fish may have adverse effects on these wild coho stocks.

Recommendations:
1. Work cooperatively with ODFW to monitor straying.

Data Gaps: Distribution and abundance of coho in the watershed. Key spawning and rearing habitats for coho.

Monitoring Needs: Monitoring of spawning. Fish sampling in the Big Elk watershed to determine distribution and abundance of coho populations.

Terrestrial Domain

Improving the terrestrial and riparian habitat conditions within the Big Elk landscape is expected to be a slow process and probably will never reach the pre-settlement or reference conditions. Management activities for the majority of the Big Elk analysis area must meet LSR and Aquatic Conservation Strategy Objectives, as well as other limitations outlined in the Northwest Forest Plan. In addition, areas which are currently designated as Late Successional Reserve in the Northwest Forest Plan are also designated Critical Habitat for the spotted owl (USFWS Recovery Plan, 1992) and the marbled murrelet (USFWS Draft Recovery Plan, 1995). As such, management activities within the LSR must also maintain or enhance the elements of current or near-future habitat.

Protection and Restoration of Mature Forests and Connectivity of Late-Successional Habitat.

Management Objective: The primary purpose for the treatment of managed stands within the Late-Successional and Riparian Reserves should be to accelerate the development of late-successional stand characteristics and to enhance the connectivity of this habitat type across the landscape. Treatment prescriptions should not focus on the enhancement of one stand characteristic at the expense of others, such as increasing diameter growth or development of an understory without leaving adequate levels of snags, logs, and defective trees. Since this watershed is currently at threshold levels for mature conifer and dispersal habitat, a conservative

approach to stand management may be more appropriate. Only those stands which may benefit from treatments, based on stand exams and field observations, should be considered (see Figure 38 for map of plantations by age class).

Recommendations:

1. Treatment of plantations should focus on improving connectivity within a corridor starting in Homestead Creek and moving in a broad band across the southern half of the analysis area towards Upper Big Elk and Marys Peak.
2. Silvicultural prescriptions should focus on maintaining dispersal habitat through the landscape in the short term, as this is currently a limiting factor. First entry treatments should favor increasing diameter growth over the development of an understory. Creating openings is not considered appropriate in this landscape at this time. Do not thin plantations below 40-50% crown closure. This limitation should be applied to the entire plantation, including portions in areas designated as matrix. Consider underplanting thinnings with shade-tolerant trees, such as western hemlock and redcedar. Options for other stand treatment regimes may be considered in the future as the condition of dispersal habitat improves.
3. Treatment of plantations in areas where road closures are a high priority, such as Grant and Feagles Creeks, may be single entry in order to close roads as needed, while prescriptions in other areas, such as upper and middle Big Elk, may be more conducive to multiple entry options.
4. Treatments of plantations in Grant and Savage Creeks may be different than in upper and middle Big Elk, Spout or Homestead Creeks, due to the fire history and hardwood components in the latter drainages.
5. Thinning prescriptions should maintain a range of diameter classes, as well as clumps of unthinned areas, within the stands through time. This may be achieved using basal area thinning techniques and random spacing, rather than thinning from above or below.
6. Silvicultural treatment of managed stands should be coordinated with the BLM to assure consistency in stand management within the LSR and across ownerships
7. Stand characteristics which provide or may provide nesting, roosting, foraging or dispersal habitat in the future should be maintained or enhanced. These include the development of:

- Large snags and logs (4-10 snags and 10-30 logs > 20" dbh per acre at age 200)
- Trees with deformities, such as broken or multiple tops and large limbs
- Natural levels of disease within the stand
- Multi-layered canopy with species diversity and uneven distribution of dominant, codominant and understory trees (15-25/ac or approx. 1/3 of the total trees per acre at age 150)
- Hardwoods maintained as a component of the stand
- Scattered small openings (<1 ac in size) and clumps of close-growing trees
- Protect mosses, lichens, fungi, and other non-vascular plants within the stands

Data Gaps/Monitoring: Although we have over 30 years of information on the effects of silvicultural treatments of plantations to enhance stand growth and understory development, we have little or no information on using this tool to develop late-successional stand characteristics.

Big Elk Analysis Area
Plantations by year of origin

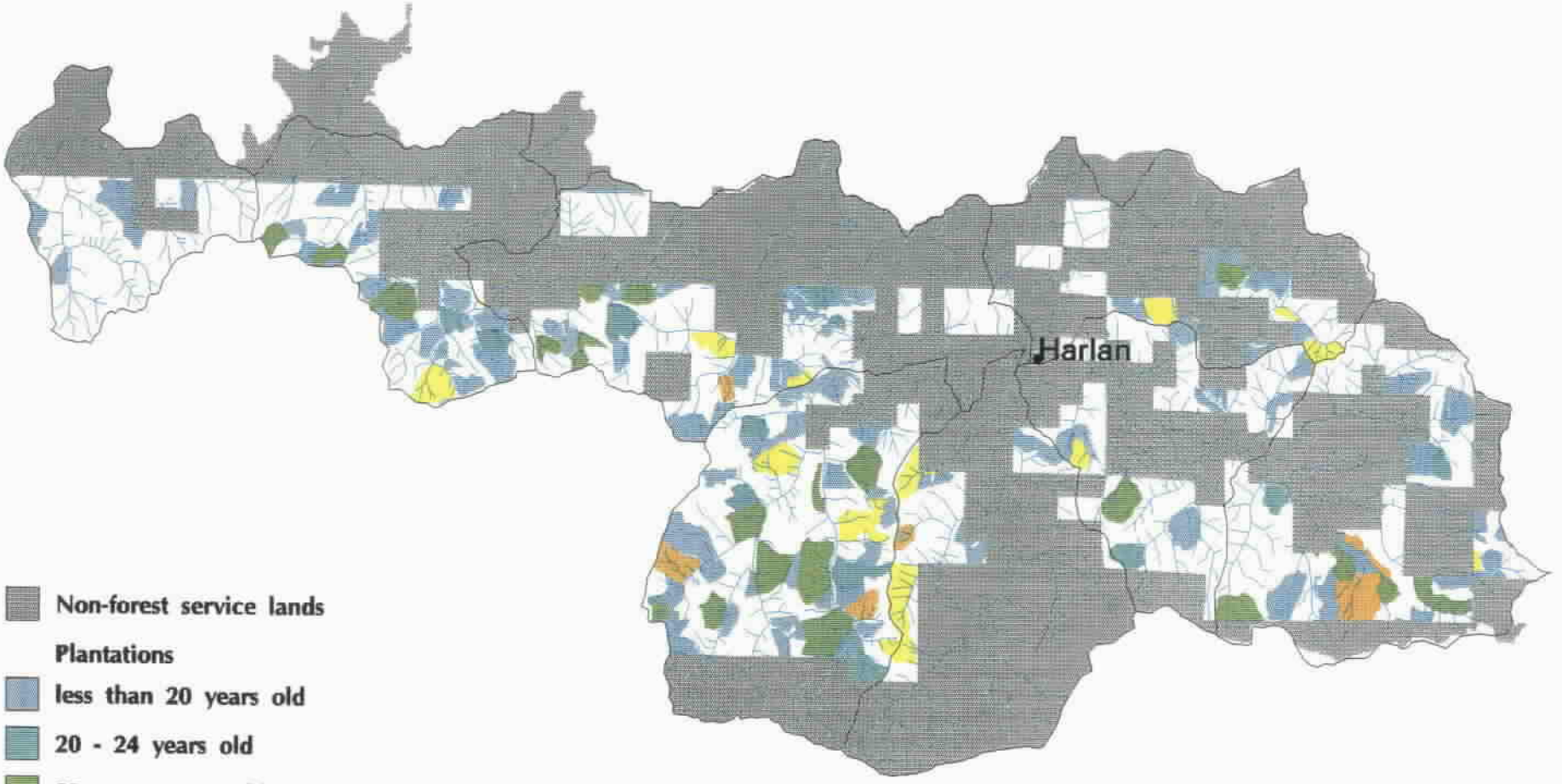


Figure 38.

Potential Conflicts With Forest Plan Designations:

Several areas currently designated as matrix and Late Successional Reserve appear to be in direct conflict with the issue of maintaining and enhancing the connectivity of mature forests in this watershed. Options for potential trades of areas designated as LSR and matrix were considered in the watershed analysis and the following recommendations are proposed.

Recommendations:
1. Consider trading three isolated squares of SNF parcels in the western portion of Spout Creek and one square in the eastern portion of middle Big Elk Creek (currently designated as LSR) for the large patch of matrix in Savage and upper Feagles Creek adjacent to the bald eagle management area (See Figure 34). Although one of the LSR trade parcels is currently located within 1.5 miles of the Chinquapin owl activity site, stands in this block are almost entirely hardwood-dominated and likely are not critical nesting, roosting or foraging habitat for the owls at this time. A similar trade was originally considered for the long isolated piece of SNF land in Homestead Cr., but was later dropped, due to the fact that the block was needed to protect numerous headwalls.
2. The current riparian reserve network would not be altered under the trade recommendations, as there is insufficient information regarding the effects of a proposed boundary adjustment on all of the species which this reserve is designated to protect. Although the riparian reserve network would remain in place under the trade proposal, this opportunity would free up areas currently tied up by LSR restrictions in lower priority watersheds for commodity production, and fish enhancement work, while securing areas in a high priority area for aquatic and terrestrial restoration and connectivity.

Maintaining Terrestrial Ecosystem Functions

Management Objectives: Other than improving the amount and distribution of mature forest stands, the natural levels of early seral and hardwood stands should be determined and maintained over the long-term. This system has been highly altered and is slowly recovering. The objective for this watershed is not to maintain the current levels of early seral and hardwoods, but to gradually transition the landscape towards the reference conditions within the framework of the key issues and current management direction. Increasing the levels of woody material on the landscape and controlling the spread of non-native plant and animal species should be a focus for restoration.

Recommendations:
1. Underplanting of shade-tolerant trees and shrubs should be a priority within precommercial and commercial thinnings, particularly in areas designated as LSR or Riparian reserves.
2. Tree topping of mature conifers may be used to improve the critically low levels of large woody material on the landscape. Since the amount of mature conifer trees is a limiting factor in this watershed, this activity should be conducted in such a manner that the tree is not killed and should be used with restriction. Blowdown trees should not be made available for firewood

cutting unless it has been determined that down woody material levels exceed those in mature and late-successional stands.
3. Short operator spur roads should be considered for closure to reduce disturbance to wildlife and to reduce the risk of road-related slope failures. Road closures should focus on reducing the risk of failure on unstable slopes (upper Grant Cr. and Feagles Cr.) and in subwatersheds with high road densities (See the road management table for more information).
4. Control the spread of non-native plants in openings such as meadows and along non-maintained roads. Meadow maintenance activities should focus on enhancing the biodiversity of these areas for a variety of wildlife species. Non-native plant species should not be used for meadow or road restoration. All meadow maintenance activities must meet the direction outlined in the aquatic conservation strategy and management of LSR and riparian reserves.

Data Gaps and Monitoring Needs: Since this watershed is in a transition to recovery, it is difficult to determine the rate at which the different seral types should be represented across the landscape while transitioning towards the reference conditions. In addition, information for many species is lacking (C-3 and sensitive species).

Limitations and Guidelines for Areas Currently Designated as Matrix

The following is a list of limitations and management considerations which apply to all federal lands within the Big Elk drainage, based on the watershed analysis and S&Gs outlined in the ROD:

1. All mature conifer stands on federal lands (BLM and SNF) within areas currently designated as matrix (including stands which are outside of Riparian Reserve boundaries), should be protected at this time. This 5th field watershed is considered to be at the 15% minimum level for late-successional forest habitat (see ROD, p. C-44). The release of the 318 sale program will further reduce this level. Harvest practices or research activities which affect mature conifer stands are considered to be inappropriate and outside of the current management direction at this time. Commercial thinning activities which were conducted in mature conifer stands in the '70's could be evaluated as to their effectiveness for future stand treatments.

The following lists some options which should be considered only if it has been determined that the use of mature conifer trees is necessary to improve other critical watershed conditions, such as the riparian condition or down woody material levels:

a. Consider taking mature conifer trees from areas outside of the analysis area first. If it has been determined that bringing logs in from outside of the analysis area for watershed restoration is not feasible, individual trees may be considered for removal if their removal does not diminish the overall function of the stand or increase the risk of blowdown.

b. Trees should be individually selected to assure that they do not currently serve as potential nesting or roosting trees for listed species. All remnant old growth trees should be left on the landscape.

c. Removal of individually selected trees should focus on stands which are not currently serving an important role for connectivity. Trees should be selected from small isolated patches along road corridors, the edges of stands and on ridgetops.

e. Mature conifer trees which are used to improve aquatic condition should contribute to the restoration of the riparian area as a whole and not be limited to use as fish structures alone. Placing whole trees such that they are partially in the stream and on the bank, rather than placing or anchoring cut lengths in the channel, would more closely reflect natural conditions.

2. A bald eagle management area is located in Grant Cr. within an area designated as matrix in the Northwest Forest Plan. Standard and guidelines for management area MA 4 (Siuslaw National Forest Land and Resource Management Plan) apply for this designation.

3. Retention levels of large snags and logs within planning areas should be set at levels which are higher than the minimums in order to improve the critical condition of large wood in this landscape. (See the S&Gs outlined on pages C-40 for the retention of snags and logs in matrix).

4. Restrict the use of fire as a tool for fuels treatment and vegetation control within the analysis area to allow soil conditions to recover from the repetitive fire history of the area. (See also ROD, page C-44)

Literature References

Adams, J.N. and R.L. Beschta. 1980. Gravel bed composition in Oregon coastal streams. Canadian Journal of Fisheries and Aquatic Sciences 37:1514-1521.

Applegarth, J.S. 1994. Special status of amphibians and reptiles of the Eugene District. Eugene District Bureau of Land Management, Eugene, Oregon. 52 pp.

Beier, P. and R.H. Barrett. 1987. Beaver habitat use and impact in Truckee River Basin, California. Journal of Wildlife Management 51(4):794-799.

Bilby, R.E. and J.W. Ward. 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society 118: 368-378.

Bureau of Land Management. 1993. Riparian Area Management: Process for assessing proper functioning condition. Bureau of Land Management Technical Reference 1737-9-1993, Denver, Colorado.

Bustard, D.R. and D.W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (Onchrhynchus kisutch) and steelhead trout (Salmo gairdneri). Journal of the Fisheries Research Board of Canada 32:667-680.

Cederholm, C.J., G. Grette, and T. Terich. 1984. The importance of organic debris in salmonid habitat within the stream and marine continuum. The Pacific Northwest Bioenergy Systems: Policies and Applications Conference, May 10, 1984, Portland, Oregon.

Chen, J., J.F. Franklin, and T.A. Spies. 1992. Vegetation Responses to Edge Environments in Old-Growth Douglas Fir Forests. Ecological Applications 2(4): 5167

Cronquist, M.J. and R.P. Brooks. 1991. Use of Avian and Mammalian Guilds as Indicators of Cumulative Impacts in Riparian-Wetland Areas. Environmental Management, Vol. 15 00: 701-714.

DEQ. 1988. Oregon Statewide Assessment of Non-point Sources of Water Pollution. Water Quality Division, Oregon Department of Environmental Quality, Portland, Oregon. 189 pp.

Grant, F. C. 1990. The Grants of Grant Valley, Frank C. Grant, 435 NW Merrie Dr. Corvallis, OR 97330.

Gregory, S.V., F.J. Swanson, W.A. McKee, and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. BioScience 41(8):540-553.

Huntington, C.W., W. Nehlsen, and J. Bowers. 1994. Healthy Native Stocks of Anadromous Salmonids in the Pacific Northwest and California. Oregon Trout Report, Portland, Oregon. 42 pp.

Leonard, W.P., H.A. Brown, L.L.C. Jones, and others. 1993. Amphibians of Washington and Oregon. Seattle Audubon Society, Seattle, WA. 168 pp.

Leidholt-Bruner, K, D.E. Hibbs, and W.C. McComb. 1992. Beaver dam locations and their effects on distribution and abundance of coho salmon fry in two coastal Oregon streams. Northwest Science 66(4): 218-223.

Madej, M.A. 1994. Changes in channel morphology following passage of a sediment wave. Session 161, Seattle, Washington.

Marshall, D.B., M. Chilcote, and H. Weeks. 1992. Sensitive Vertebrates of Oregon. Oregon Department of Fish and Wildlife, Portland, Oregon.

McGarigal, K. 1993. Relationships Between Landscape Structure and Avian Abundance Patterns in the Oregon Coast Range. Research Thesis for degree of Doctor of Philosophy, Oregon State University, Corvallis, Oregon.

McGarigal, K. and W.C. McComb. 1993. Streamside versus upslope associations of small mammals and amphibians. Coastal Oregon Productivity Enhancement Program (COPE) Report 6(1): 7-9.

Meehan, W.R. ed. 1991. Influences of forest and rangeland management on salmonid fishes and their habitat. American Fisheries Society Special Publication 19.

Montgomery, D.R. and J.M. Buffington. 1993. Channel classification, prediction of channel response, and assessment of channel condition. Report TFW-SH10-93-002 for the SHAWM committee of the Washington State Timber/Fish/Wildlife Agreement, Olympia, Washington. 84 pp.

Nakamura, F. and F.J. Swanson. 1993. Effects of coarse woody debris on morphology and sediment storage of a mountain stream system in western Oregon. Earth Surface Processes and Landforms 18:43-61.

Nehlsen, W., J.E. Williams, and J.A. Lichatowich. 1991. Pacific Salmon at the Crossroads: Stocks at Risk from California, Oregon, Idaho, and Washington. Fisheries 16(2):4-21.

Nickelson, T.E., J.W. Nicholas, A.M. Mcgie, and others. 1992. Status of Anadromous Salmonids in Oregon Coastal Basins. Research and Development Section, Oregon Department of Fish and Wildlife, Corvallis, Oregon. 83 pp.

ODFW. 1991. Yaquina River Basin Fish Management Plan. Lincoln District, Oregon Department of Fish and Wildlife, Newport, Oregon. 121 pp.

ODFW. 1995. Lincoln District Fish Management Review: Stock Status. Lincoln District, Oregon Department of Fish and Wildlife, Newport, Oregon. 43 pp.

Pearcy, W.G. 1992. Ocean Ecology of North Pacific Salmonids. University of Washington Press, Seattle, Washington.

Pearsons, T.N., H.W. Li, and G.A. Lamberti. 1992. Influence of habitat complexity on resistance to flooding and resilience of stream fish assemblages. Transactions of the American Fisheries Society 121:427-436.

Perkins, S.J. 1994. Effects of landslide-supplied sediment on channel morphology of a small salmon-bearing stream in southwestern Washington. Session 161, , Seattle, Washington.

Poff, N.L and J.V. Ward. 1990. Physical habitat template of lotic systems: Recovery in the context of historical pattern of spatiotemporal heterogeneity. Environmental Management 14(5):629-645.

Reeves, G.H., F.H. Everest, and T.E. Nickleson. 1989. Identification of physical habitats limiting the production of coho salmon in western Oregon and Washington. General Technical Report PNW-GTR-245, USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.

Rheas, Susan. 1994.

Ries, R. 1995. Siuslaw National Forest, Landscape Architect.

Schwartz, J.S. 1991. Influence of geomorphology and land use on distribution and abundance of salmonids in a coastal Oregon basin. Masters Thesis, Oregon State University, Corvallis, Oregon. 207pp.

Sedell, J.R., G.H. Reeves, F.R. Hauer and others. 1990. Role of refugia in recovery from disturbances: Modern fragmented and disconnected river systems. Environmental Management 14(5):711-724.

Siuslaw National Forest. 1993. Watershed protection and restoration in the mid-Oregon coast range. Pacific Northwest Region USDA Forest Service, Siuslaw National Forest, Corvallis, Oregon.

Siuslaw National Forest. 1993a. Big Elk Creek Integrated Resource Analysis. Siuslaw National Forest, Alsea Ranger District, Alsea, Oregon.

Spies, T. A. and J.F. Franklin. 1988. Coarse Woody Debris in Douglas-Fir Forests of Western Oregon and Washington. Ecology 69(6):1689-1702.

Spies, T.A., W.J. Ripple, and G.A. Bradshaw. 1994. Dynamics and Pattern of a Managed Coniferous Forest Landscape in Oregon. Ecological Applications 4(3): 555-568.

Stack, W.R. and R.L. Beschta. 1989. Factors influencing pool morphology in Oregon Coastal Streams. Pages 401-411 in Proceedings of the Symposium on Headwaters Hydrology, Woessner, W.W. and D.F. Potts eds. American Water Resources Association, Bethesda, Maryland.

Suzuki, N. 1992. Habitat Classification and characteristics of small mammal and amphibian communities in beaver-pond habitats of the Oregon Coast Range. Masters Thesis, Oregon State University, Corvallis, Oregon.

Swanson, F. J., J.F. Franklin, and J.R. Sedell. 1990. Landscape Patterns, Disturbance, and Management in the Pacific Northwest, USA.

Trotter, P.C. 1989. Coastal cutthroat trout: A life history compendium. Transactions of the American Fisheries Society 118:463-473.

USDA. 1979. Memorandum for the proposed Grant Creek '81 Timber Sale, November 20, 1979. Siuslaw National Forest, Alsea Ranger District, Alsea, Oregon.

United States Department of Agriculture, Forest Service. Pacific Northwest Research Station, July 1986. Interim Definitions for Old-Growth Douglas-Fir and Mixed-Conifer Forests in the Pacific Northwest and California; Research Note, PNW-447.

USDA. 1994. Final Supplemental Environmental Impact Statement on Management of Habitat and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Washington D.C.

USDA Forest Service, USDI Bureau of Land Management 1994. Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.

USDA. 1994b. North Fork Siuslaw Watershed Analysis. Pacific Northwest Region USDA Forest Service, Siuslaw National Forest, Corvallis, Oregon.

USDA, USDI, and others. 1994. Nestucca Watershed Analysis. Pacific Northwest Region USDA Forest Service, Siuslaw National Forest, Corvallis, Oregon.

USDA and USDI. 1994. Environmental assessment for the implementation of interim strategies for managing anadromous fish-producing watersheds in eastern Oregon and Washington,

Idaho, and portions of California. United States Department of Agriculture, United States Department of the Interior, Washington D.C.

USDA. 1995. Draft ecosystem analysis at the watershed scale, version 2.1. United States Department of Agriculture, Pacific Northwest Region, Portland, Oregon. 188 pp.

USDA Forest Service, Pacific Northwest Region. 1995. Interim Late-Successional Reserve Assessment, LSR #RO268. Siuslaw National Forest.

USDA. 1995. Cummins/Tenmile Watershed Analysis. USDA Forest Service, Pacific Northwest Region, Siuslaw National Forest, Corvallis, Oregon.

Wallin, D.O., F.J. Swanson, and B. Marks. 1994. Landscape Pattern Response to Changes in Pattern Generation Rules: Land-Use Legacies in Forestry. Ecological Applications, 4(3): 569-580.

Walls, S.C., A.R. Blaustein, and J.J. Beatty. 1992. Amphibian Biodiversity of the Pacific Northwest with Special Reference to Old-Growth Stands. The Northwest Environmental Journal 8:53-69.

Washington Forest Practices Board. 1993. Standard methodology for conducting watershed analysis, version 2. Washington Forest Practices Board, Olympia, Washington.

Williams, J.E. and R.J. Neves. 1992. Introducing the Elements of Biological Diversity in the Aquatic Environment. Pages 343-354 in Biological Diversity in Aquatic Management. Transactions of the 57th North American Wildlife and Natural Resources Conference, Special Session 6: 343-432.

Wydoski, R.S. and R.R. Whitney. 1979. Inland Fishes of Washington. University of Washington Press, Seattle, Washington. 220 pp.

Appendix A - Stream Data

Table 1: Continuous Stream Temperature Monitoring Data

Stream Name	Date	#days > 15 C	Max Temp (C)	Total Days	Period of Max. Temp
Big Elk	7/29 to 10/5/94	58	20	68	7/29 to 9/28
Feagles	7/29 to 10/5/94	58	19	68	7/29 to 9/27
Feagles	7/5 to 8/29/89	42	18	86	7/5 to 8/29
Savage	7/12 to 10/11/93	45	17.7	92	7/26 to 10/11
Savage	7/13 to 10/26/92	31	17.3	106	7/13 to 8/27
Savage	8/2 to 9/10/91	9	16	40	8/8 to 8/22
Rail	7/11 to 9/8/90	55	20	68	7/11 to 9/13
Beaver Dam	7/20 to 8/31/89	26	20.5	42	8/3/ to 3/31
Grant	7/6/ to 9/24/89	58	19.5	80	7/6 to 9/24
Mill Creek mouth	7/8 to 10/6/94	67	20.8	90	7/8 to 10/1
Cougar Creek	7/19 to 10/19/89	78	22	82	7/19 to 10/8

Table 2: Temperature Data from Stream Surveys

Survey Date	Stream Name	Reach	Water Temp (C)	Air Temp (C)	Agency	Comments
7/13-23/92	Big Elk	1	19.5-19.5		ODFW	
7/13-23/92	Big Elk	2	17.5-17.5		ODFW	
7/13-23/92	Big Elk	3	17.5-18.5		ODFW	
7/13-23/92	Big Elk	4	18.5-20.0		ODFW	
7/13-23/92	Big Elk	5	18.0-19.5		ODFW	
7/13-23/92	Big Elk	6	15.5-18.0		ODFW	
7/30 to 8/6/92	Spout	1	14.5-18.5		ODFW	
7/30 to 8/6/92	Spout	2	17/0-17.0		ODFW	
7/30 to 8/6/92	Spout	3	15.0-16.0		ODFW	
7/30 to 8/6/92	Spout	4	15.5-15.5		ODFW	
7/30 to 8/6/92	Spout	5	15.0-19.0		ODFW	
7/30 to 8/6/92	Spout	6	15.5-17.0		ODFW	
8/17-18/92	Mill	1	15.0-16.5		ODFW	below reservoir
8/17-18/92	Mill	2	16.0-17.0		ODFW	below reservoir
8/17-18/92	Mill	3	16.0-17.0		ODFW	below reservoir
8/17-18/92	Mill	4	14.0-14.0		ODFW	above reservoir
8/8/92	E.Fk.Mill	1	14.0-14.0		ODFW	above reservoir
8/8/92	E.Fk.Mill	2	14.0-14.0		ODFW	above reservoir
8/8/92	E.Fk.Mill	3	13.5-14.0		ODFW	above reservoir
8/8/92	E.Fk.Mill	4	14.0-14.0		ODFW	above reservoir
7/26/94	Wolf	WLF-1	12.0		ODFW	
7/25/94	Wolf	WLF-2	18.0		ODFW	
7/25/94	Wolf, Trib A	WLF-3	13.0		ODFW	
7/25/94	Wolf, Trib A	WLF-4	15.0		ODFW	
7/25/94	Wolf, Trib A	WLF-5	14.0		ODFW	
7/26/94	Wolf, Trib B	WLF-6	13.0		ODFW	
7/26/94	Wolf, Trib B	WLF-7	16.0		ODFW	

Table 2: Temperature Data from Stream Surveys (cont.).

Survey Date	Stream Name	Reach	Water Temp (C)	Air Temp (C)	Agency	Comments
7/28/81, 1600	Bull		16	21	FS	
7/28/81, 1700	Bull		16	19	FS	
8/2/78, 1100	Jackass		16.9	14.4	FS	
9/1/78, 1150	Savage		14.4	20	FS	
9/20/78, 1430	Upper Grant		12.7	21.1	FS	
Historic Data						
7/24/53, 1145	Bull (mouth)		13.3 (56F)	17.2 (63F)	ODFW	partly cloudy
7/24/53, 1225	Bull above trib C		11.6 (53F)	15 (59F)	ODFW	partly cloudy
7/23/53, 1345	Beaver	1/4 mi above mouth	18.3(65F)	20 (68F)	ODFW	sunny
7/23/53, 1500	Beaver	Trib b, at mouth	13.3 (56F)	21.1 (70F)	ODFW	sunny
7/23/53, 1553	Beaver Cr	Trib d, at mouth	11.6 (53F)	17.7 (64F)	ODFW	sunny
7/23/53, 1555	Beaver Cr	50' above trib d	13.8 (57F)	17.7 (64F)	ODFW	sunny
7/24/53, 1210	Deer Cr	300' above mouth	13.3 (56F)	20 (68F)	ODFW	sunny, stream well shaded
7/24/53, 1220	Deer Cr	mouth of trib b	13.3 (56F)	20 (68F)	ODFW	sunny
7/24/53, 1125	Deer Cr	mouth of trib c	12.2 (54F)	21.1 (70F)	ODFW	sunny
7/24/53, 1020	Deer Cr	mouth of trib d	11.1 (52F)	20 (68F)	ODFW	sunny

Appendix B - Road Summary

Subwatershed Priority Rationale														
Mill Creek. LSR/Key Watershed/Refugia, Road miles - 4.5/Road density-1.7 miles/sq.mile														
Road #	Opt. 9	Access young stands (PCT)	Thin first half decade	Thin last half decade	Multiple stream xings, hi risk soils	Side-cast	Access private land	Wildlife closure	Dispersed recreation site	Road length (miles)	Priority for stabiliza-tion	Maintenance Status	Comments
50		yes	no	no	no	?	yes			1.8			
50-216	LSR	yes	no	no	no		no			0.1			95 Engineering contract
5083		yes	no	yes	no	?	yes			3.4		Has waterbars	
5083-228		yes	no	yes	no	?	yes			1.3		Has waterbars	
5083-232		yes	no	yes	no	?	no			0.6		Has waterbars	
5083-224		yes	yes	yes	no		yes			0.6		Has waterbars	
Subwatershed Priority Rationale													
Grant Creek. Matrix/LSR, Road miles - 9.2/Road density-3.4 miles/sq.mile													
3105-11	matrix	yes		yes		yes		recmnd	yes	1.4		needs waterbars	Reviewed for ATM, 1992
3105-12	matrix		yes							0.5		none scheduled	
3105-13	matrix	yes	yes			yes				0.6			24" culvert and stream xing, problems identified
3109-16	LSR			yes					yes			needs waterbars	
3109-13	LSR			yes	yes	yes				0.8	High		
3109-112	matrix				yes	yes					High	Fills and culverts removed at beginning of rd 1995	Abandoned, large landslide blocks access
3119-116	LSR	yes		yes	yes					1.7	High	needs waterbars	2 major stream xings, no sidecast.
3119-117	LSR	yes				yes				0.5	High	needs waterbars	95 Engineering Contract
3119-113	LSR (bndry)	yes		yes						1		needs waterbars	95 Engineering contract
3119-114	matrix			yes						0.1		needs waterbars	95 Engineering contract
3119-129	matrix	yes	yes							0.3		needs waterbars	95 Engineering contract
3119-128	matrix	yes		yes	no		no	no		0.7		needs waterbars	95 Engineering contract
3119-127	matrix	yes			no		no			0.1		needs waterbars	95 Engineering contract
3119-9027	Grant Cr.	yes										?	
3100-134	matrix									0.5			
3100-124	matrix	yes								1		needs waterbars	95 Engineering contract
3119-121	LSR		no	yes						0.4		needs waterbars	95 Engineering contract
3119-111	LSR		yes							0.5		needs waterbars	conduct stand mgt./close road, 95 Eng. cntrct.
3119-130	LSR	yes	yes	no	no	no	no	no	no	0.3		needs waterbars	conduct stand mgt./close road, 95 Eng. cntrct.
3119-131	LSR	yes	no	yes	no	no	no	no	yes	0.1		needs waterbars	conduct stand mgt /close road, 95 Eng. cntrct.

Subwatershed Priority Rationale													
Spout. LSR/Restoration, Road miles - 6.8, Road density-3 miles/sq.mile													
3020	LSR	yes										needs waterbars	not on 95 Eng. contract
Subwatershed Priority Rationale													
Feagles Creek. LSR, Road miles - 8.4, Road density-2.7 miles/sq.mile													
6200-111	LSR	yes		yes	yes				1	High	needs waterbars	95 Engineering contract	
6200-112	LSR	?		no		no			0.4	High	needs waterbars	95 Engineering contract	
6200-115	LSR	?							0.3		needs waterbars	95 Engineering contract	
Subwatershed Priority Rationale													
Middle Big Elk. LSR, Road miles - 6, Road density-2.5 miles/sq.mile													
3015-112	LSR	yes	yes	yes		no			1	Medium	waterbarred		
3015-106	LSR			yes						Medium			
3015-113	LSR	yes	yes	no		BLM?			0.3		needs waterbars		
3011-112	LSR	yes	yes		yes	no			2.2	Medium	waterbarred		
Subwatershed Priority Rationale													
Upper Big Elk. LSR, Road miles - 9.1, Road density-3.7 miles/sq.mile													
3000	LSR	yes		yes				yes	4.5			Several bad culverts need to be replaced	
3000-127	LSR	yes			yes				0.6	High	waterbarred	127, 126 and 128 have been reviewed for ATM,	
3000-126	LSR	yes			yes				1.2	High	waterbarred	need to pull culvert and fills if rd is closed	
3000-128	LSR	yes							0.2		waterbarred	need to pull culverts and fills if rd is closed	
3000-114	LSR	yes			yes				0.5	Medium	waterbarred	not done yet	
3012	LSR				yes	yes			2.2	High		Deep ruts, need resolve on ownership w/Lincoln	
3000-117	LSR	yes		yes		yes		yes	1.9	Medium	waterbarred	County ROW, op. spur needs waterbars and closure at end of 117	
301	LSR						gate		2.2			road is OK	
301 -113	LSR								1		waterbarred	Gated at junction with Road 30	
3015-114	LSR	yes							0.4		waterbarred		
3015-115	LSR	yes						yes	0.3		waterbarred		
3015	LSR	yes	yes	S 1/2	yes	yes			4	High		Road is OK	
3100-131	L.Big Elk										?		
3100-115	matrix	yes		yes					0.3	Medium			

Subwatershed Priority Rationale													
Upper Big Elk. LSR, Road miles - 9.1, Road density-3.7 miles/sq.mile													
3100-118	matrix	yes								0.3		needs waterbars	Close operator spurs/whole system
3100-111	matrix	yes		yes		Starker				0.6		needs waterbars	close operator spurs at end
m3100-133	matrix	???			yes	Starker				0.3	Medium	?	
3100-112	matrix	???								1.7		needs waterbars	95 Engineering contract
3100-132	matrix	yes								0.5		needs waterbars	recommend closure?/95 Eng contract
3122	matrix	yes		yes			gate			3.6	Medium	needs waterbars	Culverts, gated at junction with Rd 30, close op spurs, Thompson gate agreement
3122-111	matrix	yes						yes		0.4		needs waterbars	95 Engineering contract
3122-112	matrix	yes						yes		0.3		needs waterbars	95 Engineering contract
3122-114	matrix			yes				yes		0.3		needs waterbars	95 Engineering contract
3122-113	matrix			yes				yes				needs waterbars	95 Engineering contract
3100-140	Bound.LSR/matrix	yes								1.5		waterbarred	Culverts present, double tank-trapped, serious erosion problem on Co. Rd 609--jeep trail
Subwatershed Priority Rationale													
Homestead. LSR/Refugia, Road miles - 6.3, Road density-2.3 miles/sq.mile													
3100-130	LSR			yes								waterbarred	
3100-141	LSR	yes			yes					0.5	High	waterbarred	
3100-129	LSR	yes	yes	yes	yes					1.3	High	needs waterbars	Not on 95 Eng. contract
3100-122	LSR	yes								0.2		?	
3100-125	LSR	yes								0.2		no work needed	close op spur at end
3100-119	LSR			yes						0.7		needs waterbars	Not on 95 Eng. contract
3127	LSR/Key WS	yes								2.6		needs waterbars	95 Engineering contract
3127-111	LSR			yes					yes	0.3		needs waterbars	95 Engineering contract
3127-114	LSR	yes	yes		yes	yes				0.6	High	needs waterbars	95 Engineering contract
5083-116	LSR	yes					yes	yes		1.4			needs to be looked at--check with John Dillingham
5083-118	LSR	yes					yes	yes		0.5		?	

Appendix C - Glossary of Terms

Glossary of Terms

Most of the following terms are taken from the new Presidents Forest Plan (Supplemental Environmental Impact Statement on the Management on Habitat for Late-Successional and Old Growth Forest Related Species within the Range of the Northern Spotted Owl, Feb 1994), Forest Ecosystem Management: An Ecological, Economic, and Social Assessment, July 1993, and Forest Landscape Analysis and Design (Diaz and Apostel, 1992). These are abbreviated ROD, FEMAT and D&A respectively.

Aquatic Ecosystem - Any body of water, such as a stream, lake or estuary, and all organisms and nonliving components within it, functioning as a natural system. FEMAT

Age Class - A management term used to define the age of a stand of trees. FEMAT

Age Class Distribution - The area in each age class across a landscape, watershed, forest or other area of consideration. ROD

Alluvial - Originating through the transport by and deposition from running water. For instance, alluvial outwashes and fans are deposits of dirt and organic material which may have resulted from landslides during heavy rainfall or accumulated over time during a slower process of deposition. FEMAT

Anadromous Fish - Fish that are born and rear in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce. Salmon, steelhead, and lamprey are some examples. FEMAT

Associated Species - A species which is found to be numerically more abundant or limited to a particular seral type or successional stage for all or part of its life compared to other areas. FEMAT

At-Risk Fish Stocks - Stocks of anadromous or resident fish that have been identified by professional societies, management agencies, and in the scientific literature as being in need of specieal management consideration because of low or declining populations. FEMAT

Basal area - The area of the cross section of a tree stem including the bark, generally at 4.5 feet above the ground.

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.

Blowdown or Windthrow - A tree or trees which have been uprooted or broken off by the wind.

Canopy Closure - The degree to which the canopy (forest layers above one's head, usually trees) blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy as opening in the branches and crown must be accounted for. FEMAT

Cavity Nester - Wildlife species, most frequently birds, that require cavities (holes) in trees for nesting and reproduction. Primary cavity excavators refers to those species which actively create cavities (eg. woodpeckers), while secondary cavity utilizers refers to those species which use natural cavities or the holes created by primary excavators (examples include squirrels and birds such as chickadees, nuthatches or owls).

Channel Morphology - The shape of the stream channel. This includes floodplain, substrate, large wood, pools and riffles.

Climax - The stage in plant succession for a given site where the vegetation has reached a highly stable condition.

Commercial Thinning - The practice of cutting and removing trees of commercial value (saleable) within a stand so that the remaining trees will grow faster.

Congressionally Reserved Areas - Areas that require Congressional enactment for their establishment, such as National Parks, Wild and Scenic Rivers, National Recreation Areas, National Monuments, and Wilderness. FEMAT. These are also referred to as Congressional Reserves.

Connectivity - The spacial contiguity within a landscape. It is a measure of how easy or difficult it is for organisms to move through the landscape within one habitat type without crossing habitat barriers. The degree of connectivity within a particular landscape depends on the organisms being considered; e.g. species that require mature forest habitat corridors to travel or small species with limited mobility will experience connectivity in a given landscape differently from species that can travel across a variety of habitat types.

Cover - Vegetation used by wildlife for protection from predators, or to mitigate weather conditions, or to reproduce. May also refer to the protection of the soil and the shading or forage provided by herbs and forbs. FEMAT.vegetation.

Crown - The upper part of a tree that carries the main system of branches and foliage.

Cummulative Effects - Those effects on the environment that result from the incremental effects actions when added to the past, present and reasonably forseeable future actions regardless of what agency or person undertakes the action(s). Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. FEMAT

DBH - Diameter at breast height, the diameter of a tree 4.5 feet from the base.

Debris Flow - A rapid moving mass of rock, soil and mud down a slope, usually triggered by heavy rains which have saturated the ground past the point of slope stability.

Debris Torrent - Rapid movement of a large quantity of rock, soil and organic material (wood and vegetation) down a stream channel during storms or floods. This generally occcurs in smaller streams and results in scouring of the streambed. ROD

Decommission - To remove those elements of a road that reroute hillslope drainage and present slope stability hazards. FEMAT

Decomposition Class (Snags and Logs) - Generally, five distinct stages of decomposition are recognized for both logs and snags: Decay Class 1. sound logs or recently dead trees with branches and bark still intact; 2. sound logs or snags with peeling bark and most of the branches gone; 3. visible decay starting to set in; bark and branches are gone; conchs or fungy may begin to grow on the log or snag; 4. heavy decay setting in; logs begin to break appart and get punky; snags begin to break down from the top; 5. final stage of decay; logs "melting" into the ground; very punky and soft; snags have the characteristic reddish duff look and have broken down to the stage where they are short and falling appart.

Dispersal Habitat - Habitat that supports the life needs of an individual animal during dispersal (ie. when moving from one patch of optimal habitat to another). Generally satisfies the needs for foraging, roosting and protection from predators. FEMAT

Dissected - Cut by erosional processes into hills and valleys, or into flat interstream areas and valleys. FEMAT

Disturbance - A force that causes significant change in the structure and/or composition of landscape elements through natural events such as fire, flood, wind or mortality, or by human-caused events, such as timber harvest or road-buidling activities.

Drainage - An area (basin) mostly bounded by ridges or other similar topographic features, encompassing part, most or all of a watershed (generally around 5,000 acres in size)

Duff Layer - The layer of loosely compacted debris underlying the litter layer on the forest floor (see also litter layer).

Edge - The interface between landscape elements of different composition and structure, for example between an open clearcut and a closed-canopy forest. Edges have environmental conditions (temperature, light, humidity, wind) that are different from either of the adjacent landscape elements. Edges can be high or low contrast, depending on the similarity or differences of the adjacent patches to each other. The degree of contrast of the edge determines how wide the edge is, or how deep into the adjacent patch the edge effects penetrate. In the Pacific Northwest, an average edge depth of two tree heights (mature or old growth trees) is commonly assumed for a forest/opening interface.

Endangered Species - Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register. FEMAT

Endemic - A species that is unique to a specific locality. FEMAT

Ephemeral Streams - Streams that contain running water only sporatically, such as during and following storm events. FEMAT

Extirpation - The elimination of a species from a particular area. FEMAT

Fish-bearing Streams - Any stream containing any species of fish for any period of time.

Floodplain - Level lowland bordering a stream or river onto which the flow spreads at flood stage. FEMAT

Fragmentation - The process of reducing the size and connectivity of stands that compose a forest. FEMAT

Fry - Fish that have recently emerged from the gravel and are free swimming.

Gap Dynamics - The various forces that create, maintain and transform gaps in the forest canopy over time.

Geomorphic - Pertaining to the form or shape of those processes that affect the surface of the earth. FEMAT

Hardwoods - A term for used for broadleaf or deciduous trees (trees which loose their leaves in the winter and do not have needle-shaped leaves). In the coast range this term is mainly applied to red alder, bigleaf maple and cascara,

Headwall - The upper portion of a stream drainage where the slope becomes very steep.

Herbiverous - Animals which feed on plants.

Herbs/Forbs - Early seral plant communities such as grasses, shrubs and low-growing leafy plants (non-tree species). They are an important food source for herbiverous species.

Heterogeneity - The condition or state of being different in kind or nature.

High Intensity Fire - A wildfire event with acute ecological impact; usually, but not always of stand-replacement intensity, incinerating all vegetation and organic material in the top layer of the soil.

Interior Forest Habitat - Interior forest habitat is a term which is used to define that portion of the forest which is beyond the edge effect. Patch size and shape greatly influences the amount of area which is affected by edge. Interior forest habitat patches which are large and have a regular shape (esp circular) have less edge than irregular shapes. In a landscape with small irregular-shaped patches of forest, the amount of interior forest habitat is much less than it appears, since much of it is functioning as edge habitat.

Intermittent Streams - 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 the National Forest and Bureau of Land Management District fish biolgists, 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 repreated in similar form throughout. FEMAT For the most part, the term is used in this report to define the watershed analysis area, but may also include the surrounding area to emphasize a bigger picture. The term generally refers to the visible things which make up the landscape, such as topography, geographic features, vegetation and streams.

Landscape Structures and Functions - Landscape structures are the tangible elements of a landscape, the things we can touch, see and feel. They can be living or non-living, mobile or fixed. The physical landscape elements are the non-living things which are the foundation of the landscape. They include the geology, soils and water (refering to the actions of ground and surface water in erosion processes, rather than the aquatic ecosystem). The biological landscape elements generally refers to the vegetation and the patches and patterns of vegetation types on the landscape, the aquatic ecosytem and the living organisms in the landscape

Functions are the activities, roles or processes performed by the structures. Structures are often involved in more than one function, and a function often requires more than one structure. Functional interactions within the ecosystem elements is what makes the system dynamic. D&A

Late Successional - Stage in forest development at which the forest exhibits old growth characteristics, including old large diameter trees with varying degrees of deformities, multiple canopy layers, and numerous large snags and logs.

Late Successional Associated Species - Plant and animal that exhibit a strong association with old growth forests. FEMAT

Litter Layer - The loose, relatively undecomposed organic debris on the surface of the forest floor made typically of leaves, bark, small branches and other fallen material (see also duff layer) FEMAT

Managed Forest/Stands - Any forest land that is treated with silvicultural practices and/or has been previously harvested. Generally applied to land that is harvested on a scheduled basis. FEMAT

Mass Movement - The downslope movement of earth caused by gravity. Includes but is not limited to landslides, rock falls, debris avalanches, and creep. It does not, however, include surface erosion by running water. It may be caused by natural erosional processes, or by natural disturbances. FEMAT

Minor Species - A term silviculturists in the coast range use to denote species other than Douglas-fir, usually applied to conifer seedlings used in reforestation (such as western redcedar, western hemlock, Sitka spruce or yew)

Monitoring - A process of collecting information to evaluate if objective and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned. FEMAT

Mosaic Burn - A burn pattern that leaves a range of spatical and temporal effects as a result of different fire intensities and durations. ROD

Multistory - Forest stands that contain trees of various heights and diameter classes and therefore support foliage at various heights in the vertical profile of the stands. FEMAT

National Environmental Policy Act (NEPA) - An Act passed in 1969 to declare a National policy that encourages productive and enjoyable harmony between humankind and the environment, promotes efforts that prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council of Environmental Quality (The Principal Laws Relating to Forest Service Activities, Agric. Handb. 453. USDA Forest Service, 359 p.) FEMAT. The National Environmental Policy Act requires the Forest Service to evaluate potential impacts of proposed actions, develop a range of alternatives and address cummulative effects. Proposed actions are subject to public review and appeal.

National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resource Planning Act, requiring the preparation of Forest Plans and the preparation of regulations to guide that development. FEMAT

Naturals - Seedlings that become established within an area from the seed of neighboring trees.

Neotropical - Designating or of the biographic realm that includes South America, the Indies, Central America and tropical Mexico.

Off-Channel Habitat - Channels or ponds in a floodplain, at least seasonally connected to the primary channel, that are in addition to and frequently parallel to the primary flowing channel. These most frequently occur in unconstrained reaches.

Overstory - Trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage. FEMAT

Passerine - Pertaining to an order (Passeriformes) of small or medium-sized, shifly perching songbirds having grasping feet with the first toe directed backward.

Patch - A relatively small (20-200 acres) area of similar vegetation or composition which is homogeneous internally (with respect to successional stage, composition etc) and is different from the surrounding landscape. D&A

Pathogenic - Capable of causing a disease.

Perennial Stream - A stream that typically has running water on a a year-round basis. FEMAT

Physiographic Province - A geographic area having a similar set of biophysical characteristics and processess due to effects of climate and geology which result in patterns of soils and broad scale plant communities. Habitat patterns, wildlife distributions, and historical land use patterns may differ significantly from those of adjacent provinces. FEMAT

Plantations - A forest stand established by human action following the harvest of the previous stand

Plant Association - Plant community type based on land management potential, successional patterns and species composition. FEMAT

Plant Community - An association of plants of various species found growing together in different areas with similar site characteristics. FEMAT

Precommercial Thinning - The practice of cutting some of the trees less than merchantable size within a stand so that the remaining trees will grow faster.

Range - Pertaining to the geographic distribution of species and subspecies.

Record of Decision - A document separate from but associated with an environmental impact statment 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 has been adopted and, if not, why not. FEMAT

Recovery Plan - A plan for the conservation and survival of an endangered or threatened species listed under the Endangered Species Act. The plans are generally written and/or approved by the US Fish and Wildlife Service and are designed to improve the status of the species in order to justify delisting the species in the future in accordance with the Endangered Species Act

Reforestation/Regeneration - The natural or artificial restocking of an area of with forest trees; most commonly used in reference to planting efforts. FEMAT

Refugia - Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographic range (i.e. endemic populations). FEMAT

Research Natural Area (RNA) -An area set aside by a public or private agency specifically to preserve a representative sample of an ecological community, primarily for scientific and educational purposes. In Forest Service usage, research natural areas are areas designated to ensure representative samples of as many of the major naturally occuring plant communities as possible. FEMAT

Resource Management Plan - A land use plan prepared by an agency under current regulations in accordance with the Federal Land Policy and Management Act. FEMAT

Riparian Area - A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplain, woodlands, and all areas within the stream influence zone and the area where vegetation, organic and inorganic matter is contributed to the stream system (generally between 100-200 feet from the normal line of high water of a stream channel, depending on topography).

River Basin - An area, defined by physical boundaries, in which all surface water flows to a common point. River basins are associated with large river systems and are typically 1000's of square miles in size. Example: Willamette river basin, (3rd field).

Roost - The resting behavior of birds. FEMAT

Salmonid - Refers to fish of the family Salmonidae. Within the range of the northern spotted owl, these include all salmon, trout, and whitefish. ROD

Salvage - Harvest of trees killed by fire, insects, disease, windthrow, etc.

Scour - Evidence of movement of material, erosion or deposition, in a downslope direction due to transport by water. ROD

Second Growth - Relatively young forests that have developed following a disturbance of the previous older forest (e.g., harvest activities, fire, blowdown or disease) FEMAT

Seral Stages - A series of plant communities that change through time in the course of natural succession.

Seep - Places where water oozes from the ground and forms a pool.

Senescence - A decline in the rate of growth of a tree due to age.

Sensitive Species - Those species that (1) have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species or (2) are on an official state list or (3) are recognized by the US Forest Service or other management agency as needing special management to prevent their being placed on the Federal or state lists. FEMAT

Seral Stages - The series of relatively transitory plant communities that develop during ecological succession from bare ground to the climax stage. FEMAT

Shade Tolerant/Intolerant - Ability of a tree to grow satisfactorily in the shade of, and in competition with, other trees.

Silvicultural Prescription - A professional plan for controlling the establishment, composition, constitution and growth of forests. A planned sequence of treatments or prescriptions over part of or the entire life of a forest stand to meet management objectives. FEMAT

Slope Stability - The resistance of a natural or artificial slope or other inclined surface to failure by landsliding (mass movement). FEMAT

Snag - Any standing dead, partially dead, or severely defective tree.

Soil Productivity - Capacity or suitability of the soil to establish and sustain the growth of plant species, primarily through nutrient availability.

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 adjoining forest area. FEMAT

Stand Density - An expression of the number and size of trees on a forest site. May be expressed in terms of numbers of trees per acre, basal area, stand density index or relative density index. FEMAT

Stocking Levels - The degree to which 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 habitat for plants and animals. The variety results from layering or tiering of the canopy and the death and ultimate decay of trees. In aquatic habitats, the presence of a variety of structural features such as logs and boulders contribute to the aquatic diversity. FEMAT

Subspecies - An aggregate of phenotypically similar (i.e. similar in appearance) populations of a species generally inhabiting a geographic subdivision of the range of the species and differing taxonomically (i.e. different color, size, morphological characteristics, behavior etc) from other populations of the species. ROD

Substrate - The base on which an organism lives, e.g. soil, bark, etc. FEIS

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 disturbance event. FEMAT

Surface Erosion - A group of processes whereby soil material are removed by running water, waves and currents, moving ice, or wind. FEMAT

Smolt - Fish that are migrating from freshwater to the ocean.

Territory - The area that an animal defends, usually during the breeding season, against intruders of its own species. FEMAT

Threatened Species - Those plant or animal species likely to become endangered throughout all or a significant portion of their range with the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register. FEMAT

Toeslope - The lower portion of a hillslope adjacent to a valley floor.

Underplanting - The planting of trees or shrubs in the understory of a forest.

Understory/Overstory - Understory: the trees and other woody species growing under the canopies of larger adjacent trees. Overstory: the trees that comprise the canopy that overtops all other woody species in a stand, the tallest layer. FEMAT

Unstable Lands/Slopes - Lands which are prone to mass failure under natural conditions and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space, to the point where the change is likely to modify natural geomorphic and hydrologic processes (such as the delivery of sediment and wood to the channel), which may in turn affect the aquatic ecosytem. ROD

Viability - The ability of a wildlife or plant population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; a population that contains an adequate number of reproductive individuals to ensure the long-term existence of the species; FEMAT

Watershed - An area within a river basin in which all surface water flows to a common point. There are many watersheds within a river basin. Watershed areas range from 20 to 200 square miles in size, (5th field). For analysis purposes, the Presidents Plan identified some watersheds as Key and further defined them as Tier I or Tier II. (See FEMAT Report page V-74).

Watershed Analysis - A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. It provides a basis for ecosystem management planning that is applied to watersheds of approximately 20 to 200 square miles.

[**Natural Range of Variability** - The natural range of terrestrial and aquatic elements of the ecosystem and their proportions on the landscape at any given time.]