United States
Department of
Agriculture

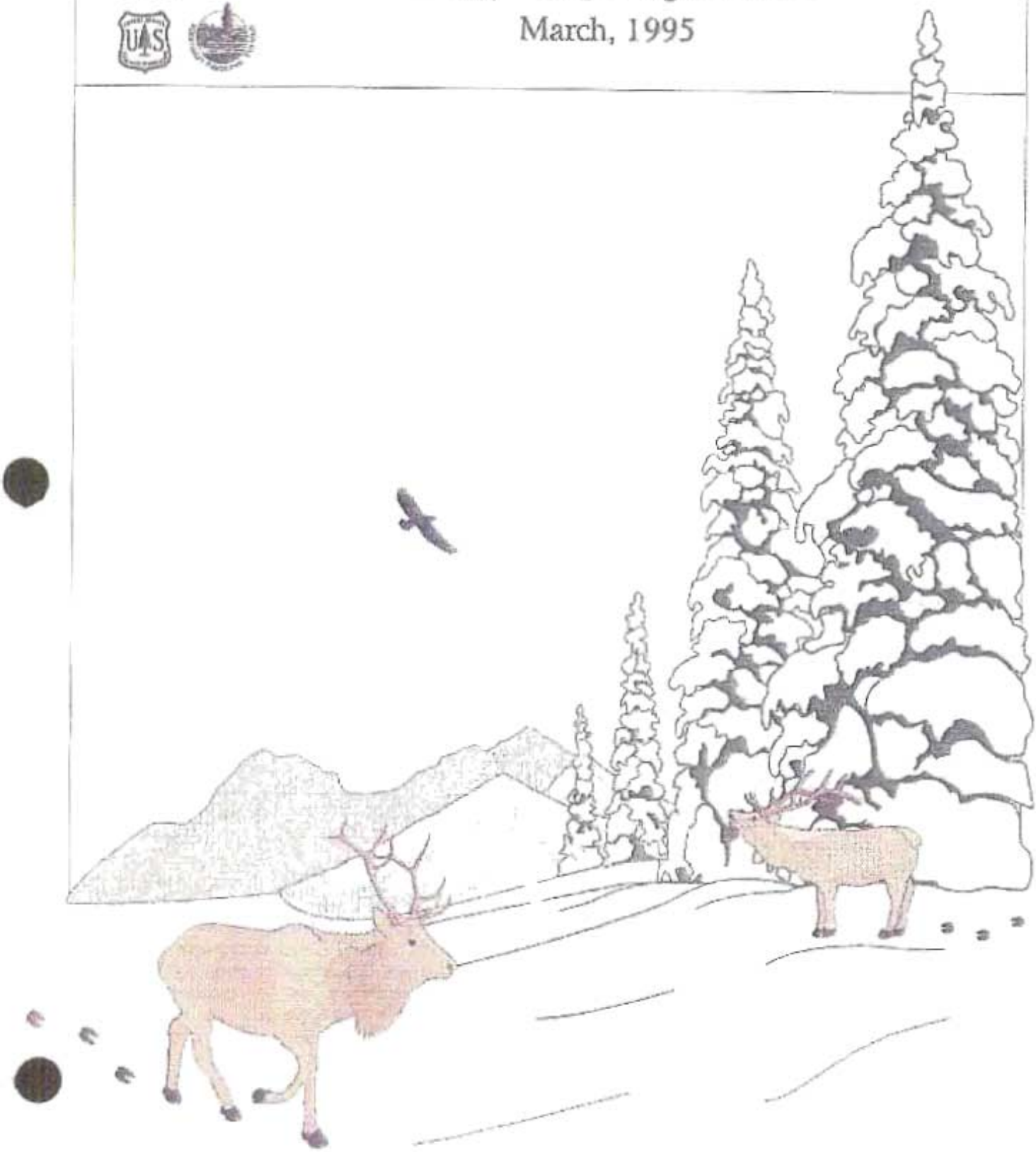
Forest Service

Pacific
Southwest
Region

Elk Creek Ecosystem Analysis

Happy Camp Ranger District

March, 1995



ELK CREEK WATERSHED ANALYSIS

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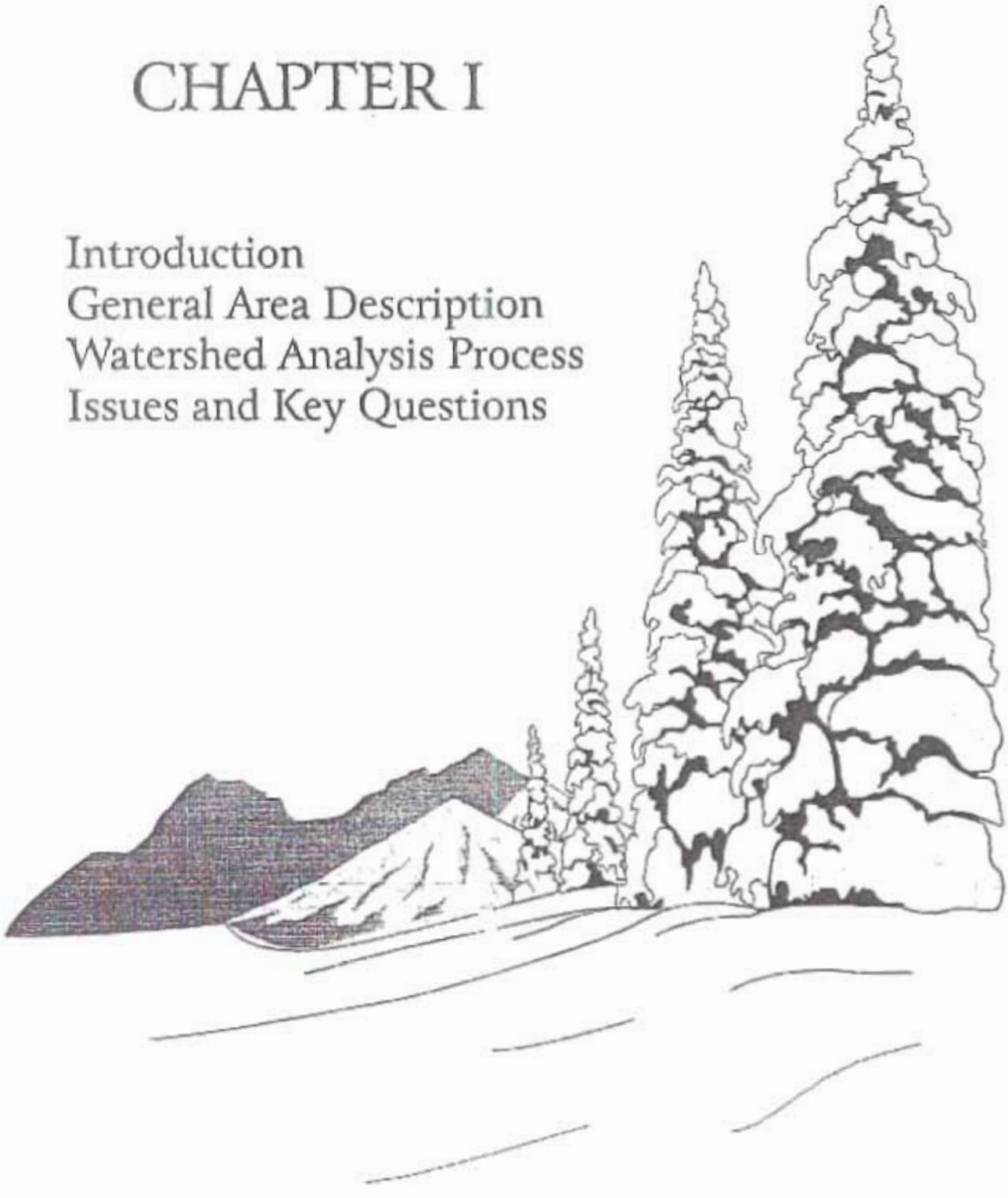
CHAPTER I

Introduction
General Area Description
Watershed Analysis Process
Issues and Key Questions



INTRODUCTION

This document is a summary of the information compiled and discoveries made by the Happy Camp Ranger District Interdisciplinary Team (IDT) while performing ecosystem analysis on the Elk Creek watershed. The purpose of ecosystem analysis is to develop and document a scientifically-based understanding of the ecological features, functions and processes occurring within the watershed. This ecosystem analysis is primarily watershed analysis that examines the terrestrial, aquatic and social aspects of the watershed.

Watershed analysis is one of the four elements of the Aquatic Conservation Strategy, as described in Option 9 of *The Final Supplemental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl*, often referred to as the President's Forest Plan. The selection of Option 9 is documented by *The Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl* (ROD.) The ROD describes the standards and guidelines that are to be implemented on applicable forest lands. Option 9, The President's Plan and the Record of Decision will be referred to as the ROD in this document. The other three elements include: riparian reserves, key watersheds and watershed restoration. These three elements are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystem. Elk Creek is a Key Tier 1 watershed, which means that it has been identified as a crucial refugia for at-risk fish species.

Ecosystem analysis is an ongoing, iterative process. This report is a dynamic document, and is intended to be revised and updated as new information becomes available.

The final outcome is a tool to help prioritize opportunities and choose projects to achieve conditions. Any project proposals that result from this document will have site specific analysis and related decision documents prior to any actual activities on the ground. The intent is that the information compiled through this analysis will serve as a guide to resource management in the Elk Creek Watershed for many years.

WATERSHED DESCRIPTION

The Elk Creek Watershed is approximately 60,780 acres. Elevations in the watershed range from about 1000 feet at the mouth to 7000 feet at the headwaters. The watershed is approximately 18 miles long, and 6 miles wide. Elk Creek flows from south to north into the Klamath River just west of the town of Happy Camp. Figure 1 shows the location and vicinity of the Klamath Basin and Elk Creek watershed.

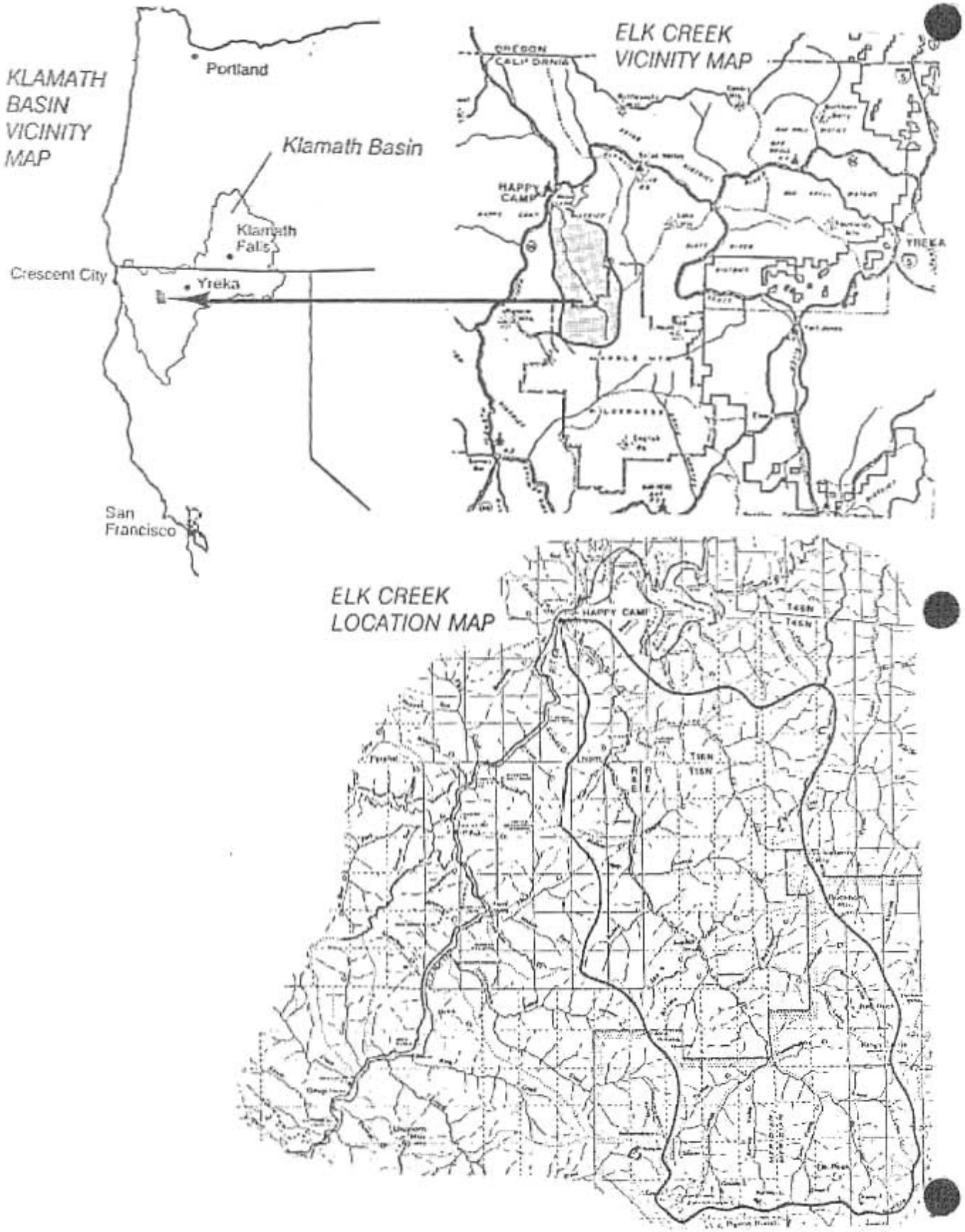
MANAGEMENT DIRECTION

The strategies used are intended to be in harmony with existing policies, direction, and Draft Forest Plan Standards, Guidelines and Land Allocations.

Ecosystem management is a central theme for the future of the Forest Service. In December 1993, the Chief of the Forest Service provided a synopsis of what Ecosystem Management represents.

> First it means thinking and managing at different scales than we have in the past. Second, it means managing for systems that are ecologically sustainable. Outputs, economics, and people are very much a part of this definition, but the production of outputs requires maintaining diverse, sustainable, healthy systems.

Figure 1 VICINITY AND LOCATION MAPS



This type of management calls for sustaining ecological systems and meeting human needs. These objectives are sometimes conflicting. By taking a close look at watershed processes with a more holistic, integrated approach, thresholds for ecological sustainability can be better understood.

By completing ecosystem analysis it is assured that ecosystem management objectives will be considered during the implementation of the Land and Resource Management Plan (LMP). The Elk Creek analysis focuses on applying the resource allocations, standards and guidelines established in the Draft LMP to the Elk Creek watershed specifically. Figure 2 is a diagram of the Forest Plan implementation process. It illustrates how this analysis fits into the larger picture of Forest land and resource management.

The LMP for the Klamath National Forest is not final. The Draft LMP has incorporated direction from the ROD. When finalized, the LMP and ROD together will provide management direction in the form of goals, desired future conditions, land allocations, and standards and guidelines.

Figures 3 and 4 present a map of the watershed and summary of land allocations. This information is presented here as a reference to introduce allocations mentioned throughout the document and not intended to indicate any final allocations.

This process is a means of implementing current direction, not changing it. If during the analysis, a need to modify the Forest Plan is identified, the process to amend the it will be initiated.

Figure 2 FOREST PLAN IMPLEMENTATION

ELK CREEK WATERSHED

LMP FINAL PREFERRED ALTERNATIVE WITH ROADS

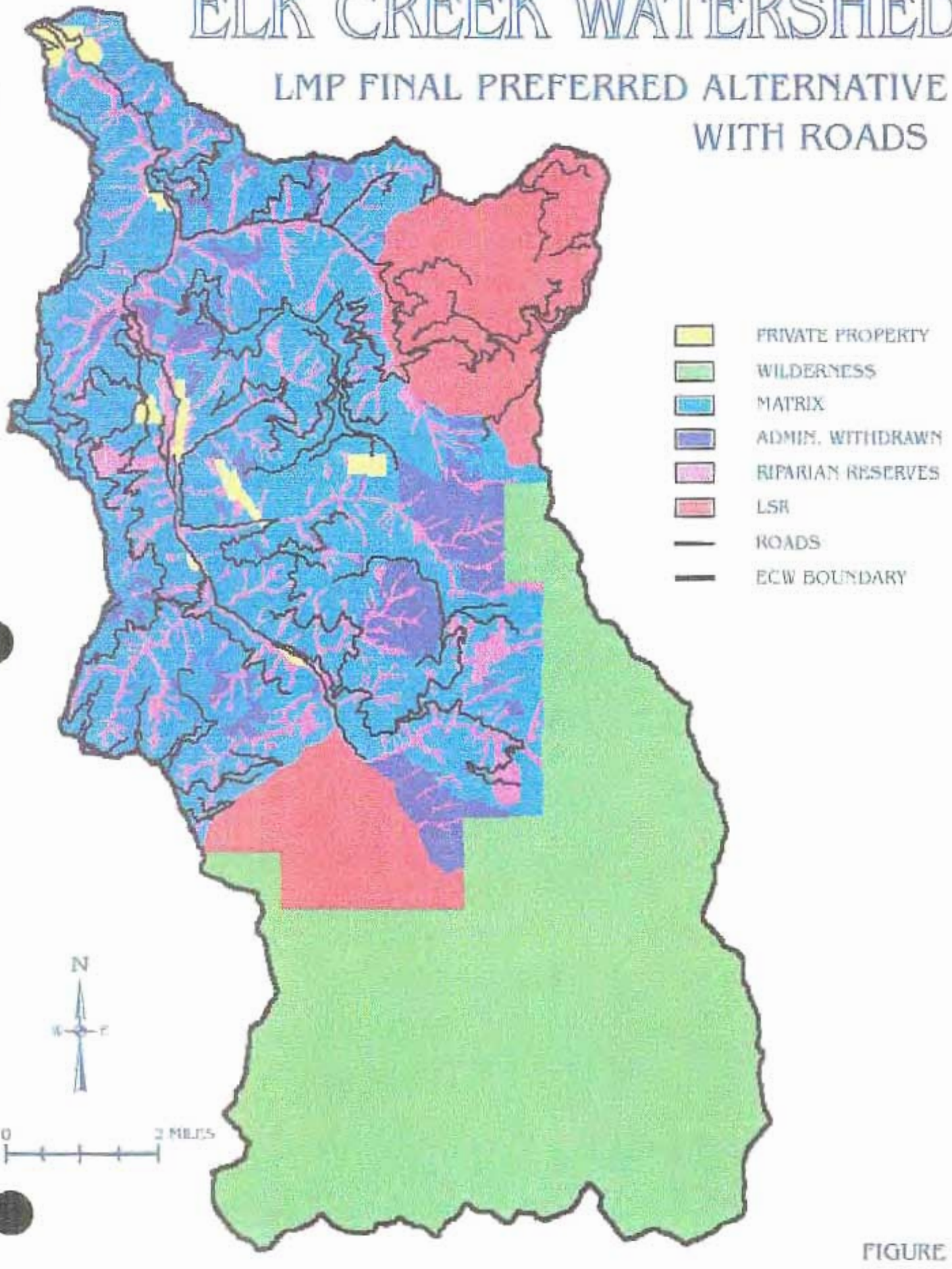


FIGURE 3

Figure 4 BREAKDOWN OF LMP LAND ALLOCATIONS

ROD ALLOCATION	DRAFT LMP MANAGEMENT AREA	ACRES WITHIN WATERSHED	PERCENT OF WATERSHED	DESIRED CONDITIONS
PRIVATE PROPERTY	PRIVATE PROPERTY	648	1	N/A
CONGRESSIONALLY WITHDRAWN	WILDERNESS	23,618	39	NATURAL APPEARANCE WITH AND MINIMUM OF HUMAN DISTURBANCE
ADMINISTRATIVELY WITHDRAWN	WILD RIVERS	377	0.5	PRIMITIVE APPEARANCE WITH LITTLE EVIDENCE OF HUMAN ACTIVITY
	SPECIAL MANAGEMENT AREAS	11	-	EMPHASIZE UNIQUE RESOURCE FOR WHICH AREA IS DESIGNATED
	HARSH SITES	3,061	5	NO REGULATED TIMBER HARVEST
SUBTOTAL		3,339	5.5	
RIPARIAN RESERVE	MAPPED RIPARIAN RESERVE	4,934	8	MULTI-LAYERED CANOPY WHERE FORESTED PROVIDES CONNECTIVITY, THERMAL REGULATION, AND LARGE WOOD TO STREAMS.
LSR	LSR	7,621	13	WELL DISPERSED AREAS OF CONTINUOUS MULTI-LAYERED FORESTS WITH LATE SUCCESSIONAL CHARACTERISTICS.
MATRIX	RECREATIONAL RIVER	2,389	4	WATERWAY NATURAL IN APPEARANCE, RIVER AREA SHOWS EVIDENCE OF PAST AND ONGOING TIMBER HARVEST
	RETENTION	229	0.5	NATURAL APPEARING WITH SIGNS OF MANAGEMENT
	PARTIAL RETENTION	14,043	23	VIEWS FROM VISUALLY IMPORTANT ROADS AND TRAILS SHOW EVIDENCE OF ONGOING MANAGEMENT ACTIVITIES BUT ARE NEARLY NATURAL LOOKING
	GENERAL FOREST	3,678	6	MOSAIC OF HEALTHY FOREST STANDS OF A VARIETY OF SPECIES, SIZES, AGES AND STRUCTURAL CHARACTERISTICS
SUBTOTAL		20,619	33.5	
TOTAL	—	60,780	100	—

PUBLIC PARTICIPATION

Public participation in this analysis project has occurred since the initial data collection started. In January 1993, a letter introducing the project and soliciting feedback was sent to 150 potentially interested individuals. A newsletter was mailed locally in April 1993 soliciting comments.

The Interdisciplinary Team worked closely with representatives from the U.S. Fish and Wildlife Service, State Fish and Game, California Department of Forestry, The Karuk Tribe of California, and Siskiyou County Planning. Members of the public were also invited to participate. They were contacted through mailings to residents of Elk Creek and 150 individuals who have expressed interest in resource management planning. Other individuals were also reached through newspaper articles in the Siskiyou Daily Newspaper.

Three field trips were conducted and anyone who expressed interest was sent regular mailings to share information and provide opportunities to review draft documentation.

ISSUES AND KEY QUESTIONS

Aquatic Systems, Their Condition and Function: This includes water quality, sediment, stream channel integrity, and riparian vegetation. Maintaining viable fish and other aquatic/riparian dependant populations and high quality drinking water for the people of Happy Camp are primary goals.

Key questions for aquatic species:

1) Are the following stream characteristics at desired levels and if not, what can be done to facilitate progress towards desired conditions?

- water quality, flow rate and fluctuation
- bed load, suspended and dissolved sediment
- temperature
- coarse woody material
- pool frequency
- rate of change in bottom configuration and texture

2) How do the riparian reserves vary from desired conditions and what can be done to facilitate progress towards desired conditions?

3) What watershed features are adversely affecting aquatic health and integrity and what can be done to change this?

Key questions to assess how well the aquatic system is providing quality drinking water to the community:

1) Are suspended and dissolved sediments at desired levels and if not, what can be done to facilitate progress towards desired conditions?

2) What can be done to avoid temperature increases and bacteria and algae growth?

Forest Vegetation Conditions and Functions: This includes vegetative pattern, structure and species composition, and the role of fire in the ecosystem.

Key Questions Include:

Are the following vegetation characteristics at desired levels and if not, what can be done to facilitate progress towards desired conditions?

- Forest stand density
- Species composition
- Seral stage distribution
- Fuels conditions

Maintaining Resilient and Viable Wildlife Populations: This includes habitat characteristics and connectivity (fragmentation), and the distribution of those habitats across the landscape. Maintaining viable wildlife populations and contributing to recovery of threatened and endangered species populations are primary goals of wildlife management.

Key questions include:

1) Are the following habitat characteristics at desired levels and if not, what can be done to facilitate progress towards desired conditions?

   - Seral stage distribution and condition
   - Canopy closure
   - Dead and down material
   - Snags

2) What are the unique and sensitive habitats and what can be done to maintain or recover these habitats?

Human use, Expectations, and Values: This includes Native American interests, economic opportunity, recreation activities, visual quality and private property integration.

Key Questions Include:

1) What are the attributes for Native American uses and how can they be maintained or enhanced?

2) What are the economic opportunities and where do they overlap with opportunities to progress towards desired conditions for vegetation communities, aquatic systems, or wildlife populations?

3) What opportunities exist to enhance experiences for recreational users and improve visual quality?

DOCUMENT ORGANIZATION

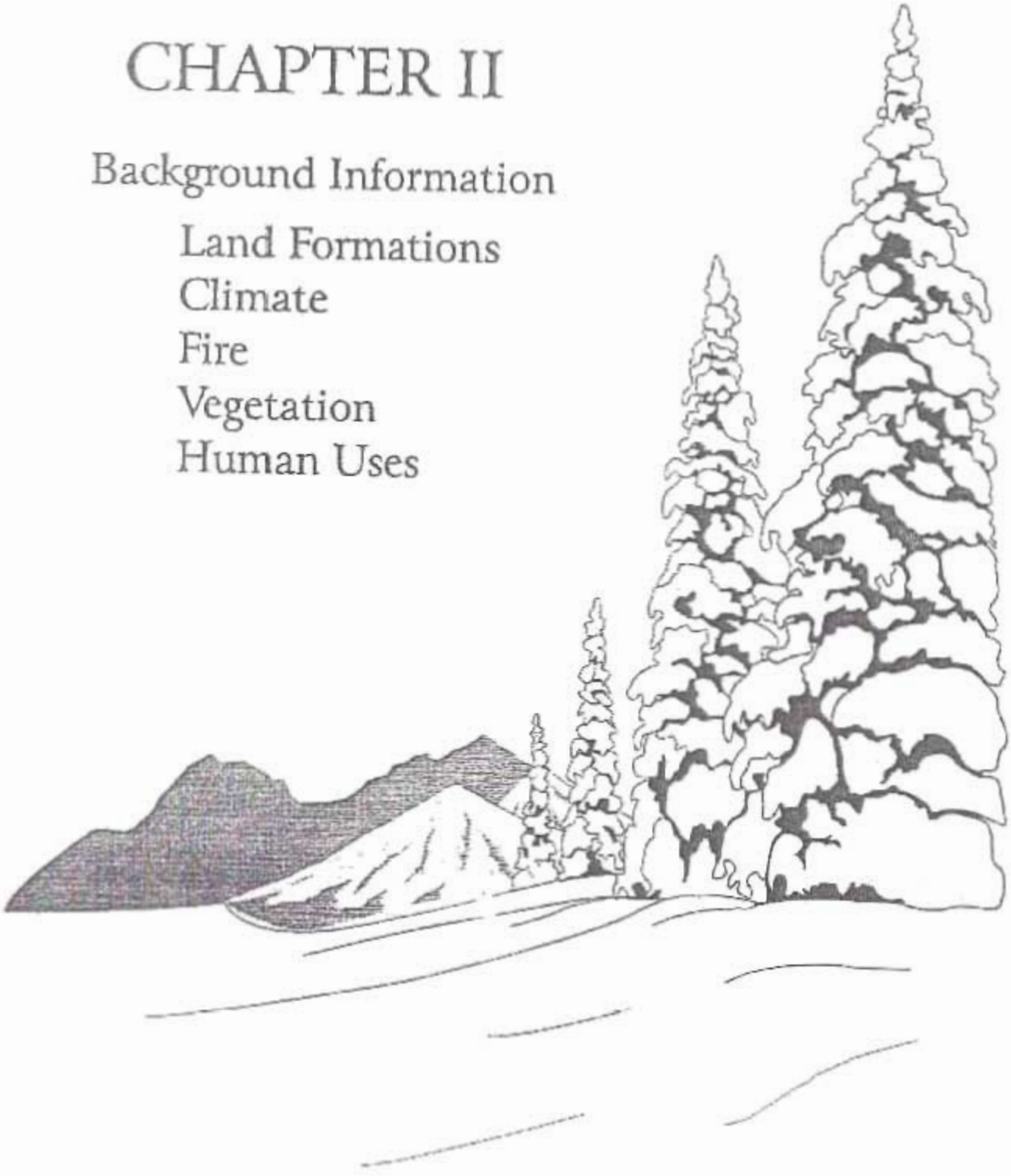
The following document starts by introducing the watershed in general terms, then provides background information on the geologic formation of the watershed, fire and its role in forming the existing vegetation conditions, and early human uses. A chapter is then devoted to each issue. Chapter III provides information on the status of fish populations and describes the aquatic system in terms of the processes that influence fish habitat. Chapter IV describes the vegetation and associated processes. Chapter V provides information on the wildlife populations and describes habitat conditions. Chapter VI describes human uses, expectations and values. Chapter VII summarizes the desired conditions for the watershed and introduces possible projects to work towards desired conditions.

The Elk Creek watershed is referenced throughout the document as the watershed, landscape, and assessment area. All of these names refer to the same area which includes the entire Elk Creek Basin.

CHAPTER II

Background Information

- Land Formations
- Climate
- Fire
- Vegetation
- Human Uses



BACKGROUND

GEOLOGIC HISTORY

The Klamath Mountains are constructed of marine rocks that have been scraped off the ocean floor as it collides with the North American continent. Near Yreka, the rocks are about 500 million years old and they get younger toward the Pacific coast. At the coast, the rocks are as young as a few million years. The scraping continues today, generating the earthquakes that occur along the coast. The marine rocks are composed of igneous basement and sediments deposited on it. Sediments include fine grained mud, deposited in open ocean, and limestone from reefs that formed on islands. About 70 million years ago, volcanoes (much like those of the modern Cascade Range) erupted through the mush of, by then metamorphosed, marine rocks. These volcanoes have been eroded away, exposing their roots which is the "granite" found in the southwest portion of the Elk Creek basin.

The land form of the Elk Creek basin is very young compared to the age of the rocks that form it. The lack of rocks younger than the "granite" indicates that this area has been eroding during much of the last 70 million years. Thick, red soil found high on the flanks of Titus Ridge and deeply weathered "granite" in the southern portion of the Elk Creek basin suggests that within the last few hundred thousand years, the landscape was of low topographic relief under a moist climate. Ongoing uplift and drier climate have resulted in deep stream gorges being cut into that low relief landscape. Thick soils that developed on the low-relief landscape are now elevated above the stream and eroding rapidly. Glaciers have occupied high mountain valleys in the Marble Mountains. The last glaciers retreated about 10,000 years ago. Glacial action was likely accompanied by increased rate of sediment production to streams.

The "Rivera Landflow" (See Figure 7) is a large, earthflow landslide, composed of red soil, extending from Titus Ridge to Elk Creek. The origins of the earthflow are interpreted to be older than the last glaciation and older than 40,000 years. Movement of this landslide has pushed Elk Creek to the east. The cliffs on the east side of Elk Creek are formed as the creek under-cuts the slope. The landslide creates a barrier in Elk Creek that has resulted in the accumulation of sediment up-stream of the landslide. The resulting broad, low-gradient channel makes some of the best anadromous-fish spawning habitat in the basin. This and similar landslides occur as a result of uplift of the red soil, wet climate (wetter than today at times in the past) and seismic shaking.

CLIMATE

In the central Klamath Mountains, the coastal climatic influence is moderated by the mountains to the west. The annual precipitation during the period of record (1914 to present) at Happy Camp, located at the mouth of the Elk Creek basin, ranges from 23 to 88 inches (See Figure 5). The average annual precipitation at the station is about 51 inches. Approximately 90% of the precipitation occurs from October through May from north Pacific cyclonic storms. The remainder occurs during summer thunderstorms. Winter precipitation occurs mainly as snow above 4,000 feet elevation, and rain below that elevation. Storms generated in the Gulf of Alaska are colder (40 degrees F) and occasionally produce snow at valley floor elevation. As much as seven feet of snow accumulated in Happy Camp in 1972. Storms generated in the mid-latitude Pacific are warmer (50 degrees F). Fluctuation of the snow level occasionally results in warm rain falling on snow, causing rapid snow melt.

Summers are hot, the daily temperature typically ranges from 50 to 90+ degrees Fahrenheit at Happy Camp. Winters are cool. Storms originating in the Gulf of Alaska bring 40 degree temperature with rain, 34 degrees with snow. Storms originating in the central Pacific ocean bring 50 degree air temperature. High

pressure, continental air masses bring sub-freezing temperature in mid-winter. The record low temperature at Happy Camp is two degrees Fahrenheit.

Climate is useful in understanding the behavior of fire, erosion, landsliding, forest health, stream water quantity and quality, and the structure of stream channels. The precipitation record is characterized by three distinct climate trends (Figure 5). These alternating periods of wet and dry conditions lasted for a few decades. The short duration of the record and irregular nature of climatic change makes forecasting of these periods impossible. The drier periods are of approximately 40 inches average annual precipitation. Warmer, drier storms originating in the central Pacific ocean are dominant. The wetter years are of approximately 60 inches average annual precipitation. Colder, wetter storms originating in the Gulf of Alaska are dominant. The Happy Camp record, along with longer records from Eureka and other stations in northwestern California, indicate that the period 1870 to 1910 was a wet time; 1911 to 1937 dry; 1938 to 1975 wet; and 1976 to present dry.

The occurrence of landslides is strongly influenced by weather and climate. The time scale of precipitation intensity associated with landslide activity ranges from years to minutes. Most of the landslide activity of the last 75 years occurred with the close of the 1938 to 1975 wet period. Many landslides were reactivated by intense precipitation during 1982 and 1983. Landslides may also be activated by intense summer thunderstorms.

FIGURE 5 NUMBER OF YEARS IN ANNUAL PRECIPITATION RANGE SHOWING CLIMATIC TRENDS, 1915-1990, Happy Camp, California.

INCHES	1915-90	1915-37	1938-75	1976-90
20-30	4	3	0	1
30-40	20	10	5	5
40-50	15	6	6	3
50-60	19	3	12	4
60-70	8	1	7	0
70-80	3	0	3	0
80-90	6	0	4	2
AVERAGE	50.7	40.6	57.6	48.6

Range of Observations: 23.3 - 88.5 Inches

FIRE HISTORY

Wildfires have been very common in all areas of the Klamath National Forest. Limited fire suppression began with the creation of the Forest in 1905, and became very effective in the 1940's. Fire records are incomplete, but over 200 fires have been suppressed in Elk Creek (records from the 1930's for small fires and the 1920's for large fires over 100 acres). The majority of fires have been lightning caused. During the 20 year period from 1968 to 1987, the drainage averaged 4.6 fires per year (see Figure 6).

In spite of fire exclusion efforts, there have been 13 fires larger than 100 acres recorded since 1920. The most recent were the lightning caused wildfires of 1987 where 26,000 acres burned in Elk Creek. Only two of the large fires (1922, 160 acres; and 1924, 120 acres) were man caused. Several of the large fires reburned or burned around previous large fires (see Figure 6). This pattern is typical of the Happy Camp Ranger District where over half of the District has burned at least once since 1920 and a significant portion of that half two or three times.

ELK CREEK WATERSHED

FIRE HISTORY

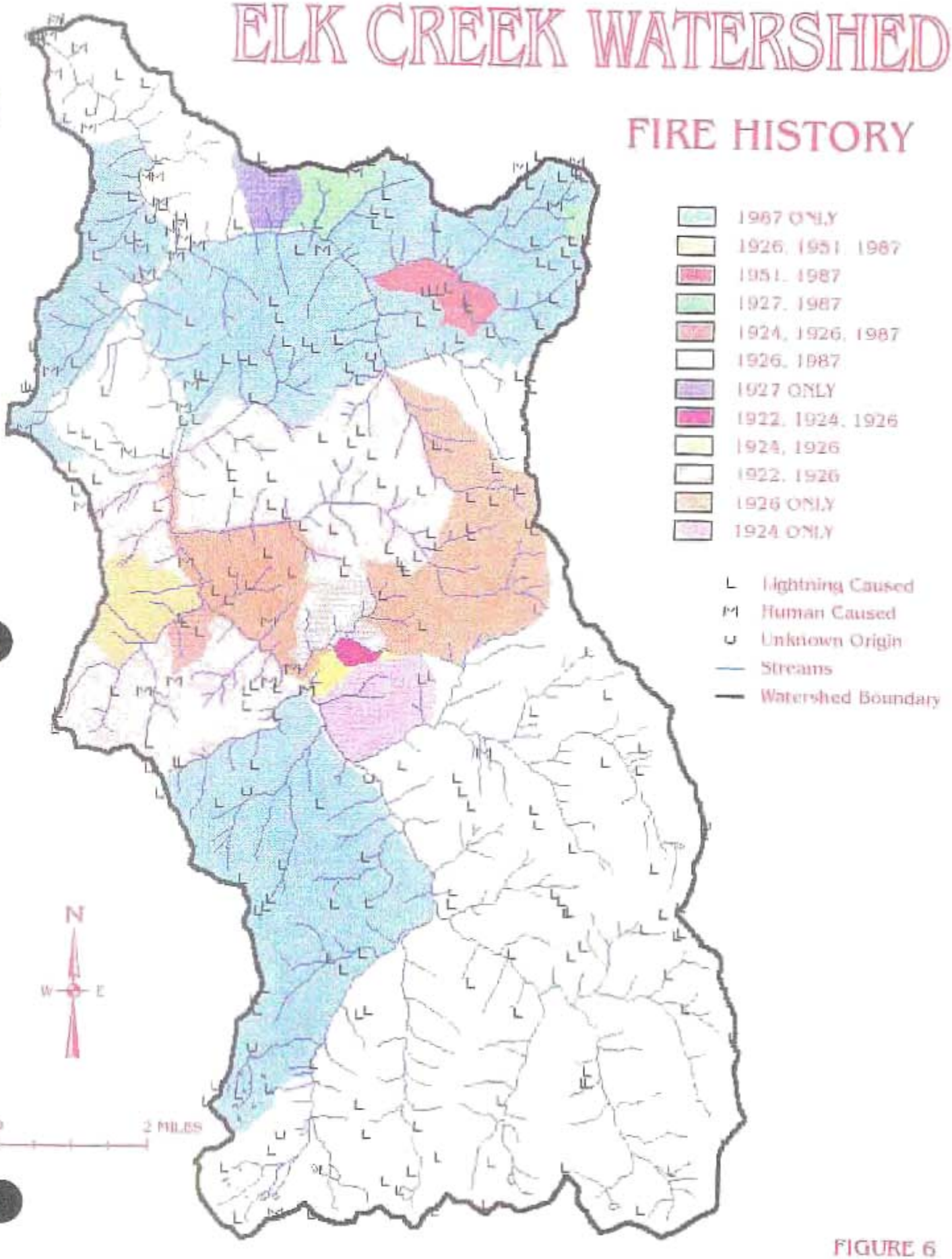


FIGURE 6

Lightning fires have been recorded from early spring through late fall. However, the majority of lightning fires occur from late June through early September. Only one large fire occurred in the spring (4/25/24 - 1700 acres) and it was confined to a large south aspect area. The remainder of large fires started in July or August, and often burned for several weeks before being controlled. All of the large fires were in years when dry season precipitation (May through September) was below average. All but two fires that burned 1123 acres in 1951, were in years when the entire rain year was also significantly below average. Most of the acres burned in large wildfires have been outside of the wilderness, and at lower elevations in the drainage. This coincides with sites that are generally the warmest, driest and most productive.

VEGETATION

Elk Creek lies within the Klamath Mountains geological province. This forested province is more diverse and complex than any other in the West (Whittaker, 1961). The complex species and plant community distributions and patterns are a result of the climate (Axelrod, Waring), high and rugged relief, and soil parent material (Whittaker, 1960). In recent years, the importance of disturbance has also been recognized in distribution and abundance of plants and vegetation communities at the stand and landscape level (Taylor, Agee). Landscape level vegetation patterns are probably best understood as a composite of species response to both the environment and disturbance.

HISTORIC USES

PRE-HISTORIC USE

Indigenous ancestral Karuk are identified as the early occupants of the watershed. Although most settlements were located along the Klamath River, it is likely that at least one permanent living site was positioned adjacent to Elk Creek. Less permanent hunting and food processing camps were probably more prevalent. They would have been located on flats, especially those near Elk Creek with a good source of fish. The Elk Creek watershed is a particularly important area for religious use as well as traditional uses integral to Karuk daily life.

Although Euro-Americans first viewed the Klamath River region as a pristine forested landscape, the Karuk have influenced landscape settings for centuries. Compared with modern agricultural management practices, impacts were more subtle over the landscape. Information about how the Karuk managed settings in Elk Creek is extremely limited. Comprehensive studies are needed to more adequately describe and define specific measures and uses. Information passed on by tribal members would further increase present knowledge about indigenous landscape settings.

Settlements and encampments usually correlated nicely with proximity to the most important food sources: anadromous fish and hardwood stands that supplied acorns. Residence often shifted to upland camps in the summer and fall where a variety of plant and animal sources were dried and stored for winter subsistence.

Complex social and religious traditions influenced Karuk land management practices. The physical environment played an immense role in shaping Karuk beliefs, customs, and social practices. Ceremonies were conducted at special locations which served as religious sanctuaries and cleared the path for the well being of their world.

Important plant resources essential for food, medicine, and domestic needs were managed through territorial rights of ownership, by judicious harvesting, and by continued use including pruning and tending valuable plants.

Using fire as a tool was particularly important for managing habitats, especially acorn/oak settings. Fire was used to stimulate new plant growth, control plant and insect infestations and increase the range and frequency of wildlife habitat. In addition to reducing the severity of uncontrolled wildfire, fire applications helped improve access for hunting and travel. Fire was also utilized in conjunction with ceremonial practices. By the 1920's federal enforcement (fire prevention laws) prohibited indigenous burning practices.

Evidence taken from early photography and personal interviews leads to the conclusion that forest settings were generally more open than today. Denser stands of conifers were found on north facing aspects, good soils, and down in the drainages. South facing aspects generally supported less dense stands of conifers and were the places where several of the other oak species could be found. Trails and travel across the landscape were more dependent on physical features, serving as linkages to "cultural use zones" and travel and trade routes.

HISTORIC USE

In the late 1850's miners from many ethnic backgrounds including Chinese began to enter the area to work the region's gold fields. By the end of the 1870's several streams in the Elk Creek watershed were diverted to supply water for hydraulic mining operations. A main ditch along Elk Creek supplied water to the Richardson Bed Rock Mine four miles east of Happy Camp on the Klamath River. Most of the mining activity within the drainage was concentrated along the main fork of Elk Creek in lower elevations.

By the 1930's, homestead settlement had occurred on many of the small alluvial terraces adjacent to Elk Creek. Some flat areas near streams were cleared for pasture, farming and grazing purposes. High elevation meadows were also used for grazing activities in conjunction with limited rural residences.

The Klamath National Forest was established in 1906. Before World War II the emphasis was on forest protection, such as fire prevention, fire suppression, and timber theft reduction. The majority of the trail projects were for the above purposes. Mining activity increased during the depression and WW II due to Government subsidies for some minerals such as chrome. With the end of World War II, homestead and mining activity dramatically decreased. Land use shifted to timber products for the next four decades only to decrease significantly after 1990.

The most significant human influences shaping Elk Creek result from stream channel mining disturbances, timber management activity, homesteading, road development, and fire suppression. Other influences result from human uses such as hunting, fishing and recreational activity. Also there has been some introduction of non-native plants such as thistle and mustard as a result of rural use.

ACCESS DEVELOPMENT AND HARVESTING

Trails in the area are documented on Forest Service maps as early as 1909. Homestead applications date back to 1910. By the 1920s most of the alluvial terraces at lower elevations in the watershed had been used as homestead sites. In addition to mining, cattle, horses, and sheep were grazed over the entire drainage.

The Elk Creek road (7C001, 16N05) was constructed by the California Conservation Corps in 1935. Improved road access increased homesteading and introduced recreational use. The Sulphur Springs area, near the end of the present Elk Creek Road, was known to have been accessed for therapeutic purposes.

Nearly all subsequent roads were constructed to access timber for commercial harvest. The majority of the construction was in association with 12 to 15 of the larger timber sales in the Elk Creek Landscape. Additional small sales, which mainly utilized the existing road system, were also harvested. The first recorded road construction in conjunction with harvest was in the area of Twin, Malone, and Bishop Creeks from 1952 to 1955. This included both green sales and fire salvage from the 1951 Bishop fire.

Construction of the main road along the East Fork of Elk Creek (45N19) began in the mid 1950's. From 1956 to 1960, several timber sales were harvested and the main road up the East Fork drainage was completed and extended west to the ridge above Cougar Creek. The road that runs from East Fork along Fryingpan Ridge was completed all the way to the Grider Ridge road (45N77).

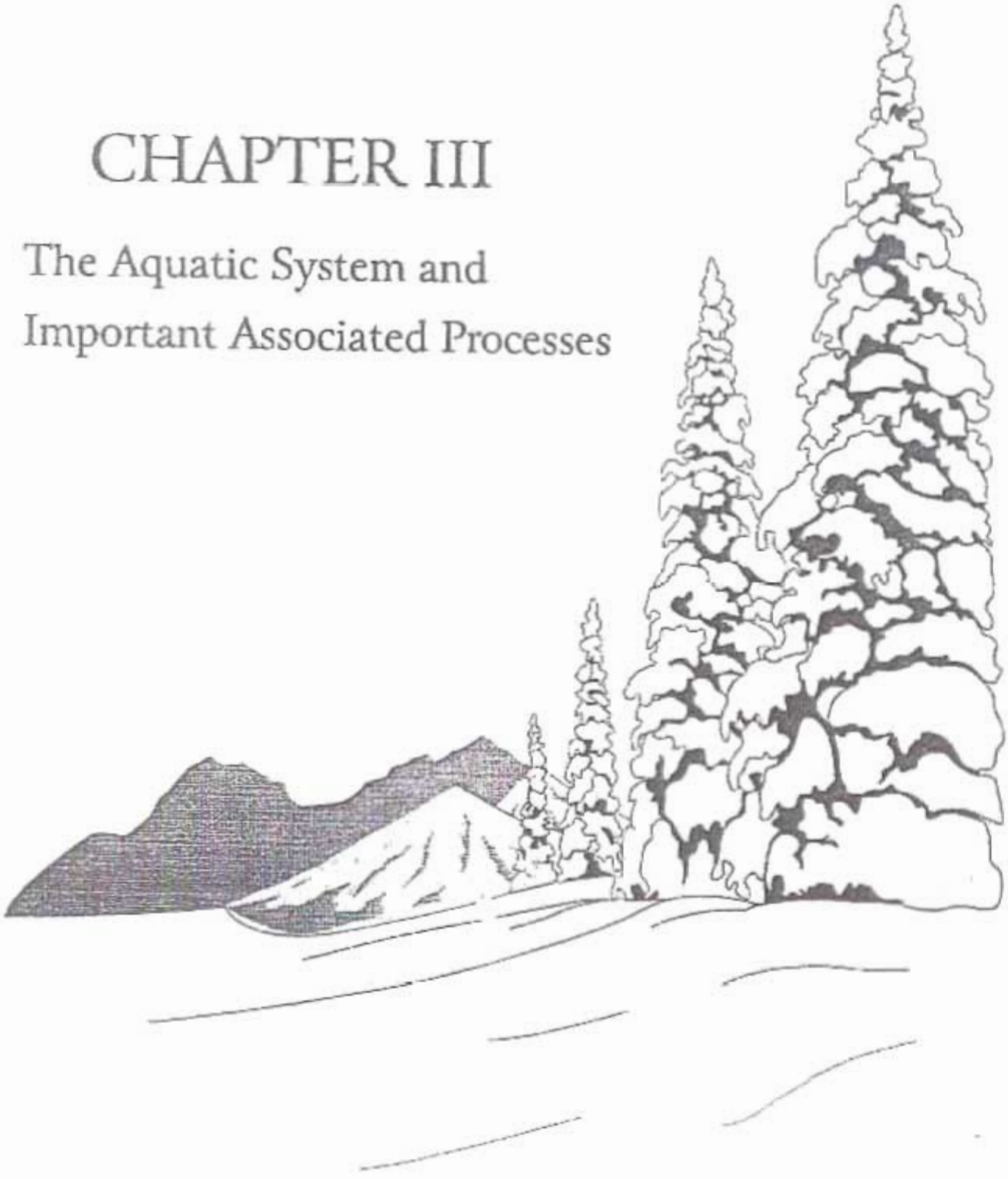
In the mid to late 1960's, harvest and road construction was extended on lower Titus Ridge, in the Bishop Creek area, and up into the Lick Creek drainage. The first roads and harvest units were put into the Cougar Creek and Copper Creek drainages.

In the early 1970's in association with one large timber sale, the first roads were put into the Stanza Creek area including the road that extends across Bear Creek and roads on the south side of Doolittle Creek. From the late 70's up until the 1987 wildfires, five large green sales consisting of clearcuts and partial cuts harvested approximately 1,600 acres and several spur roads were constructed.

Fire salvage has driven timber harvest in the Elk Creek Landscape since the 1987 fires. Elk Creek includes parts of four of the large fire salvage sales from 1987. The road construction associated with these sales included roads in the upper Lick Creek drainage, and extensions on lower Titus Ridge and north of Doolittle Creek. Since 1987, all timber sales in Elk Creek have been in conjunction with fire, drought related insect salvage, road hazard trees, or salvage of trees that were blown down by wind.

CHAPTER III

The Aquatic System and Important Associated Processes



AQUATIC SYSTEM

The aquatic system is discussed here beginning with sediment generation processes on the slopes above the channels. Climate, the primary driver of slope processes, is described in Chapter II. Stream flow and the configuration of channels is then described, followed by discussion in terms of habitat quality and fish populations.

GEOMORPHOLOGY

Bedrock in the Elk Creek basin consists of structurally complex, metamorphic, marine volcanic and sedimentary rocks that were deposited on mafic and ultramafic igneous, oceanic basement. The marine rocks have been strongly deformed while being scraped off the ocean floor and pushed onto the continent. They have been intruded by younger granitic rocks of intermediate composition, the roots of andesitic volcanoes. Contrast in the character and behavior of the bedrock units is the basis of the geomorphic terranes described below. Together, these rocks have been rapidly uplifted and deeply eroded. Rapid uplift and erosion continue today. Earthquakes felt in Happy Camp in recent years originate from subduction related coastal faults and movements related to Cascade volcanoes. Although there is no historical record of local, active faults or strong shaking, there is insufficient information to preclude the possibilities.

The topography consists of steep slopes (greater than 40%), and dispersed benches up to about 500 acres in size on moderate slope gradients (less than 40%). Soils on the steep slopes are thin in comparison with the thick soils on the benches. Differences in the origin and hydrology between these two slope classes result in strong contrasts in landslide and erosion processes.

GEOMORPHIC TERRANES

Geomorphic terranes are identified by differences in composition, history, topography and hydrology (see Figure 7, Geomorphic Terranes). They are the units used in describing ecological relationships and landslide processes. Each terrane has a unique set of characteristics and associated habitats. By relating terranes with the management activities, a practical estimate of the landslide contribution to stream sediment and opportunities to apply mitigation measures can be determined.

Alluvial Terrane (Qal)

This terrane occupies less than one percent of the Elk Creek Basin. The active, unconsolidated stream sediment in storage along broader, lower-gradient stream reaches. Composed of silt to boulder size particles, abundant anadromous fish-spawning habitat is associated with this terrane.

Glacial Terrane (Qg)

This terrane occupies ten percent of the Elk Creek Basin. The high elevation sites of Pleistocene alpine glaciers includes various erosional landforms and unconsolidated, weathered deposits of glacial erosion (moraines). This terrane occurs in the glacially carved valleys of north aspect and high elevation in the Marble Mountains. Small lakes (tarns), alpine meadows and bogs are found in the bottoms of these valleys.

ELK CREEK WATERSHED

GEOMORPHIC TERRANES

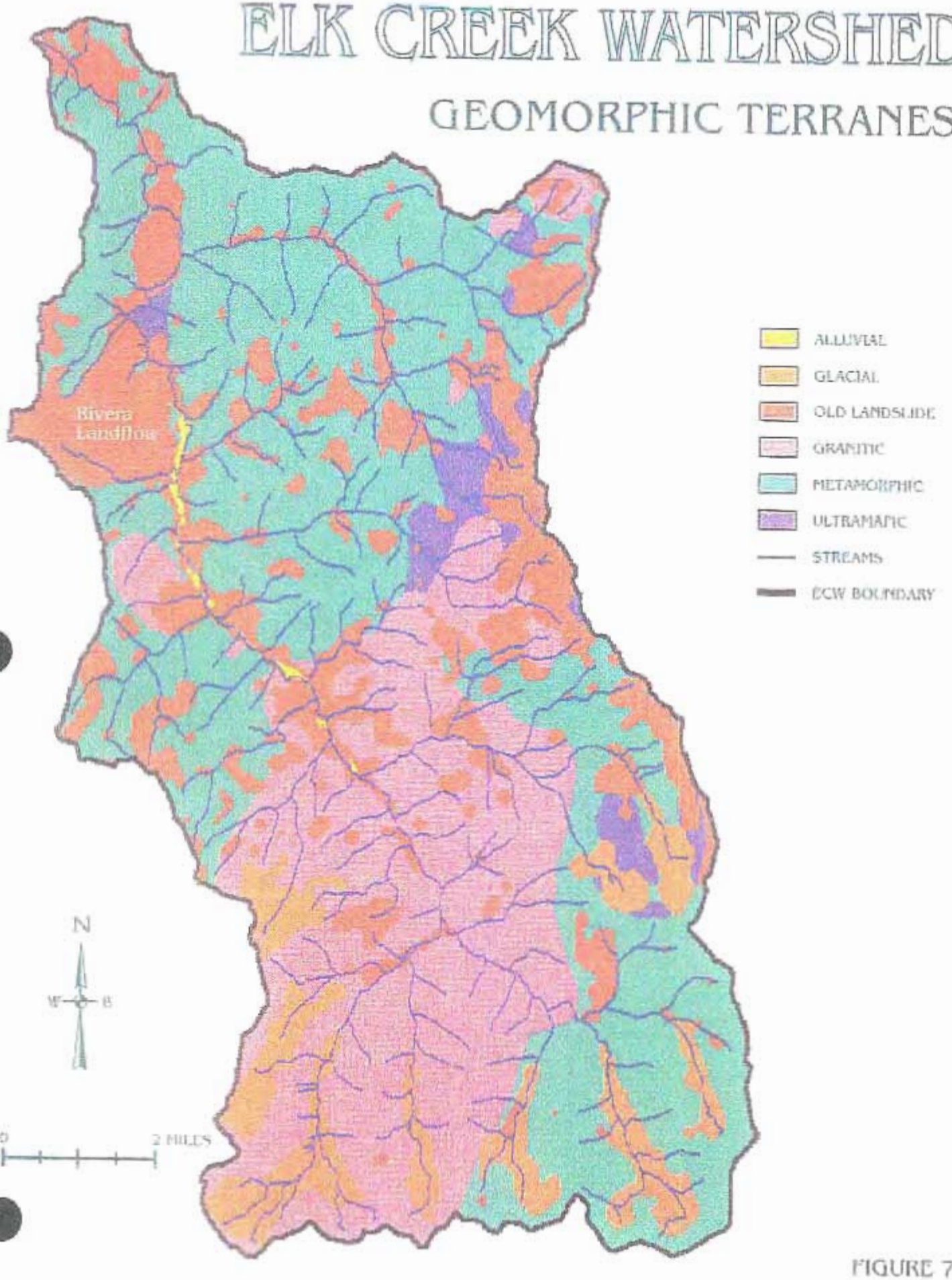


FIGURE 7

Old Landslide Terrane (Ools)

This Terrane occupies about 20% of the Elk Creek basin. It is composed of very thick (greater than ten feet, to as much as a few hundred feet), typically fine-grained, cohesive soils. The soils of this terrane began forming under ancient climates. They are presently a major source of landslides. Much of the area of this terrane has been involved in very large (up to a square mile) earthflow-slump landslides. Bedrock is extensively covered by these deposits. Blocks of rock in soil are composed of mafic, ultramafic igneous rocks and, less commonly, metasedimentary and granitic rocks. Slope gradients range from 5% to 85% and average about 45%. Small portions of this terrane are involved in active landslides during wetter years. Active earthflows in the assessment area are recognizable by stands where trees are tilted from vertical (jack-strawed) and distinctive, hummocky land forms. Soil moisture in active landslides is typically high. Ephemeral ponds are found in association with landslide scarps and very gentle slopes. Road construction can locally activate or accelerate activity of these landslides by altering drainage and/or the distribution of mass on the slope.

Granitic Terrane (gr)

This terrane occupies about 25% of the Elk Creek watershed. It consists of oceanic mafic (gabbro) and continental silicic (granodiorite, diorite) granitic rocks. Soils are thin to thick. Slope gradients range from 45% to 85% and average about 60%. Thick, soft, cohesive and loose, granular residual soils occur in belts that are genetically related to the deep, red soils of Old Landslide terrane.

Metamorphic Terrane (m)

This terrane occupies about 40% of the Elk Creek assessment area. It consists of metamorphosed sedimentary bedrock with thin (less than three feet) cohesive and granular soils. Landslides in this area typically involve thin soil mantles. Slope gradients range from 60% to 85% and average about 70%. Also found are debris slides and slumps that originate in old landslide deposits that are too small to be mapped as Old Landslide Terrane. Natural landslides often occur in soil accumulated at the head of draws (also known as zero-order basins) and along stream channels in soil accumulated from up-slope. The large number of potential landslide sites and low short-term probability of occurrence at any given site make them difficult to predict. Clastic sedimentary rocks in this terrane are typically resistant to weathering so form thin, coarse soils of distinctive vegetation. In the upper East Fork basin, native soils and fill of meta-andesite are more susceptible to debris sliding. Limestone is common in this terrane in the upper portion of the basin. Elsewhere, limestone occurs as small, local bodies. High solubility of the limestone results in local, irregular under-ground caverns.

Ultramafic Terrane (um)

This terrane occupies about five percent of the Elk Creek watershed. The bedrock of this terrane consists of peridotite and serpentinite. Locally, serpentinite is intensely fractured. Slumps occur in the deep, cohesive soils that form as a result of the greater susceptibility of these rocks to chemical weathering of the bedrock. The chemical character of these rocks (high magnesium, low potassium) results in distinctive biotic habitats.

LANDSLIDES

Landslides introduce large volumes of coarse sediment to streams during rare episodes of intense precipitation. This results in changes in the form of stream channels and the texture of the bed. Landslides also damage roads and other improvements. Fine sediment produced from landslides contributes to the supply of fine sediment that may infiltrate into spawning gravels and increase the turbidity of stream water.

Landslides include a variety of modes of movement of bodies of soil, rock, and organic debris under the influence of gravity. Movement is initiated as a result of reduction in strength and increase in stress. Most landslides occur in response to surface drainage, intense rainfall or melting snow, but are always of multiple causes. Typical causal elements include, soil strength reduced by water saturation, redistribution of mass by natural processes or management activities, the existence of dormant natural landslides, and earthquakes. Patterns of landslide behavior are associated with geomorphic terranes (Figure 8). Landslides are also distinguished as being natural, influenced by management activities, and activity associated.

Figure 8 LANDSLIDE HAZARDS OF THE GEOMORPHIC TERRANES

GEOMORPHIC TERRANE	CHARACTER OF LANDSLIDE PROCESSES	RELATIVE MAGNITUDE AND FREQUENCY OF HAZARD
METAMORPHIC	Thin soil, small landslides, moderate tendency for coarse debris flow, steep slopes	Low to Moderate
OLD LANDSLIDE	Thick soft soil, large landslides, moderate tendency for debris flow, earthflows may be persistent sources of large quantities of coarse and fine sediment, moderate to high surface erosion potential, susceptible to reactivation	High
GRANITIC	Thick soft soils, moderate size landslides, high tendency for fine sediment rich debris flows, high surface erosion potential	Moderate to High
ULTRAMAFIC	Thick soils, larger landslides, moderate tendency for debris flow of coarse and fine sediment	Moderate to High

Most recent landslide movements are storm related, the result of intense rain that occurred during the years 1955 to 1975 and 1982 to 1986. Two types of landslides are distinguished here: debris slides and earthflows. Debris slides originate in shallow soil on steep slopes. Debris slides often move off the source site as debris flows (also known as mud flows). Debris flows typically move through ephemeral and intermittent channels as thick slurries, to deposit on low gradient channels or be diluted by water in higher order channels. Such shallow slides are less likely to be reactivated at the same site. Some of the landslides are debris slides that occurred on earthflow landslides and may reoccur at the same site. Although there are patterns in occurrence of debris slides, prediction at a site is not feasible. Similar landslides occur at new sites under similar precipitation conditions, at rates that may only be approximated from past experience under similar conditions. Debris slides occur in all of the geomorphic terranes. The highest rates of debris sliding occur in granitic and old landslide terranes.

Earthflow landslides are the smallest number of all the mapped landslides, but are typically large and reactivated by intense storms. Earthflow landslides are significant contributors of coarse and fine sediment to streams. Earthflows are found exclusively in Old Landslide Terrane.

Vegetation is a significant element in the strength of soil. The fiber reinforcement of roots provides strong resistance to erosion. There are many effects of vegetation on slope stability (see Figure 9). In most cases vegetation has a net beneficial effect.

FIGURE 9 INFLUENCES OF VEGETATION ON SLOPE STABILITY (Modified from Greenway, 1987)

Key:(+) Tends to increase stability
(-) Tends to decrease stability
(+/-) May increase or decrease stability

HYDROLOGICAL INFLUENCES	
+	Canopy interception and retention of precipitation
+	Retention of precipitation by duff
+/-	Decayed roots provide paths for subsurface drainage
+/-	Depletion of soil moisture by evaporation and transpiration: beneficial if pore-water pressures are reduced, adverse if desiccation results in cracks that subsequently admit water to the soil
-	Increased surface roughness and permeability enhances infiltration
MECHANICAL INFLUENCES	
+	Roots increase shear strength of the soil
+	Roots anchor soil to competent foundation, provide buttress and arch support
+/-	Surcharge of tree mass increases normal and down-slope stress
-	Roots reduce soil density
-	Trees transmit dynamic wind stress to the soil
CHEMICAL INFLUENCES	
+/-	Chemical reactions among organic acids, ash lechate and soil that effect friction, cohesion, and mineral content of the soil

SOILS AND EROSION

Soils in the landscape outside of the wilderness have been mapped at the Order 2 level. The Wilderness is mapped at the Order 3 level. The Order 2 soils mapping is higher intensity soils inventory than the Order 3 mapping with many more soil profiles checked and much more ground surveying. However, both levels of inventory are adequate for analysis purposes. A useful attribute derived from the soil map units is potential Erosion Hazard Rating (EHR) which is relative ranking of the erodibility of different soils without vegetative ground cover. There are four rankings from Low to Very High with Low EHR soils generally rocky on flat slopes and Very High typically granitic soils on steep slopes. The amount of each EHR soil group in each subbasin is displayed in Figure 10.

Figure 10 AMOUNT OF SUBBASIN IN EHR SOIL GROUP

SUBBASIN	Low EHR %	ModerateEHR %	High EHR %	Very High EHR %
UPPER ELK CREEK	1	21	18	59
EAST FORK ELK CREEK	1	10	89	1
LOWER ELK CREEK	2	19	62	17
Bear Creek	>1	8	63	28
Johnson Creek	0	8	60	32
Bishop Creek	2	45	49	4
Doolittle Creek	0	15	67	18
Cougar Creek	3	10	87	0
ELK CREEK TOTAL	1	19	52	28

STREAM FLOW AND GRADIENT

Water quality of streams in the assessment area is very good. Turbidity is very low, except during intense precipitation or landslide activity. The water quality data available includes ten years of daily turbidity in Elk Creek and undocumented observations of turbid flow events in Elk Creek. Average daily discharge-rate record exists for nearby Indian Creek since 1957.

Streams in the Elk Creek basin are high-gradient, coarse-bedded and, due to on-going uplift and climate of the region, erosion dominated. Channels typically run in steep, narrow gorges. Although influenced by large landslides, bedrock structure and composition, channel patterns are dendritic (branching).

Roads influence stream flows by decreasing infiltration on the road surface and increasing direct storm run off. This contributes to increased peak flows and decreased summer low flows. However, the road density is low enough in Elk Creek that changes are hard to detect in all but the smallest streams.

Indian Creek, similar in many ways to Elk Creek, has summer low flows of about 40 cubic feet per second (CFS). The average flow (exceeded 50% of the time) is about 400 CFS. Storm flow (with a return probability of once in a few years) is about 4,000 CFS. The peak discharge during the flood of 1964 has been estimated to be 40,000 CFS. Roughly half of the total annual discharge of the streams occurs in close association with storms. The remainder is delayed by movement through soil and bedrock, emerging at springs and feeding summer flow. Poorly integrated drainage networks and thick soil in old landslide terrane result in less efficient drainage. The steep slopes, thin soils, and well integrated drainage of the Metasedimentary Terrane result in more efficient drainage. Since flood data has been collected only in the last few decades, statistical analyses have a high degree of uncertainty. The return probability of a flood like that of the winter of 1964-65 is about once in 100 years. Several floods in the past few hundred years have been of a magnitude similar to the 1964 flood. These events have been documented from the study of flood deposits in the Klamath River and other nearby basins. The Indian Creek stream gage recorded peak flood discharge in the range of 10,000 to 20,000 CFS in 1971, 1972 (3 events), 1974, 1980, and 1982. Such events are more frequent during wet trends (as described in the Climate section). Coghlan (1984) concluded that the return probability of 1964 style precipitation, and thus flooding, would occur once in 45 to 50 years, and once in 25 to 30 years for the 1955 flood (approximately 20,000 CFS peak discharge in Indian Creek) during wet trends.

In the long-term, stream discharge, driven by average annual rainfall of 50 inches, provides erosional power that exceeds that necessary to transport the fine sediment delivered to channels. Sediment is generated and transported primarily during peak stream-discharge events. There are two important aspects of this

general behavior that are most relevant to the assessment of effects: 1) fine sediment in traction or suspension may infiltrate into spaces in the coarse framework of the channel bed, and 2) deposition of coarse sediment and included fine sediment delivered by landslides. Fine sediment generation and transport events are seen a number of times every year (see Figures 13a, average monthly turbidity; and 13b, maximum monthly turbidity). Turbid stormflow occurs about five percent of the time. Storm-flow turbidity typically lasts a few hours to a few days after cessation of rainfall. The coarse fraction is less easily transported and may be temporarily stored in stream channels as bars, terraces and debris jams (Lisle, 1987) and local alluvial plains. Madej (1987) found the residence time of coarse sediment in Redwood Creek to be on the order of decades for active alluvium and hundreds to thousands of years for alluvium stored in older stream terrace deposits. In a study of stream bed elevation from U.S. Geological Survey stream gages, Lisle (1981) found a decade high rate of channel bed adjustment due to the large input of sediment from the 1964 flood event.

One of the delivery mechanisms of coarse woody debris (tree stems, roots and branches) to stream channels is by debris flow. Such material often accumulates as debris jams that form in first through fourth order streams. Temporary dams formed by landslide deposits or debris jams in channels have occurred at Murderer's Bar (circa 1955), Nordheimer Flat (1964), North Russian Creek (circa 1974) of the Salmon River (Klamath Mountains) (Juan de la Fuente personal communication, 1989) and at Happy Camp (1964). Such dams occur on a variety of scales and may fail suddenly, resulting in floods.

FINE AND COARSE SEDIMENTATION

Sediment can affect the fish rearing potential of steams by altering substrate composition and pool: riffle ratios as well as reducing the ability of the bottom substrate to support food organisms important to many aquatic and terrestrial species. Sediment can affect spawning gravels by filling voids and reducing water circulation. Well oxygenated water is needed by embryos for higher survival. After hatching, alevins must work their way through the gravel to enter the stream. This effort can be impeded and even blocked by excessive sedimentation. Channel aggradation resulting from sedimentation can reduce channel stability, increase egg loss during high flows, and reduce pool area in the streams. Winter habitat deteriorates when sediment fills streambank and streambed crevices (embedding) reducing winter holding capacity and/or hiding places during high flows.

Except for broad, coarse alluvial deposits in Elk Creek, upstream of the mouth of the East Fork, relatively little sediment is stored in stream channels. Channels in Metasedimentary and Granitic Terrane are typically cut in bedrock. In the Old Landslide Terrane, channel banks are commonly of earthflow landslide deposits, so there is less mechanical resistance to erosion. Most of the coarse sediment generated in stream channels is delivered by landsliding. Fine sediment is generated by surface erosion of disturbed areas, as well as landsliding.

Coarse sediment production associated with rare, intense storms has been estimated by projecting the volume of landslide movement during the period 1964 through 1975 (see King-Titus Fire Recovery Project FEIS, Chapter IV and Appendix H). Landslide production rates (Figure 11) for natural, harvested acres and roads were used to assess the relative contribution of these activities on geomorphic terranes. The conclusion of this estimate is that management related ground disturbance results in approximate doubling of intense storm related landslide production compared to an undisturbed basin. This change is likely expressed as an increase in the magnitude and duration of disturbance of the riparian habitat that results from such episodes of precipitation and sediment production. The dominant mechanisms of sediment production are described in Figure 12.

FIGURE 11 LANDSLIDE PRODUCTION ESTIMATES FOR GEOMORPHIC TERRANES

GEOMORPHIC TERRANE	LANDSLIDE PRODUCTION (Cubic Yards Per Acre)		
	Natural	Harvested	Road
Metasedimentary (1)	1.4	1.6	145
Metavolcanic (2)	3.0	15.0	160
Old Landslide (1,3)	9.0	27.0	329
Granitic (1)	4.8	22.2	198
Ultramafic (1)	0.4	7.0	34.2

(1) Data modified (annual rate to period) from Amaranthus and others, 1985.
(2) Relative rate based on local conditions.
(3) Mean of Colluvial and Hummocky terranes of Amaranthus and others, 1985.

Figure 12 CLASSIFICATION OF SEDIMENT SOURCES

	CHRONIC - FREQUENT, FINE SEDIMENT	EPOSODIC - RARE, FINE AND COARSE SEDIMENT
NATURAL	•SURFACE EROSION OF BARE SOIL -BURNED SURFACE -UNVEGETATED SURFACE •CHANNEL EROSION	•DEBRIS SLIDES OF THIN SOIL ON STEEP SLOPE •REACTIVATION OF EARTHFLOW LANDSLIDES OF THICK SOIL ON GENTLE SLOPES
MANAGEMENT RELATED	•SURFACE EROSION OF ROADS -DUST FROM DRY ROAD -MUD FROM WET ROAD -EROSION FROM BURNED, LOGGED, PILED SURFACE	•DEBRIS SLIDING OF ROAD FILL OR CUT •DEBRIS SLIDING DUE TO CONCENTRATED DRAINAGE FROM ROADS •AGGREVATION OF EARTHFLOW BY CHANGE OF DRAINAGE OR SOIL DISTRIBUTION

TURBIDITY

Elk Creek and its tributaries are a source of domestic and irrigation water for single-family residences. Low rainfall in recent years has resulted in increasing use of creek water in homes and for irrigation. A few small placer gold mines have been active in recent years.

Daily turbidity measurements of Elk Creek by the Happy Camp Water District provides evidence of the frequency and magnitude of events of turbid storm flow. Peaks in turbidity mark the times when fine sediment is introduced into spawning gravels. Figures 13 a-c (average monthly turbidity, a; maximum monthly turbidity, b; and monthly precipitation, c) summarize daily (July 1980 to December 1989) turbidity observations by the Happy Camp Water District at the intake of the facilities near the mouth of Elk Creek in Happy Camp. To facilitate comprehension of the large body of data, daily values of turbidity and precipitation are averaged for each month. In addition, the maximum value in a month is displayed. Generally, months with high average turbidity and precipitation had many days of turbid flow. When average turbidity and precipitation are low, a few days of turbid flow may have been experienced. The correlation between turbidity and precipitation indicates the strong influence of precipitation intensity on

turbidity. The high levels of turbidity in the winters of 1982 and 1983 are associated with the 150% of average annual precipitation that occurred in those years.

Turbidity is measured in Jackson Turbidity Units (JTU), an index of the transmittance of light through the water. In the assessment area, turbidity is caused in large part by suspended sediment concentration, and dissolved or suspended organic materials in the water. Turbidity is used as an index of potability in evaluating water quality for domestic uses. The town water supply is treated with flolulent and filtered in a sans/charcoal bed filter to clarify water prior to delivery to customers.

Figure 13a AVERAGE MONTHLY TURBIDITY (JULY 1980 - DEC 1989) FOR ELK CREEK AT HAPPY CAMP

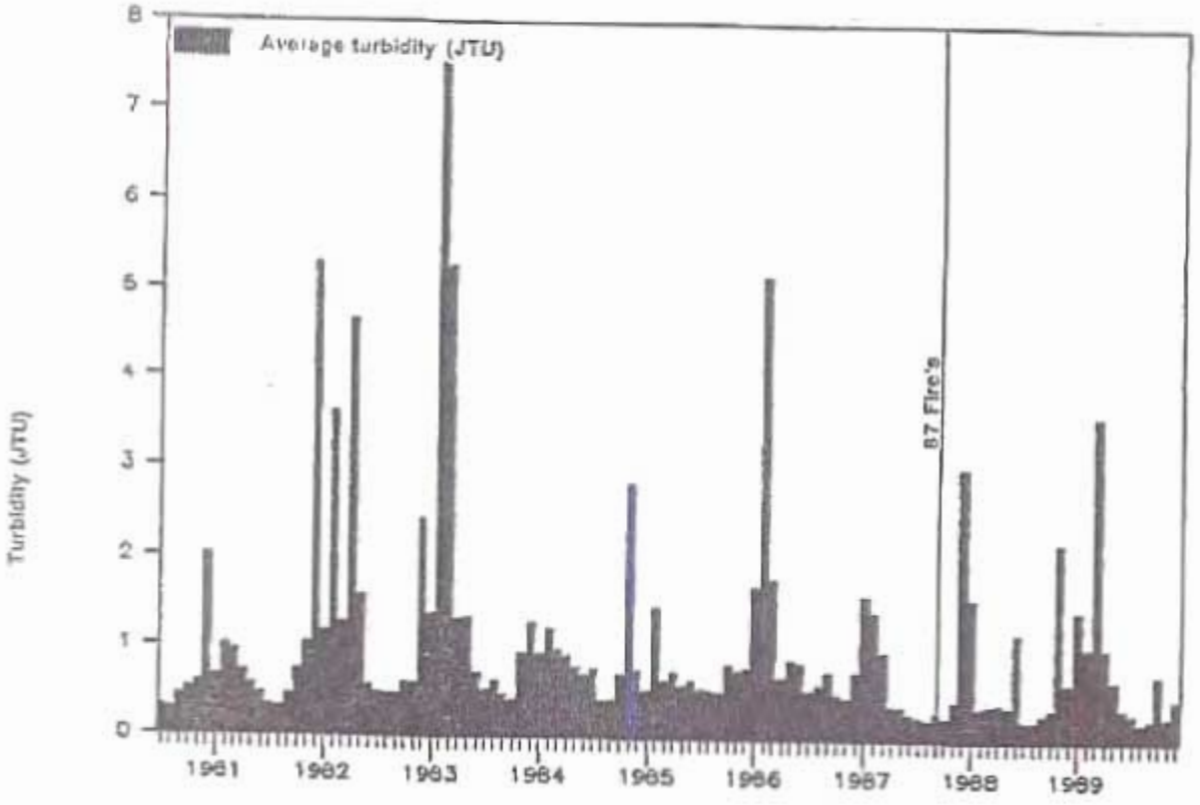


Figure 13b MAXIMUM MONTHLY TURBIDITY (JULY 1980 - DEC 1989) FOR ELK CREEK AT HAPPY CAMP

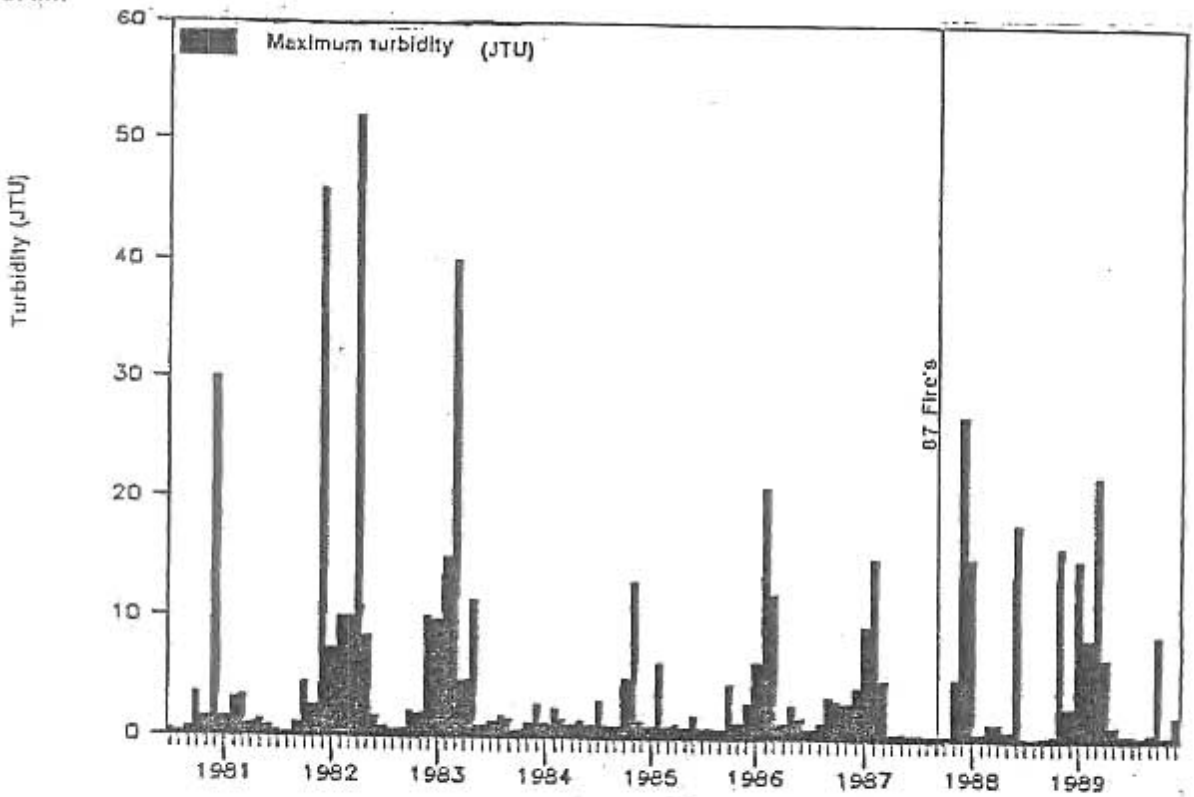
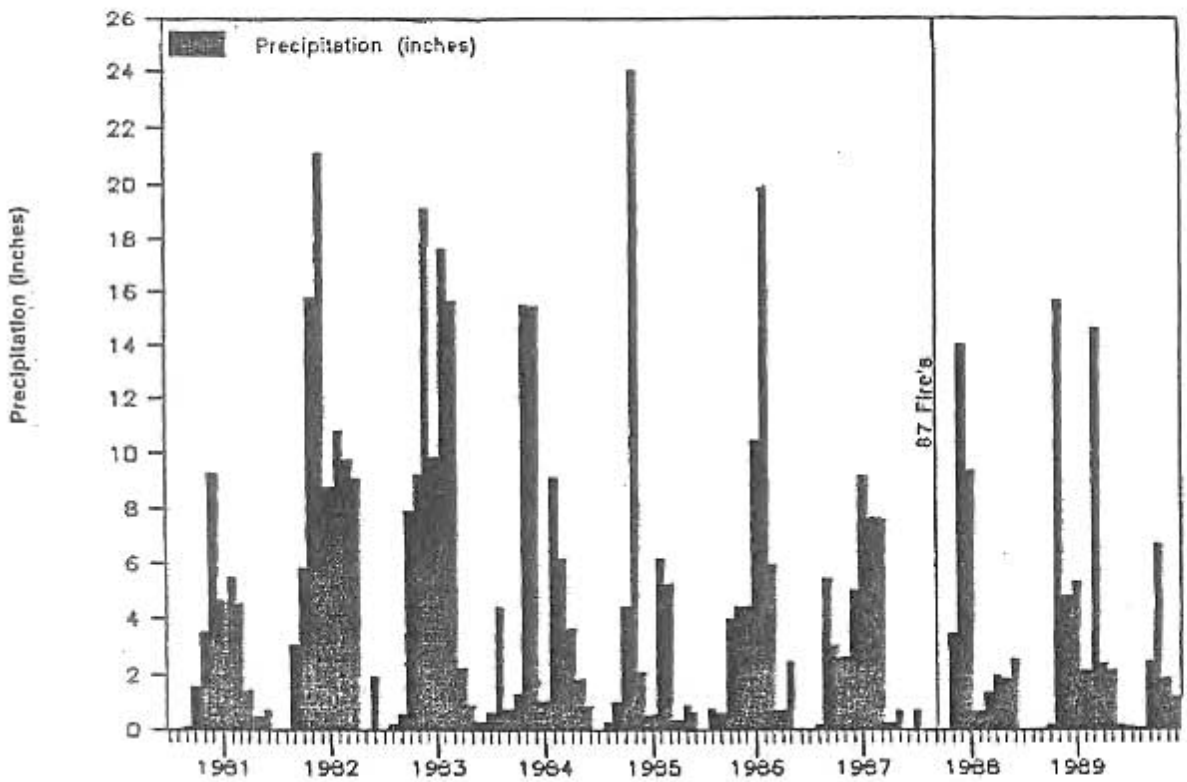


Figure 13c MONTHLY PRECIPITATION (JULY 1980 - DEC 1989) FOR ELK CREEK AT HAPPY CAMP



RIPARIAN AREAS

Riparian vegetation is an important link between the aquatic and terrestrial ecosystems. Riparian corridors provide travel routes for both plants and animals within the watershed and between watersheds.

Riparian vegetation exists in a dynamic system that is influenced by both aquatic disturbances, like floods, and terrestrial disturbances, like fire and wind.

The summary of terrestrial vegetation described in the next chapter, is generally applicable to riparian vegetation. The effects of disturbance from flood events play an added role as a localized cause of injury and mortality to conifers to reduce densities. However, most riparian-dependent plants are highly adapted to survive mechanical disturbance from floods, and can often regrow rapidly from only a piece of root or stem. Fire frequency and history is similar to that of the upland areas, but because of higher relative humidity and fuel moisture from adjacent streams, the intensities were likely much less. Lower fire intensities in riparian areas can also be attributed to their location at the bottom of the slopes. Moist fuel conditions make it less likely that the larger material is consumed by fire in riparian areas. This leaves plenty of large woody material available to make its way to the stream course from adjacent riparian areas. This large woody material performs an important role in stream morphology and tends to increase habitat values for spawning and rearing of fish.

RIPARIAN RESERVES

The Riparian Reserve (Figure 14) consists of lands where riparian dependent resources receive primary emphasis, and where special standards and guidelines apply. They include those portions of a watershed required for maintaining hydrologic, geomorphic, and ecologic processes that directly affect standing and flowing water bodies such as lakes and ponds, wetlands, streams, stream processes, and fish habitats. Also included are the habitat needs of a variety of animals such as mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets and northern spotted owls.

Riparian Reserves include the land adjacent to all permanently flowing streams, constructed ponds and reservoirs, wetlands, lakes and natural ponds, seasonally flowing or intermittent streams, floodplains, and unstable and potentially unstable land (including earthflows).

INTERIM RIPARIAN RESERVES

The ROD identifies Riparian Reserve widths to be applied in the interim period until Watershed Analyses are completed. These widths are as follows:

a. Fish-bearing streams - two site potential trees or 300 feet, whichever is greater.

b. Permanently flowing, non Fish-bearing streams - one site potential tree or 150 feet, whichever is greater.

c. Constructed ponds and reservoirs, along with wetlands greater than one acre - one site potential tree or 150 feet, whichever is greater.

ELK CREEK WATERSHED

Interim Riparian Reserves and Roads

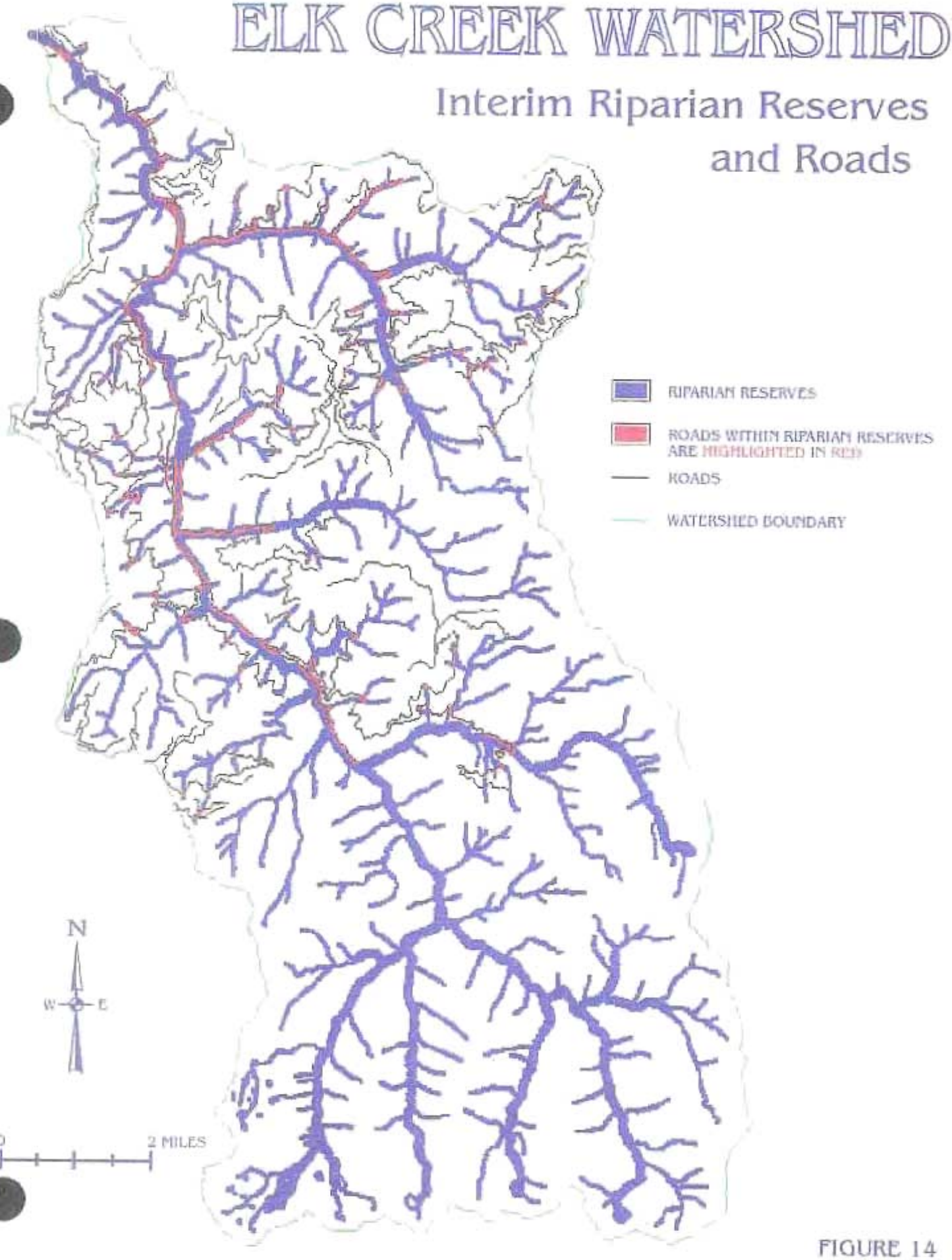


FIGURE 14

d. Lakes and natural ponds - two site potential trees or 300 feet, whichever is greater.

e. Seasonally flowing or intermittent streams - one site potential tree or 100 feet, whichever is greater.

f. Floodplains

g. Wetlands less than one acre - to the outer edge of the riparian vegetation.

h. Unstable and potentially unstable land (including earthflows)- the extent of unstable and potentially unstable areas.

MANAGEMENT GOALS

Riparian Reserves are delineated and protected as a major component of the Aquatic Conservation Strategy in the ROD. The primary goal for this land is the maintenance of a healthy, functioning ecosystem where the aquatic and terrestrial components are properly linked. Riparian Reserves are used to maintain and restore riparian structures and functions of the aquatic system, confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed. The Riparian Reserves will also serve as connectivity corridors among the Late-Successional Reserves (USDA, 1994).

DESIRED CONDITION

The desired condition for the Riparian Reserve is the presence of healthy plant and animal communities living in an environment where physical and biological processes are maintained within a range similar to that under which these communities evolved. Vegetation will be vigorous and healthy, and in tune with the local environment. There will be a great variety of biotic communities within the Riparian Reserve. In the case of intermittent streams on south aspects underlaid by shallow soils, they will include manzanita, live oak, knobcone pine, ponderosa pine, and other drought-resistant species. Along the floodplains of major streams, they will include a multitude of species, including firs, pines, and phreatophytes such as maples, alder, and willow. In unstable areas, the desired plant communities will also depend on local site conditions, with attention to deep-rooted species capable of providing root support to the slope, and transpiring water from deep in the soil mantle. Wildlife habitat needs will play an important role in desired plant communities in most reserves. Emphasis will be placed on native species. In meadow areas, overhanging banks with herbaceous and/or shrubby vegetation provide canopy cover. Riparian Reserves provide shade, thermal buffering, large wood, organic matter, habitat, nutrient cycling, bank stability, and sediment filtration as appropriate to site capability.

Delineation of Riparian Reserves at the Project Level

Numerous species identified in the ROD were intended to benefit from the Riparian Reserves, including mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets and northern spotted owls. Information regarding the ecological requirements of most of those species is lacking. Due to this lack of information, ***it is recommended, as a result of this analysis, that the interim Riparian Reserve widths not be reduced on Elk Creek.*** More information may be available in the future as the Forest begins to implement surveys for late-successional and old-growth forest related species.

Maintenance of geomorphic and hydrologic function may locally require expansion of the Riparian Reserve boundaries. The need for such expansion is properly assessed at the project level.

Guidance for Field Delineation of Riparian Reserves

Intermittent Streams- These are defined rather simply in the ROD as: "any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria." Project teams will need to field verify intermittent streams identified by this analysis.

Unstable and Potentially Unstable Lands- These lands are defined in the FSEIS (1994) as follows:

> lands which are prone to mass failure under natural conditions (unroaded, unharvested), and where human activities such as road construction and timber harvest is likely to increase landslide distribution in time and space to the point where this change is likely to modify natural geomorphic processes (such as the delivery of sediment and wood to channels), which will in turn affect the aquatic ecosystem including streams, springs, seeps and wetlands, and marshes. The following types of land are included: [1] active landslides and those which exhibit sound evidence of movement in the past 400 years; [2] inner gorges; [3] those lands identified as unstable by geologic investigations using the criteria stated above (includes lands already classified by the Forest Service as unsuitable for programmed timber harvest due to irreversible soil loss, and by the BLM as nonsuitable fragile lands). Highly erodible lands (i.e. lands prone to sheet and rill erosion) are not included in this definition (FEMAT, 1993).

The Klamath National Forest Draft Land Management Plan identified active landslides, inner gorges, toe zones of slumps and earthflows, and severely dissected granitic lands as unsuited for programmed timber harvest due to slope instability. Of these, active landslides, inner gorges, and toe zones have been mapped and are in the GIS. The severely dissected granitic lands are not mapped.

Future Projects will need to verify the existing mapping of the following unstable and potentially unstable lands:

Inner gorge

Slumps and Earthflows - Many toe zones of slumps and earthflows were not mapped on the geomorphic data layer, and projects should refine this mapping. Slump and earthflow deposits are typically very sensitive to disturbance, each feature needs to be carefully evaluated.

Severely Dissected Granitic Lands

Other Unstable Lands - swales at the heads of low order drainages are potentially unstable. These lands have not been mapped, and will need to be identified by the project. In addition, there are many other combinations of slope, soil type, rock structure and groundwater conditions which are potentially unstable, and they can only be identified at the site level by qualified personnel.

Determination of Potential Tree Height - Potential tree height should be determined at the site level. Guidelines are currently being developed in Region 5 and 6.

Qualifications of Personnel Doing Field Delineations - Personnel delineating intermittent streams, unstable lands, and hydrologic influence zones must be skilled in the appropriate earth and biological science disciplines.

Guidance to Project Teams In Delineating and Managing Riparian Reserves

The following guidelines are offered to assist project level teams in dealing with the Riparian Reserve.

1. Riparian Reserve widths applied on Elk Creek will be equal to or greater than the interim widths identified in the ROD. No reductions in width are recommended until sufficient information is acquired on habitat needs of identified species.

2. In delineating individual Riparian Reserves, teams should stratify them by primary function. For example, the inner gorge functions as a source of sediment, wood, shade, and habitat for certain species. These are the attributes which should dictate the actual widths delineated in the field. Delineations should be guided by the inherent physical and biological attributes of the site.

3. Project teams must utilize new wildlife/vegetation data as it comes available to adjust Riparian Reserves as needed.

4. Project teams should field verify existing mapping of unstable areas and intermittent streams, evaluate other lands for inclusion in the Riparian Reserve, and update the data base. Monitoring will then allow tracking of changes in the area and distribution of the Riparian Reserve.

5. Active management of the Riparian Reserves will require development of vegetation management prescriptions which meet the needs of geomorphic function as well as plant and animal habitat. It is essential that an interdisciplinary team develop these prescriptions due to the fact that desirable conditions for some values may conflict with those for others.

To assess the vegetative condition of these reserves they have been separated into five different categories. These are: 1) areas with greater than 40%stocking of conifers, considered fully stocked; 2) areas with greater than 70% stocking of trees but less than 40% stocking of conifers, considered fully stocked with hardwoods; 3) forested areas with less than 70% stocking of trees, considered not fully stocked due to site potential or disturbance; 4) plantations, generally fully stocked but with young trees and; 5) unforested areas, meadows, wetland brush areas and rock outcrop. The summary of the above described conditions is displayed in Figure 15. Figure 17 shows subbasin location.

Figure 15 PERCENT OF RIPARIAN RESERVE AT VARIOUS STOCKING LEVELS BY SUBBASIN

SUBBASIN	TOTAL ACRES IN RIPARIAN RESERVE	STOCKED >40% CONIFERS	STOCKED >70% TREES, <40% CONIFERS	<70% TREES	PLANTATIONS	UNFORESTED
ELK CREEK TOTAL	12,313	44	10	29	5	12
UPPER ELK CREEK	4,218	48	4	27	0	20
EAST FORK ELK CREEK	1,865	47	6	30	10	7
LOWER ELK CREEK	6,112	39	14	31	7	9
Bear Creek	1,268	40	12	27	1	20
Johnson Creek	310	54	0	42	2	2
Bishop Creek	347	47	5	36	3	9
Doolittle Creek	784	31	10	48	5	6
Cougar Creek	354	31	8	35	23	3

WATER TEMPERATURE

Several recording temperature gages were located in Elk Creek and tributaries during the summer of 1993. The gages were at the same locations where stream flows were measured. The peak temperatures recorded are displayed in Figure 16. The stream temperatures are generally highest in the largest streams, the streams with the largest watersheds, as Figure 16 indicates.

Figure 16 PEAK STREAM TEMPERATURES

THERMOGRAPH	ACREAGE	1993	1992	1991
Elk Creek above Bear Creek	20,400	65 F*		
Bear Creek	6,700	62 F		
Johnson Creek	1,600	57 F		
Bishop Creek	1,800	59 F		
Doolittle Creek	4,000	62 F		
Cougar Creek	1,700	62 F		
East Fork Elk Creek	10,000	65 F	68 F	68 F
Elk Creek at 5-mile Bridge	60,000	67 F	73 F	71 F

*The peak temperature of Elk Creek above Bear Creek is estimated from the relationship between temperatures at that location and the other streams. The thermistor became dewatered during the hottest day of the year.

The draft LMP has identified 69 degrees as desired temperature. That temperature is based on a level where fish growth is reduced and is mentioned here as a reference. Water temperatures in the tributaries generally meet desired future conditions with summer measurements ranging from 48 to 70 degrees Fahrenheit. However, the mainstem has averaged 70 degrees Fahrenheit during 1991-1993 (average seven day maximum) at a site approximately four miles above the mouth.

As water temperature increases, less of the benefit from food intake is converted to growth and improved fitness. The aquatic species must use more calories to maintain a higher metabolic rate. In some species this can cause increased mortality.

Riparian vegetation is important in maintaining optimal stream water temperature. Stream water temperature is primarily increased by removing riparian vegetation and by exposing the stream to direct solar radiation. Adjacent air temperatures also influence stream water temperature at the air/water interface.

The 1964 flood removed a majority of the shallow rooted trees such as alders that provided shade. By increasing the number of conifers and firmly rooted deciduous trees just beyond the alder line, it is expected that greater stream shading will result.

COARSE WOODY MATERIAL

Riparian vegetation is also an important recruitment source for Coarse Woody Material (CWM). CWM or key wood is defined as pieces at least two feet in diameter and 50 feet in length. In streams, CWM provides a diversity of spawning and rearing habitats for aquatic species and anadromous fish. In general, studies indicate that close to 100% of the CWM found in stream channels comes from trees growing within a distance from the channel that is equal to the height of one average tree (FEMAT, 1993). Steep slopes can facilitate entry of CWM. Larger order streams (4th or larger) tend to recruit CWM during storm and/or fire events when debris torrents or high flows deposit organic material from the smaller order tributaries. Terrestrial insects are important food items for aquatic species. Leaves and pieces of wood are an important source of food to aquatic invertebrates. Algae growing on gravel and cobble substrate is the major primary producer of food for some aquatic invertebrates. However, in most streams in this area, the benefit from exposing substrate to solar radiation for increases in primary production is overwhelmed by the need for canopy to reduce water temperature.

After the 1964 floods, several small sales occurred which were designed as flood salvage or stream clearing sales. Woody material was removed from the stream and the adjacent area. During floods, concentrations of woody material tends to get caught by the bridges and block water flow. Backed-up flood waters can increase damage to adjacent homes and facilities. Action was taken after the 1964 and 1974 floods to help remove the logs from the system before they contributed to flood damage. This past action has contributed to findings that current levels of CWM are below desired conditions.

DISTRIBUTION OF FISH POPULATIONS

Elk Creek and some of the smaller creeks provide anadromous fish spawning and rearing habitat. The major factors influencing habitat quality are: stream flow and gradient, fine and coarse sedimentation, especially in the material that forms the bed of the stream (substrate), available spawning gravels, the number and frequency of primary pools, riparian vegetation, water temperature, and the number of pieces of coarse woody material within the perennial stream. Figure 17 shows the complexity of these relationships.

Streams have been categorized as **fish bearing, permanently-flowing non fish-bearing streams**, and **seasonally-flowing or intermittent streams**. Figure 18 illustrates the distribution of these stream types within the watershed. This figure was created through use of GIS modeling and field verification.

Climate ⟷ Streamflows

Landform Processes

Stream Temperature

Sediment Production

Coarse Woody Material

Riparian Conditions (Shade & Habitat)

Water Quality

Habitat Type ⟶ Aquatic Species

Ocean Habitat Conditions ⟶ Anadromous Fish

FIGURE 17

ELK CREEK WATERSHED

STREAM CLASSIFICATIONS and SUB-BASINS

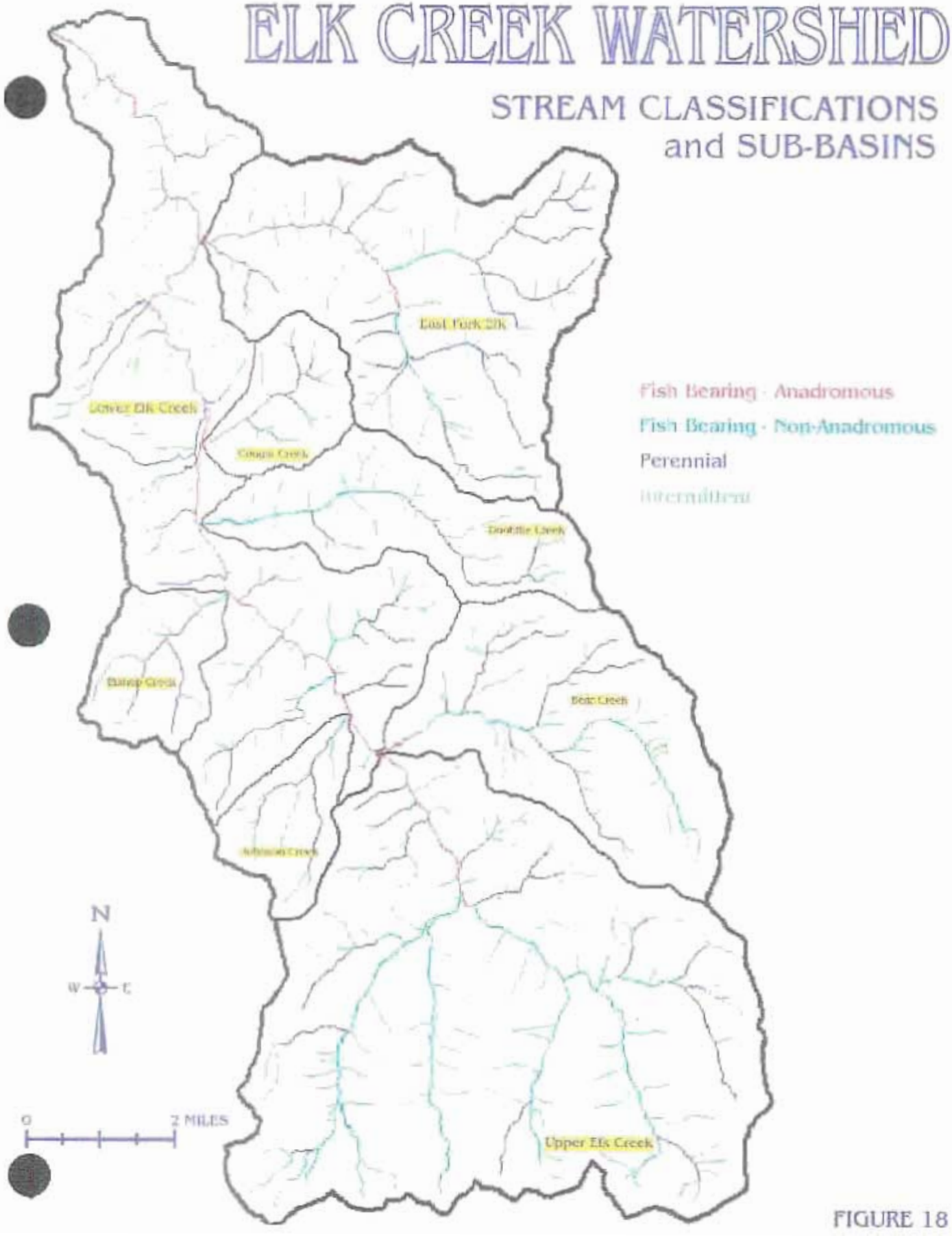


FIGURE 18

The extent of fish bearing and non-fish bearing streams were identified through field surveys. The field test used to identify intermittent streams relates to the accumulation of organic litter. If a channel is covered with a layer of decomposing duff or living vegetation, annual scour is assumed to not occur and the stream is not considered intermittent. If channel is covered by only a light layer of recent litter fall, annual scour is assumed to occur and the stream is considered intermittent. Through field verification, a trend was identified that could be used to model the location of intermittent streams. In most cases, any draw that drained an area of at least 20 acres was found to have annual scour. GIS modeling for mapping riparian reserves was based on this assumption. There are 249 miles of streams in the basin, 128 miles intermittent and the rest perennial.

There are approximately 51.6 miles of fish bearing streams in the Elk Creek landscape. Fall-run steelhead (*Oncorhynchus mykiss*) are found within Bear, Cougar, East Fork of Elk, and mainstem Elk Creeks, approximately 21 miles. Spring-run steelhead, a sensitive species, are found within the lower 16.5 miles of mainstem Elk Creek. Coho salmon (*Oncorhynchus kisutch*), a recently petitioned species, is found within the lower 9.2 miles of mainstem Elk Creek and in the lower .3 mile of the East Fork of Elk Creek. Fall-run chinook salmon (*Oncorhynchus tshawytscha*) are found within the lower 14.3 miles. Resident trout (*Oncorhynchus mykiss*) occupy all the fish bearing areas which include perennial streams: Bishop, Doolittle, Granite, Johnson, Lick, Rainy Valley, Stanza, Toms Valley, Twin, and Upper Elk, tributary to the East Fork of Elk.

The above species rely on the streams within Elk Creek for all life stages (migration, spawning, incubation, rearing, and holding). Fish populations flow up and down all the streams listed above with anadromous fish also using the migration paths leading to, from, and within the Pacific Ocean. Adult fall-run chinook are found within the landscape from late September to early November, adult coho are found mid December to January, adult spring-run steelhead are found July to April, adult fall-run are found October to April, and adult winter-run are found from November to May. Young salmon are found within the landscape year-round, with steelhead remaining up to three years before outmigrating to the Klamath River.

Other anadromous species include the Pacific lamprey (*Lampetra tridentata*). Pacific lamprey spawn in the spring. The lamprey young (ammocete) remain in the substrate up to seven years before outmigrating to the Klamath River and the Pacific Ocean.

SPAWNING COUNTS

Spawning counts in mainstem Elk have been systematically completed since the fall of 1988 for chinook and steelhead with occasional sightings of holding coho salmon. In 1988, four coho salmon were found in the East Fork of Elk Creek, and eleven were found in the lower five miles of mainstem Elk Creek. One coho salmon was found in both 1990 and 1993 within the mainstem. Figure 19 shows redd counts for chinook and steelhead. (A redd is a nest where the female deposits her eggs and the male fertilizes them.)

Figure 19 REDD COUNTS FOR CHINOOK AND STEELHEAD

YEAR	STEELHEAD	CHINOOK
1988	Not taken	96
1989	76	103
1990	104	37
1991	24	34
1992	71	13
1993	3	25
1994	26	future

Bioenhancement with Iron Gate Hatchery fall chinook occurred in 1984, 1986-1991. Forty thousand fingerlings were placed in a rearing pond adjacent to Elk Creek and released into the creek at yearling size. Bioenhancement has been stopped due to concerns with genetic mixing of hatchery and natural stocks. Without bioenhancement, the number of chinook redds in future years will likely decline. Coho salmon smolts from Iron Gate Hatchery were released in 1986-1989, but the number of returning adults from this effort is unknown.

In 1989 an estimate based on spawning habitat indicated that mainstem Elk could accommodate 76 chinook and 228 steelhead redds with no multiple use of available gravels (West, 1990).

HABITAT CONDITIONS

Fishes in small streams utilize specific habitat types throughout their fresh water life cycles in response to different spawning, feeding, and over-wintering requirements (Gorman and Karr, 1978). Stretches of stream at least one channel width in length are classified into habitat types based on channel characteristics. The three main categories of habitat types are: pools, riffles, and runs. These main categories are further divided into 24 possible types based primarily on stream gradient, water velocity, water depth and substrate composition.

Pools are critical holding and rearing habitat. They must be deep enough to provide overhead cover from predators and reduced velocities for improved food accessibility. Pool habitat types are created by bedrock and boulders with the larger pools formed by bedrock. Spawning gravels are generally associated with tailouts of these lower velocity areas.

Riffles are shallow reaches of swiftly flowing turbulent water with some partially exposed substrate which obstructs flow. Riffles are categorized according to gradient and the substrate.

A run is characterized by moderately shallow water with no major flow obstructions and little surface agitation. Typical substrate material consists of gravel, cobble, and boulders. A step-run is a sequence of runs separated by short riffle steps (West, 1990). A large portion of aquatic invertebrates, the basic food for all fish populations, reside in run and riffle habitats.

Sediment delivery to streams can influence substrate composition by causing coarse materials to be embedded by fine materials. Embeddedness is the degree that larger particles (boulders, rubble, or gravel) are surrounded or covered by fine sediment. Salmon eggs are buried sometimes as deep as one foot in spawning gravel. The freshly hatched alevins must swim through the gravel to enter the stream. Fine sediment can make this emergence impossible by filling the gaps between the larger particles. Embeddedness can reduce the flow of water through the redd. For optimum survival a constant flow is needed to remove waste by-products from the incubating egg.

Cover provides protection from predators and reduces negative impacts on aquatic populations from changes in streamflow and temperature. Population densities tend to increase with increased cover (Bisson, 1981) which is used for escape, feeding, hiding, or resting. Instream cover consists of physical structures such as bedrock ledges, spaces between boulders or cobble, and coarse woody material which are preferred over whitewater as cover. Cover structures are not as effective at increasing fish populations where other conditions such as food supply, water depth or velocity are not adequate. Overhead cover provides shade canopy that is important for maintaining water temperatures, especially during afternoon hours. Key habitat conditions in Elk Creek are displayed in Figure 20. The DLMP Desired Conditions are based on the results of research for the Columbia River basin by James Sedell (1988). This is his interpretation of minimum standards for instream and riparian conditions that affect the suitability of habitat for anadromous fish.

Figure 20 EXISTING FISHERIES HABITAT CONDITION IN ELK CREEK

PARAMETERS	MAINSTEM ELK	E. FK. ELK	BEAR	DOOLITTLE	COUGAR	BISHOP	DLMP DESIRED CONDITION
Riffle Embeddedness % average	11	25	6	18	18	7	<20%
Fine Sediment Spawning Areas % Average	10	6	16	5	13	8	<15%
Primary Pools per 6 bankfull widths	1.8	.3	.7	.05	.02	.2	1
Coarse Woody Material per 1000 feet	79	3.2	2.7	1.3	.5	6.8	20

The East fork of Elk Creek has exceeded the desired riffle embeddedness and Bear Creek has exceeded percent fine sediment in spawning areas. Doolittle and Cougar Creeks are at the high end of riffle embeddedness. Watershed restoration projects along existing roads can reduce the amount of fine sediments reaching these tributaries, thus reducing embeddedness and fine sediment in spawning areas.

Primary pools in the tributaries and coarse woody material in all creeks are below desired conditions. The addition of key wood and the planting of conifers within the riparian reserve will help both of these conditions. It is likely that these streams may not have historically held amounts of key wood thought to be generally optimum. Logs may have been flushed from the system due to the high gradient of the streams and peak flow. Local information is being used to develop more realistic criteria for amounts of coarse woody material in this area.

In Elk Creek, key wood in the tributaries will enhance pool formation and the deposition of spawning gravels. In the mainstem, it increases complexity, improves winter survival, and increases the use of summer holding habitat, particularly for coho salmon.

HISTORIC VARIABILITY AND TRENDS

Large flood events have caused the greatest changes in aquatic habitat in Elk Creek. Streamside vegetation was removed by the 1964 flood and large amounts of sediment were deposited within mainstem Elk

Creek and its tributaries. Sedimentation filled in pools and covered spawning gravels. Large numbers of logs are introduced into the mainstem from its tributaries and headwaters.

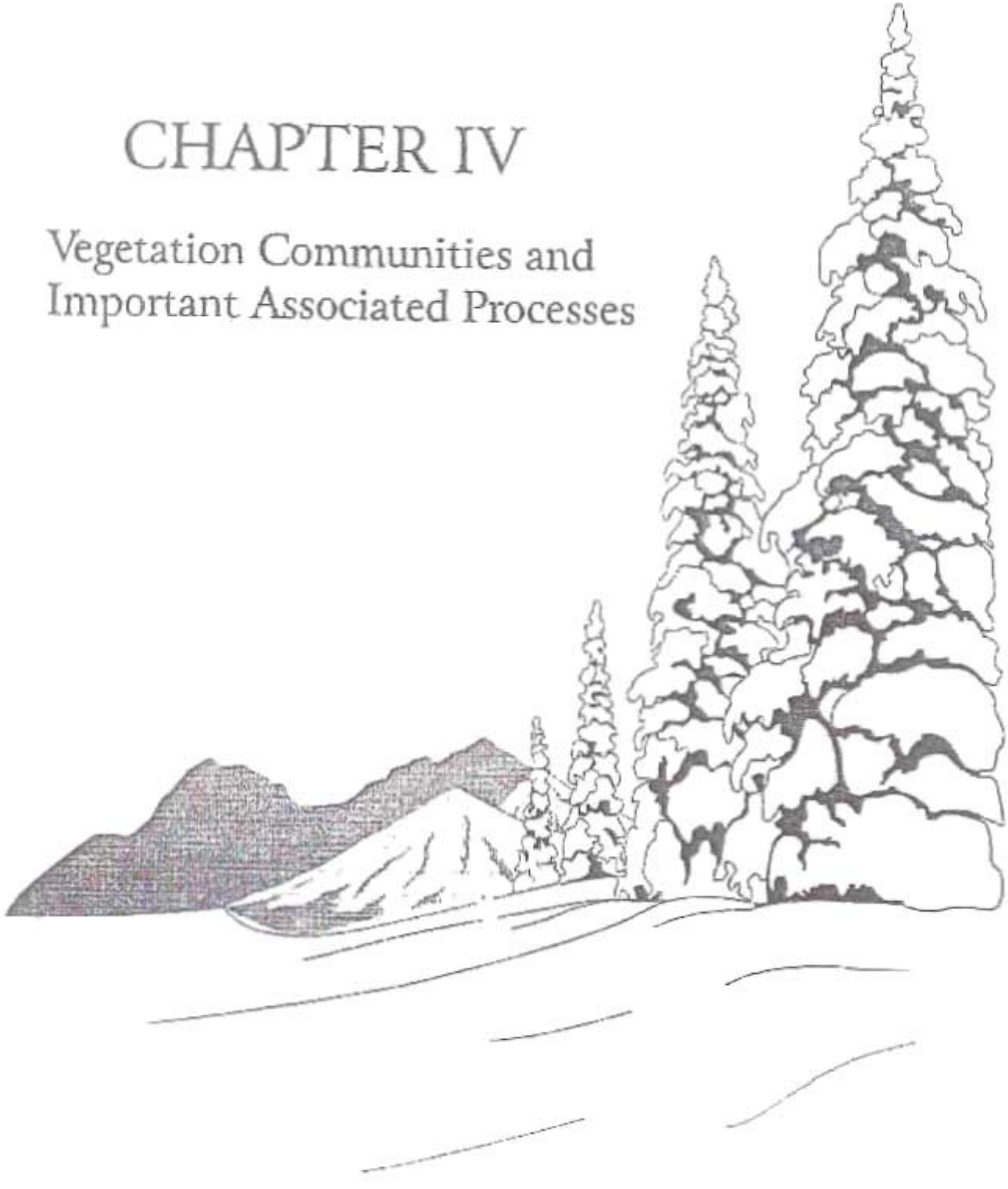
Since 1964, Elk Creek has been removing sediments and recreating pools in the vicinity of bedrock. Spawning gravels are reappearing in the tailouts of pools. Streamside vegetation has regrown to where the tributaries are usually fully canopied. Log jams have been systematically removed to protect downstream structures and provide upstream fish passage.

Drought conditions can also be detrimental to aquatic species by reducing the amount of available habitat and increasing water temperatures during summer low flow periods. However, during winter and spring these lower flows can increase survival of eggs in spawning gravels and of juveniles remaining in the creek because less of the streambed is likely to be moved and the potential for crushing them reduced.

The general trend for Elk Creek is for the aquatic habitat to continue to improve until reset by either another large flood or a catastrophic wildfire. Additional road building, timber harvesting, and other human activities have created a scenario where a storm event of less intensity than 1964 would have a similar impact on downstream aquatic resources.

CHAPTER IV

Vegetation Communities and Important Associated Processes



VEGETATION COMMUNITIES

INTRODUCTION

This chapter describes the vegetation conditions in the Elk Creek watershed that are integral to answering the key questions. The description of vegetation conditions includes the identification of important processes that lead to the development and maintenance of the ecosystem. An understanding of ecosystem processes is necessary for determining the current condition of the watershed and its relation to the ecological values of the ecosystem users. This chapter reviews the vegetation conditions around the turn of the century and, where possible, summarizes the historic range of variability in vegetation structure. The outcomes of many vegetation interactions are often very elastic due to the complexity of the determining mechanisms. Therefore, we have placed the primary emphasis on the patterns of the interactions.

FACTORS THAT INFLUENCE GROWTH OF VEGETATION

The vegetation in the Elk Creek watershed is a diverse mosaic of species, ages, sizes and densities. Generally the landscape vegetation pattern is a result of a composite of (1) distribution of plant communities along gradients of limiting environmental factors, (2) plant species response to changing conditions, and (3) patterns resulting from portions of the landscape responding to disturbance with different outcomes and at different points in time.

Figure 21 is a graphic depiction of the key processes and interactions that influence and are influenced by vegetation.

The fundamental requirements for growth of vegetation are sunlight, water, and nutrients. On any particular site in Elk Creek, the total amount of sunlight delivered to a site changes very little from year to year. The total mineralized nutrient availability also tends to change very slowly. The limiting factor on the terrestrial vegetation that changes most widely is the availability of water. The deep, red soils present in portions of Elk Creek have the best water holding capacity, and are largely responsible for the best growing conditions. These areas are considered good sites. Shallow, skeletal soils hold less water which tends to limit the rate and amount of vegetation growth they can produce. These areas are considered poor sites.

Whether the site is very good for plant growth, or relatively poor, the trees will grow until the site is fully occupied. If there is a period of years with above average moisture, the plant community can respond by growing more vegetation in the same space. If rainfall patterns later decrease, the additional vegetation that occupied the site during wetter times cannot be sustained. When the functioning of a tree becomes impeded by a major change in the amount and pattern of available water, it has less resources to allocate to defend itself from insects and/or pathogens. The weakened ability to defend itself can result in mortality. The ensuing mortality increases fuel loads. High fuel loads tend to result in high fire intensities. Intense fires alter the pattern of vegetation on the landscape which influences how the watershed functions.

The present forested character in Elk Creek has developed in spite of climate fluctuations. Most of the forest was kept below a density where stands would be at severe risk in a drought. The primary mechanism that performed the function was fire. From looking at fire scars on very old trees (discussed in a later section), we now know that low intensity fires were very frequent in the Elk Creek watershed prior to the era of fire suppression. With frequent light fires, the plants that were best able to occupy the sites were those

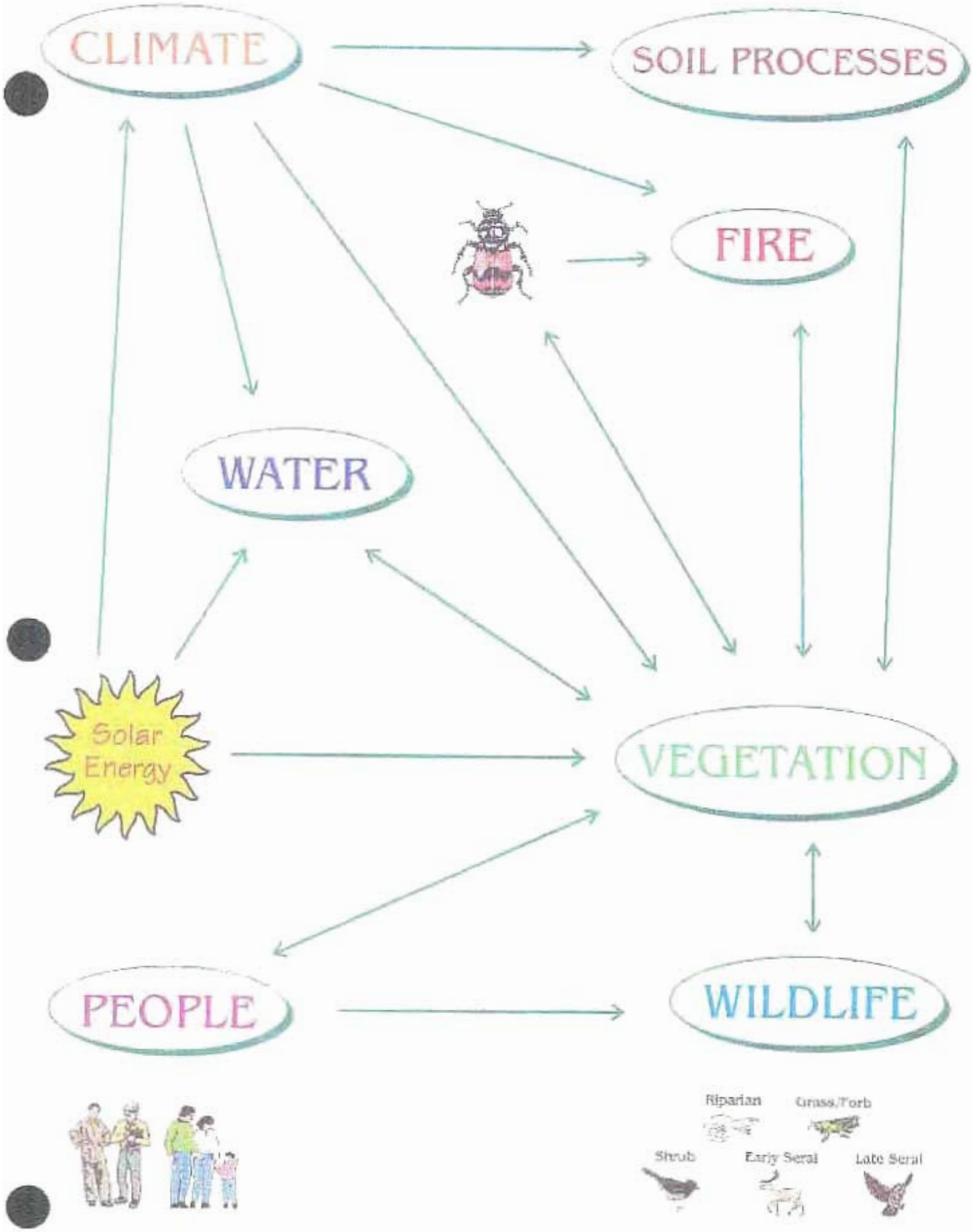

CLIMATE
SOIL PROCESSES
FIRE
WATER
Solar Energy
VEGETATION
PEOPLE
WILDLIFE
Riparian
Grass/Forb
Shrub
Early Seral
Late Seral

FIGURE 21

that adopted one of two main strategies: their leaves or crowns were above most fires and their bases were protected with thick bark, or they were able to resprout or reseed rapidly after surviving a fire in which the above ground parts are killed. As seedlings and saplings, young conifers are vulnerable to frequent fires until their protective mechanisms develop. Most did not survive, but those that did had little competition and grew very large, often living for centuries. It is this interaction with fire that allowed long term vigor of some individuals even through climatic fluctuations.

There are several interactions resulting in reduction of vegetation density, with fire involved in nearly all cases. The interaction described above is a dominant one in Elk Creek, especially at lower elevations. At the higher elevations (generally above 4000') a mosaic of larger sized patches of even aged stands is present. The mechanisms that created those stands were intense fires, often preceded by localized insect outbreaks that tended to concentrate fuel loadings in those areas. Their position on the upper slopes is a factor that can expose them to greater fire intensities, as uphill running fires are more intense and more likely to be stand replacing than a backing fire given the same amount of fuel available.

White fir has aggressively invaded many stands where fires kept it at bay in earlier times, generally extending its range to lower elevations. When white fir is allowed to reach very high densities, a drought period leaves it particularly vulnerable to insects. In the recent drought period, the rate of mortality of white fir in Elk Creek has not significantly increased, largely because maximum densities have not yet occurred. Many stands are now entering the level of competition where mortality is imminent as described by Drew and Flewelling (1979).

Density influences stand growth and transition from one seral condition to the next. If high density is reached at one stage, some individuals must die to make growing space for others to achieve larger sizes. For example, density reductions will facilitate achievement of late seral conditions in many stands.

SERAL CONDITIONS

Many characteristics of a plant community change in succession. These characteristics can include: (a) growth and size of dominant plants, (b) the species compositions of dominant plants, (c) species composition and abundance of understory plants, (d) physical structure of the vegetative canopy and (e) the presence of dead vegetation.

The concept of seral conditions is a description of the age and development of forest communities and the physical canopy characteristics present during the various stages of succession. It focuses on the size of the larger vegetation and the development along a continuum that goes from grasses and forbs to old-growth conditions. Many of these successions occur at a relatively small scale. When a large, dominant tree or groups of these trees die, succession from seedling to old-growth occurs in the opening created. Fire exclusion and harvesting has often linked many of these small interactive openings into larger groups based on the presence of similar conditions. Thus we can categorize larger areas into seral condition groups. In most cases, the size of the openings has been increasing over time due to fire exclusion and harvest as small scale heterogeneity is lost. These larger, more homogeneous stands can be categorized by structure and age. We have broken these conditions into groups that relate to their function and use by wildlife for food and shelter.

Grass/forb: The grass/forb areas have either been recently deforested by fire or harvest, or in some cases, represent a condition where other vegetation types cannot readily invade because of soil limitation or other factors.

Shrub/seedling: The shrub/seedling stages are either shrub dominated sites or deforested areas that are in the process of developing a new forest cover.

Pole stands: Pole stands are young conifer stands with trees approximately from 6 to 11 inches in diameter.

Early Mature: The early mature stage consists of mature conifer stands with trees approximately 11 to 18 inches in diameter.

Mid mature: Mid mature stands have larger conifers where vertical and structural diversity has begun to appear.

Late mature: Late mature stands have large overstory trees, with declining vigor and growth rates.

Old-growth: The old-growth title is applied to stands with trees of various sizes; the overstory trees are usually larger than 30 inches in diameter. Vertical and horizontal diversity is high, and snag density is high. These stands have many snags and logs over 20 inches in diameter, and normally a well-developed understory layer of hardwoods. Younger conifers usually have begun to fill in gaps created by the increasing mortality of the overstory.

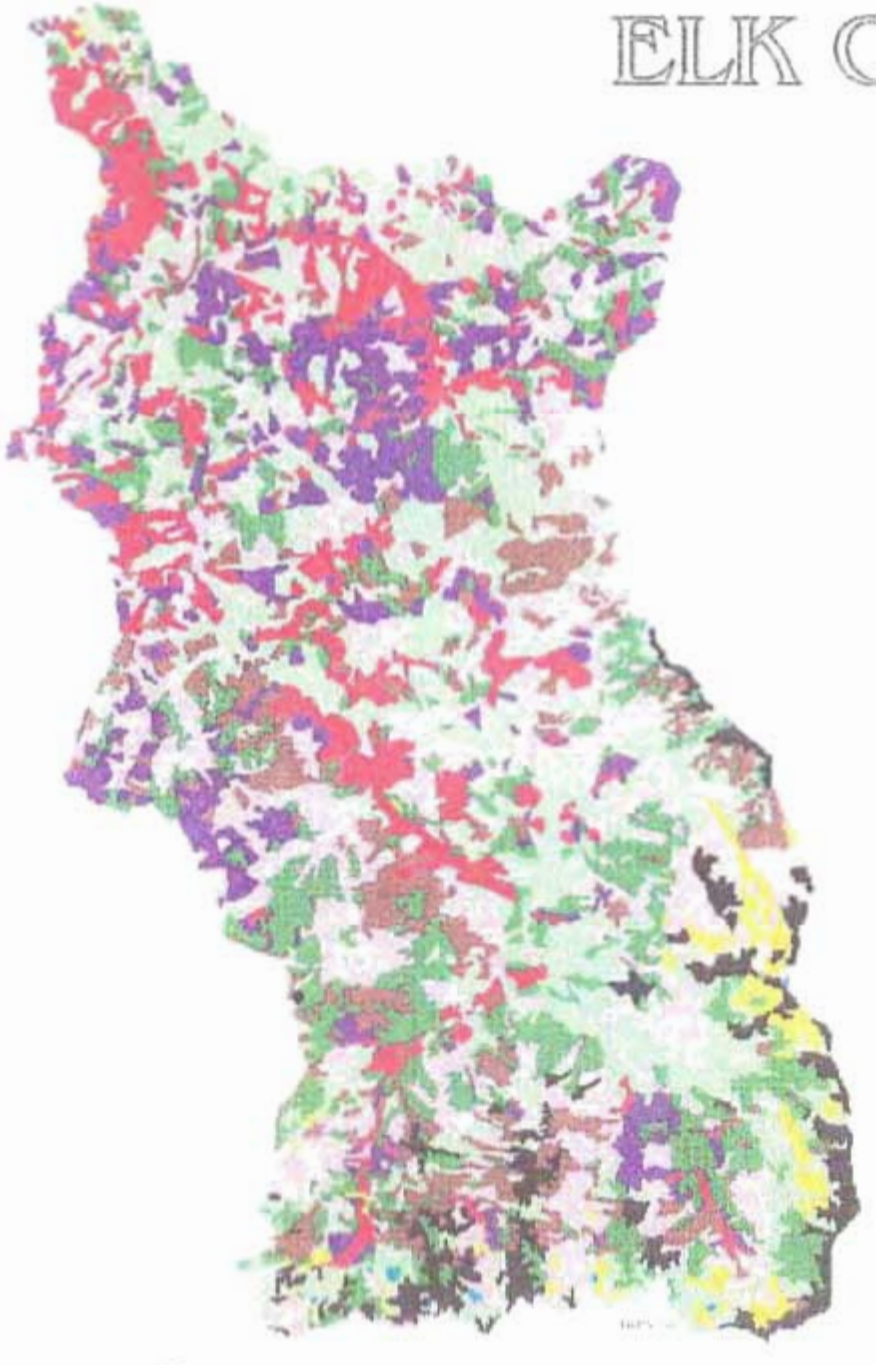
Figure 22 displays acres and percent of each seral condition for 1944 and 1994. Figure 23 shows the distribution seral stages in Elk Creek watershed for 1944. Figure 24 displays the same information for 1994.

Figure 22 SERAL STAGE BREAKDOWN

SERAL STAGE	1944		1994	
CATEGORY	ACRES	PERCENT	ACRES	PERCENT
GRASS/FORB	1,145	2	1,154	2
SHRUB/SEEDLING	5,685	9	9,138	15
POLE STANDS	9,328	15	4,318	7
EARLY MATURE	15,280	25	5,513	9
MID MATURE	13,543	23	13,374	22
LATE MATURE	6,326	11	19,372	32
OLD-GROWTH	6,732	11	5,275	9
ROCK	2,585	4	2,585	4
LAKES	51	–	51	–
TOTAL	60,780	100	60,780	100

ELK CREEK WATERSHED

SERAL STAGES 1944



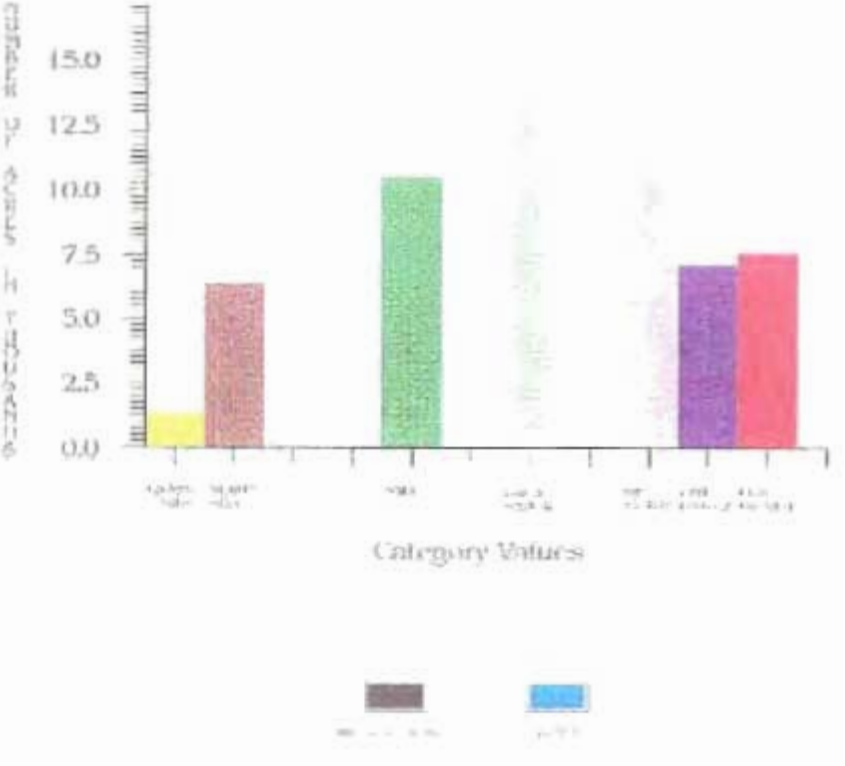
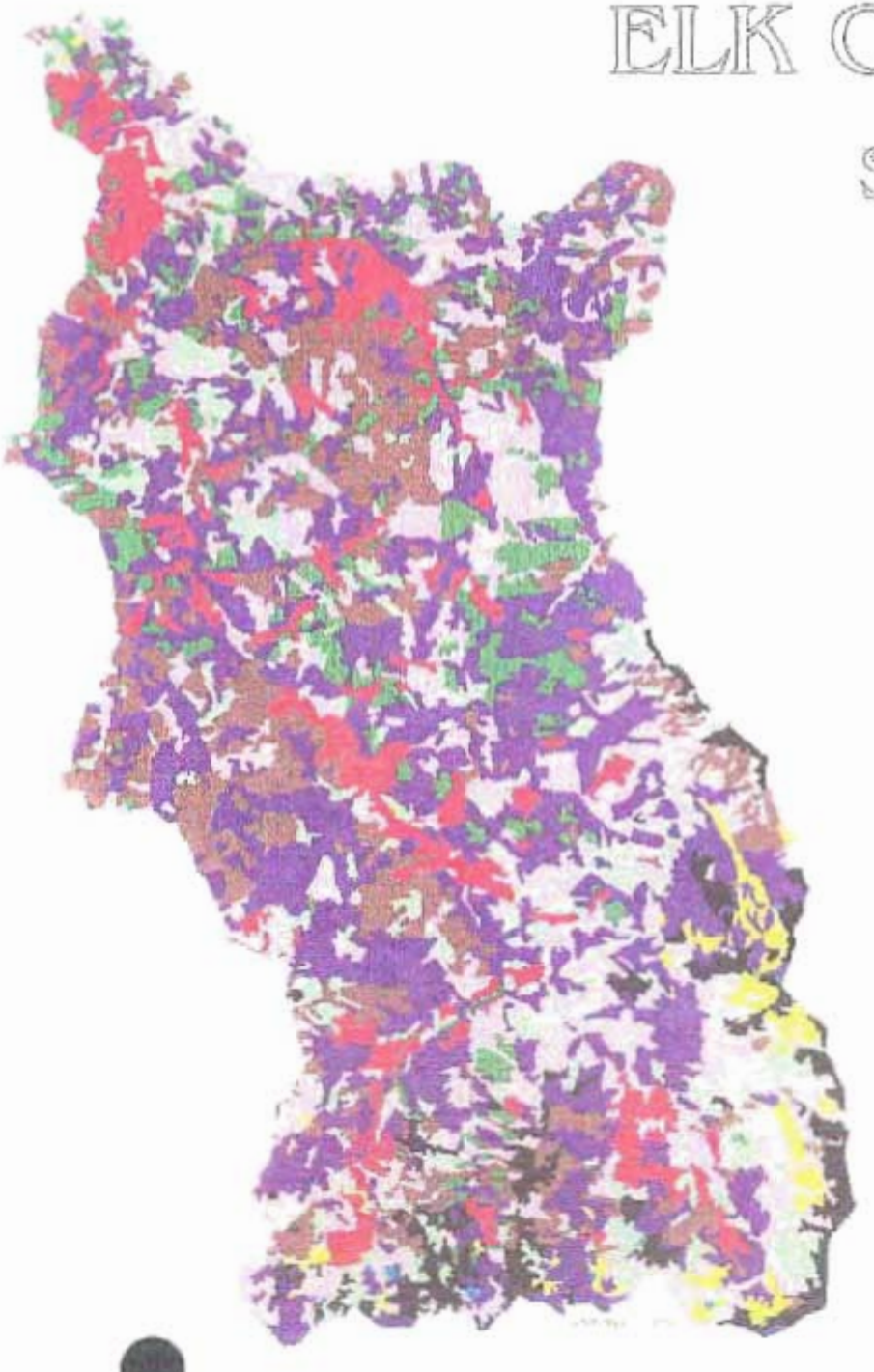


FIGURE 23

ELK CREEK WATERSHED

SERAL STAGES 1994



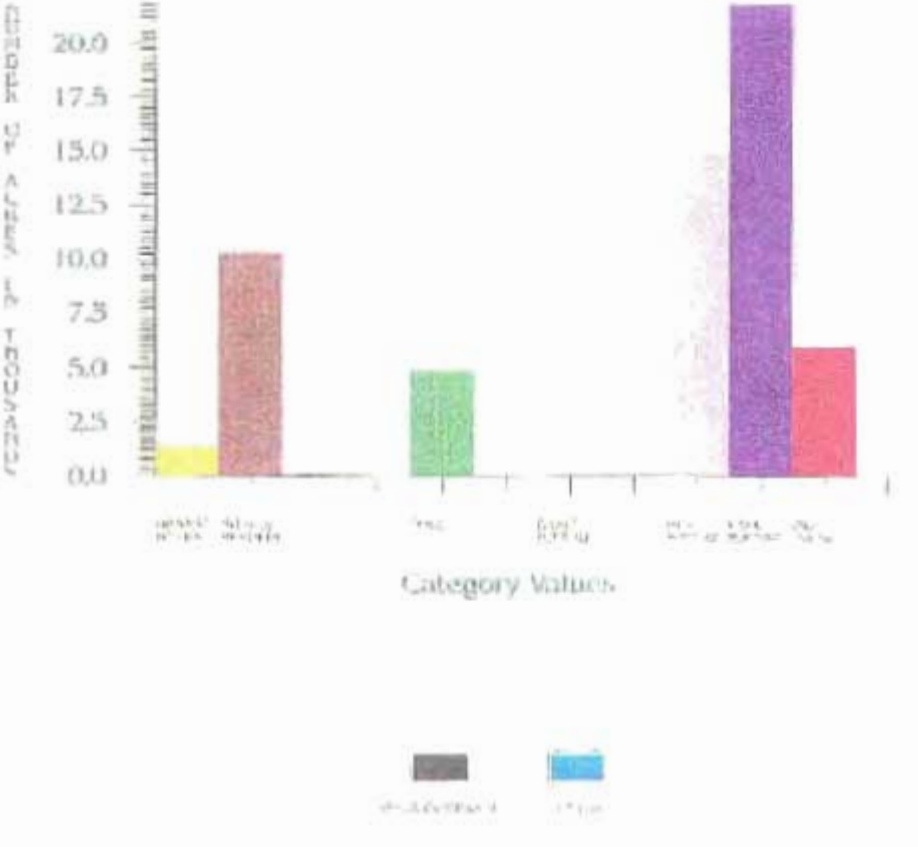


FIGURE 24

The changes is seral condition between 1944 and 1994 that are depicted in Figures 23 and 24 are representations of changes in stand structures as modeled from aerial photography for both dates. A few items are worthy of note in interpreting the information. Overstory stand densities were relatively low in 1944. Since the trees had room to grow, the progression to seral stages that contain larger sized trees was fairly rapid. Most of the pole-sized stands of 1944 have become early to mid-mature stands by 1994. The most common type in 1944 was an early mature condition with many stands of trees in the 12 to 20 inch diameter range that were not particularly dense. With 50 years of relatively unimpeded growth, most of those stands have become late mature stands that are large sized and generally healthy. At the present time, late mature forest is the most common seral condition. These stands will either become old-growth or return to shrub/seedling in the future by the mechanisms described earlier.

The old-growth stage has, by definition, a significant component of mortality and normally has very large diameter trees. The valuable large trees in stands that were beginning to decline were the first to be harvested, and because of economics were the ones most often salvaged after fires. Some of the first ones harvested in the 1950's, are already back to pole sized timber, but the majority are still in shrub/seedling/sapling stages as a result of more recent harvests, and of the many plantations destroyed in the 1987 fires. The overall condition of Elk Creek's forest is one that has more extremes than in 1944. There are more older, large sized trees and more shrub/seedling stands at present when compared to the earlier, more evenly distributed stands.

VEGETATION SERIES

Vegetation series are used to display and describe the abundance, distribution, and diversity of plant communities in the watershed. Series are named after the species of trees that would dominate a site if there were no disturbances such as fire. Series is useful in characterizing the vegetation and estimating biological productivity. The different series reflect different plant environments, which include the basics of climate and soils, and also their legacy of disturbance, particularly fire.

Figure 25 displays the vegetation series in Elk Creek and Figure 26 the acreage and percent of the watershed covered by each.

ELK CREEK WATERSHED

VEGETATION SERIES

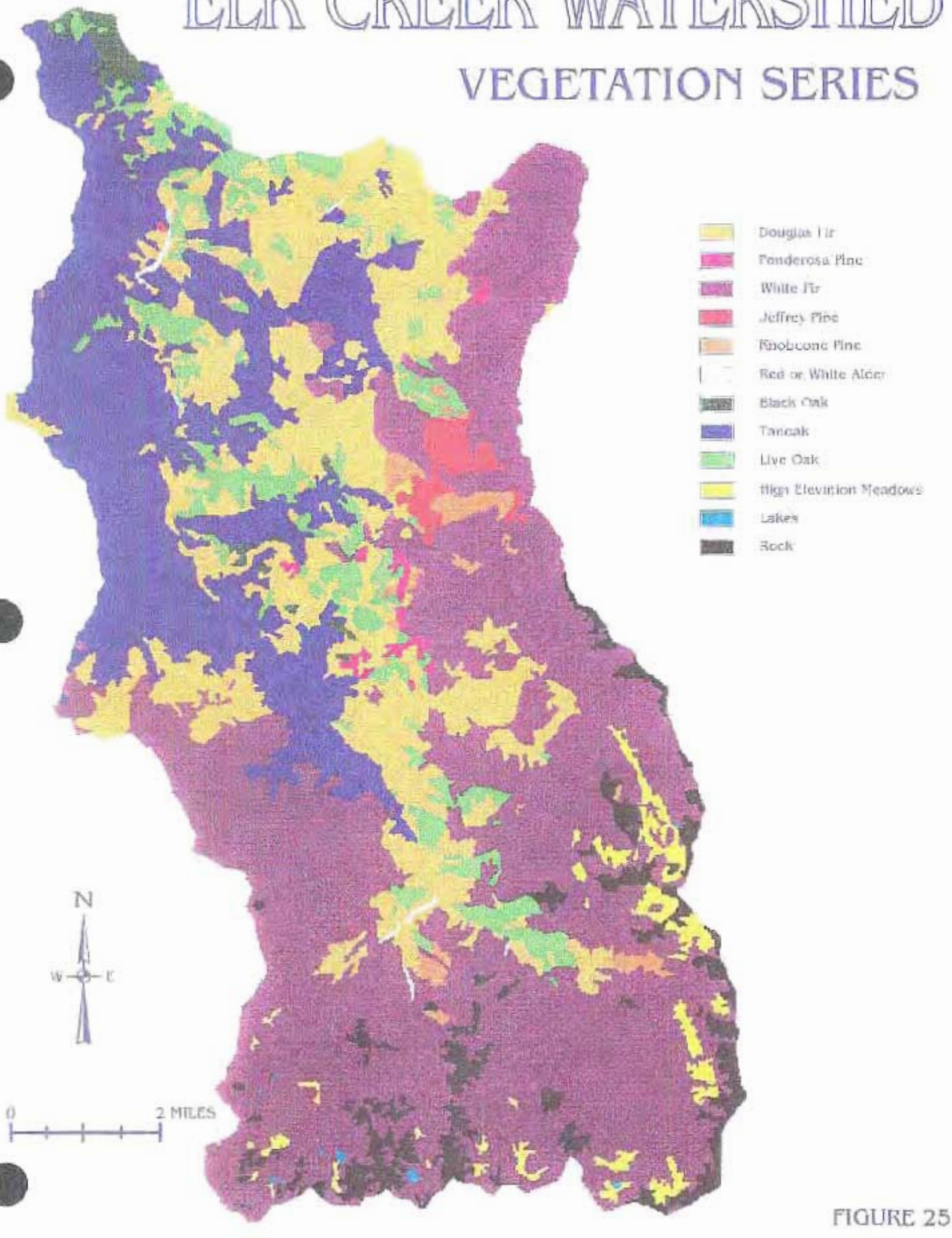


FIGURE 25

Figure 26 VEGETATION SERIES IN ELK CREEK WATERSHED

SERIES TYPE	ACRES WITHIN WATERSHED	PERCENT OF THE WATERSHED
TANOAK	12,530	21
DOUGLAS-FIR	11,501	19
WHITE FIR	26,696	44
LIVE OAK	3,995	7
BLACK OAK	455	1
JEFFREY PINE	553	1
PONDEROSA PINE	277	-
KNOBCONE PINE	581	1
RED ALDER OR WHITE ALDER	115	-
HIGH ELEVATION MEADOWS	1120	2
LAKE	51	-
ROCK	2600	5

The series displayed in Figure 25 are based upon species presence and abundance. The presence and abundance result from environmental gradients of the limiting factors discussed previously. These gradients change gradually and there are few crisp boundaries. When reviewing the following descriptions of the series, keep in mind that one series flows into the other.

Tanoak: Tanoak areas tend to be those of deep, rich soils below about 3500 feet in elevation. Tanoak sites are normally dominated by Douglas-fir and sugar pine with an understory of tanoak trees and brush. The presence of tanoak often indicates high site productivity. Tanoak distribution is sensitive to available summer moisture and cold temperatures. Temperature extremes limit its elevational distribution in the watershed. The 1944 photos show that the tanoak type had a widely spaced, well developed large overstory in almost the whole range of the tanoak series, with a peppered distribution of small gaps of multiple age smaller trees and hardwood growth.

Douglas-fir: The Douglas-fir series is generally a little higher in elevation than the tanoak series. It occurs on slightly warmer and drier sites than the tanoak series sites. The series is replaced at lower elevation moister sites by tanoak; and at upper elevation, cooler sites by white fir. The overstory is usually similar to the tanoak series but tanoak is absent in the understory. The series grades into white fir which occurs above it in elevation in most cases. The structural pattern in 1944 was similar to the tanoak description, with some distinct patches larger than five acres.

White fir: This is the most extensive vegetation series in Elk Creek. The series occurs just above Douglas-fir series. These are generally cooler, moister sites than the other series in Elk Creek. These sites are often occupied by mixed conifer overstories, with Douglas-fir and sugar pine present. The 1944 patterns showed many large patches of distinctly different tree sizes. The range of white fir is extending down in elevation, where it was previously held back by more frequent fire events.

Live oak: The live oak series is dominated by canyon live oak. These tend to be dry sites with poor, rocky soils usually found on south aspects. Very scattered Douglas-fir is not uncommon. The understories are usually sparse with bare soil and scree often present. Common understory plants are poison oak, Oregon grape and bracken fern. Because of low growth rates on these poor sites, the overall pattern has changed little on these sites in the last 50 years, with the primary change being some increase in new live oaks becoming established.

Black oak: This series is identified by areas dominated by black oak. These sites tend to have scattered Douglas-fir, Ponderosa pine and Pacific madrone. There were a number of areas that were dominated by

black oak in 1944 and still are, but it seems to be expanding its range into the Douglas-fir type, presumably due to fire exclusion.

Jeffrey pine: This series is identified by the presence of Jeffrey pine. It only occurs on soils derived from ultrabasic patent materials. Huckleberry oak and incense-cedar are usually found on these sites. The series is characteristically an open, mixed tree species stand over a dense shrub understory. Sensitive plant habitat is often found in the series. The pattern trend is that the sparse overstory nature has changed little in 50 years, but the amount of reproduction and shrubs has noticeably increased.

Ponderosa pine: Ponderosa pine as a series is often on dry sites that are a little more fertile than live oak sites. Poison oak is often present. These sites have few Douglas-fir due to low moisture availability. The pattern trend is that general widely spread, large overstory trees present in 1944 now have been invaded by shrubs, Douglas-fir and hardwoods that were previously present at much lower levels.

Knobcone pine: Knobcone pine is adapted to areas of poor soils, often derived from ultramafics. This type is maintained by stand replacement fires. Serotinous cones open to distribute seeds in the presence of high temperatures, so the shower of seeds after a hot fire enable knobcone to revegetate aggressively. The pattern of distinct blocks of knobcone pine stands is relatively unchanged since 1944, with the primary change being that some of the blocks have been regenerated by fire events since 1944.

Red or white alder: This series frequently occurs in riparian areas in and near streams and seeps, often accompanied by willow and black cottonwood.

High elevation meadows: This is a non-forested series dominated by grass, forb and/or shrub cover. Two different community types are included. The abundant water riparian meadows where subirrigation is common during the growing season and the drier grassland areas. The grasslands may border the wet meadows and may be fire maintained. Soils are commonly of glacial origin. The pattern is of reduced size of meadows as other types become successful at invading them.

Rock: These non-forested areas have little or no soil development. They can be bedrock or talus scree areas of piled cobbles and boulders. Occasional trees or shrubs are present where moisture or soil microsites are favorable.

FIRE

Fire appears to be the dominant, most frequent disturbance in Elk Creek and a major determinant of historical landscape diversity. Other disturbances, such as mass movement (landslides), floods, wind, and insect or disease epidemics have also played a role, although a more localized and/or infrequent one.

Potential ecological effects of fire can be categorized by fire regimes. A fire regime is defined by patterns of similar fire frequency, severity, extent and seasonality. Over the long term, fire regimes are not stationary and the frequencies (mean time between fire events) and extent changed through time (Swetnam, Agee).

FIRE FREQUENCY

Fire frequency and severity vary depending on annual-to-centennial climate patterns and the complex interactions of topography with vegetation, condition and fuel accumulation, and decay rates. Fire occurrence is dependent on an ignition event, a fuel bed that will carry a fire, and weather conditions conducive to fire spread. Generally warmer and drier sites will have more frequent fires than cooler and moister ones.

FIRE SEVERITY

Fire severity is the effect of fire on the ecosystem and how quickly it recovers to a predisturbance condition. Severity is largely dependent on the quantity, type and distribution of available fuels and the rate at which it burns. There is a tendency for fire severity to be inversely related to fire frequency in forested ecosystems. For example, low severity surface fires tend to occur in forests where frequent fires maintain fuels at low levels (Ponderosa Pine). High severity crown fires tend to occur in forests where large amounts of fuels accumulate between infrequent fires (True fir types).

FIRE INTENSITY

The intensity of a fire usually determines the amount of vegetation consumed or killed. The main factors in fire intensity are fuel accumulation, topography, and climatic factors including fuel moisture. The fuel that contributes to variation in fire intensities can be accumulated as a result of earlier fires or from any of several vegetation interactions, including insects, diseases, windstorms or actions of wildlife on the vegetation. Fuel accumulations are the most dynamic of the elements involved in fire intensity, as climate is often approximately the same within the landscape at any given point in time, and the topography is fixed.

FIRE EXTENT

Fire extent refers to the spatial pattern of fire effects on vegetation over the landscape. It includes the overall size of individual fires, and the size and distribution of canopy openings caused by subsequent fires following a stand replacement event. The scale of landscape dynamics influences the structure, species composition, size and distribution of patches over the landscape.

SEASONALITY

The time of year (seasonality) of fire events also influences ecosystem response and recovery. Each organism or community has a unique combination of responses to changes in weather, day length, fire intensity and fire duration. Consequently fire produces different biological effects as the nutrient storage status, phenology, and live fuel moisture content of plants change.

FUELS

Fuels are the organic materials that accumulate on a site through the growth and death of plants. Fuels also include the live vegetation that could burn under the right fire weather conditions. Fuel loading is of interest to the fire manager because it is the only aspect of the fire regime that can be managed. Neither the climate, topography nor probability of natural ignition can be changed, but the amount, size and distribution of fuels can be managed, thereby reducing fire severity.

Fire suppression has lengthened the interval between fire events in the Elk Creek watershed. This has changed the amount of fuels available to burn and increased potential fire severity. The 1987 fires burned a substantial portion of the watershed, but large areas have not burned in more than 50 years. It is not likely that these areas would burn with an historic pattern after missing several fire cycles. The areas that burned in 1987 still have relatively low fuel loadings. However, many areas have the potential for rapid increases in larger fuels. This is due to the wildfires killing a large amount of the understory vegetation that had

established without prior frequent fires. These areas would also soon have unnaturally high fuel loadings and potential for more severe fires.

DROUGHT

Climate data indicates that there can be significant short and long-term fluctuations in precipitation for the watershed. There are short-term year to year variations and long-term decadal to centuries trends. Figure 5 displays historic precipitation records for 1915 to 1990. Even during wetter times there can be years with significantly below normal precipitation. Reconstruction of long term (1600-1961) climate trends from tree rings (Fritts and Gordon) indicate that the current century has been generally wetter than the 1700's or 1800's. Long severe droughts occurred from around 1750 to the early 1800's and again in the late 1800's.

Drought can influence fire occurrence and severity. Swetnam's tree ring chronology study in California giant sequoia groves indicated that climate was the most likely cause of synchronized fire patterns between widely dispersed groves. Fires were more extensive in dry years than wet ones. More of the sequoia groves recorded fire events in response to year-to-year (short-term) differences in precipitation.

Total precipitation and its distribution during the year greatly influence available soil moisture for plant growth. The plant community in Elk Creek responded with increased growth during the wetter years from 1938 to 1975. More plants were able to occupy a given space with more moisture available. This period also coincides with the beginning of effective fire suppression. During drier years since 1976, increased vegetation from this wetter time and the lack of disturbance can no longer be sustained. When the functioning of a tree becomes impeded by lack of moisture (from competition with other plants or from drought) it is less able to defend itself from insects and/or pathogens. As a result, tree mortality often occurs, with subsequent elevation of fuel loadings.

HISTORIC RANGE OF VARIABILITY

The term "historic range of variability" is an attempt to explain the kinds, amounts and speed of the changes that tended to occur in the forest prior to European settlement. It is a useful tool for understanding ecosystem function and processes, which is essential to predicting the behavior of altered as well as natural ecosystems (Sampson, et.al.). Knowledge of what kinds of fluctuations seemed to be normal for a site forms a reference for comparison of todays conditions as one guideline on the health and sustainability of today's ecosystems.

This section contrasts historic vegetation conditions with today's. 1944 aerial photographs, 1935 look out panorama photographs, published research, research studies in progress, vegetation inventories, GIS computer modeling, and local knowledge were used to estimate historic conditions. The emphasis was on understanding the processes and functions that lead to the development and maintenance of the ecosystem and its user values.

There has been speculation that fire frequency increased during the settlement period; however, several fire history studies have failed to find a significant difference in frequencies before and after settlement in the Klamath Mountain Province (with the exception of the fire suppression period). There is some evidence to indicate that severity may have been greater, but whether this was a result of different ignition patterns or weather/fuels conditions is not clear. Heavy grazing pressure, primarily in the high elevation meadows from the late 1800's to early 1900's, could have affected forest vegetation patterns, but it is difficult to estimate effects from aerial photographs.

ASPECTS OF THE FIRE REGIME IN ELK CREEK

No fire history studies have been completed within the Elk Creek drainage. However, several studies have been completed in the Klamath Mountains Province and a major study is in progress in the Thompson Ridge area of the Happy Camp District. These studies provide insight into the fire regime in Elk Creek and its effect on vegetation structure and dynamics.

1) Stand replacement events were uncommon in the tanoak, douglas-fir and ponderosa pine series.

2) Lower elevation sites burned more frequently than higher elevation sites.

3) South tending aspects burned more frequently than north tending aspects, although the difference was probably not great.

4) Seasonality of fires was from early summer until fall rains.

5) Lightning ignitions were probably sufficient for fire frequencies found. Native Americans were known to have used fire, but their influence may have been primarily on specific sites for acorns, basket making materials, etc. Overall, fires were fuel limited in extent as ignition sources were present very frequently.

6) Mean Fire Return Intervals (MFRI) are conservative. Data is collected from tree ring scars, and not all fires will scar trees.

7) The complex topography forms many barriers to fire spread, such as riparian areas, sharp ridge tops, rock outcrop and talus slopes, and changes in aspect and plant communities. This irregular landscape produces great variation in slope gradient, fuel accumulation and drying rates, and hence variable rates of combustion and fire spread. These factors alter fire behavior producing patchy fires of variable severity. If conditions were more uniform, the spatial patterns of burn severity would have been more uniform.

8) Fire regimes influence, and are influenced by the vegetation found in an area. The vegetation series displayed in Figure 25 would be expected to have different fire regimes. This is because the series' occur in different environments which influences the association of plants present, the rate of fuel accumulation, and the drying and availability of fuels to burn. However, the size and interspersion of plant communities with typically different fire frequencies on the landscape can result in a mixing of fire regimes (Agee). This may result in reduced fire frequencies for frequent fire sites and increased frequencies for infrequent sites. The series are also based upon potential vegetation, which may not describe the current vegetation and its present fire regime. As described in the series discussion, some types are expanding their range and others declining as a result of fire suppression. The sites have been moved outside of their historic range of variability in fire frequency.

SUMMARY OF EFFECTS OF DEPARTURE FROM HISTORIC FIRE FREQUENCY

1) Fires continue to occur in spite of exclusion policies.

2) Extensive fires occur in dry years. The few fires that escape under severe conditions become very large.

3) Effects of suppression have been to lengthen fire frequency and increase severity.

4) Stand replacement events are more common and the risk of occurrence is higher.

5) As the time between fires increases for the landscape, fuels continuity increases, intensity increases, seasonality changes, fire characteristics change, responses to drying change, there is a change in landscape patterns and a loss of diversity. The historic gradient of very small patches at lower elevation, slightly larger patchiness in the Douglas-fir type and the largest patches in the true fir types, has become one of increasing patch size throughout as we have imposed different fire frequencies through suppression.

Several areas in Elk Creek, particularly where soils hold less water on hot south slopes, have stands from three to ten large old trees per acre. Lack of fires to keep the competition down has allowed hardwoods and younger conifers to fill in the spaces between the trees. Many overstory trees, most over 200 years old, have been dying within a three year time span on these sites, in conjunction with the recent era of lower rainfall. In some cases where the 1987 fires lightly underburned stands in that condition, the new trees that had grown in under them were already large enough to survive the fire. Some of those stands are also undergoing significant mortality of the older age classes. The very large, old conifers are being lost as the exclusion of fire combined with dryer weather has increased competition for moisture. These older trees are less physiologically able to respond to the changes and thus are dying at a disproportionate rate. This is a natural forest renewal process, but the rate and extent is probably unusually high, which can have serious wildlife habitat implications.

In some situations, reintroduction of fire alone cannot reinstate the interactions under which the system evolved. The absence of fire for a long period has changed the composition of the forest in ways that probably only occurred at smaller scales in the past. Some of the interactions have been approximated by human intervention, for example, thinnings done in past to accelerate tree growth for timber production purposes (when that was the primary objective) also had the effect of increasing the health of the trees, increasing the chances that conditions of mature forest structure and better fire resiliency will be present in the future. However, in some cases, fuel accumulations are high enough that they that can interact with unplanned fire in a manner that puts the long-term likelihood of development of a mature forest at risk. About a third of the young plantations that had fire introduced by the 1987 wildfires were pushed back to the shrub stage, particularly where logging slash and thinning slash were present in significant amounts.

SENSITIVE PLANTS

Botanical surveys are conducted as part of the standard management practices specified in Forest Service procedures for environmental analysis and project planning. The purpose of the surveys is to identify sensitive and managed plant species to assure that they do not become threatened or endangered because of human activities. Sensitive plants are those which are considered possible candidates for Federal threatened or endangered classification under the Endangered Species Act of 1973, and also includes species that are listed by the State of California as rare, threatened or endangered. In addition, plants that are listed by the California Native Plant Society's Inventory of Rare and Endangered Plants of California are also evaluated to determine if they may require special management or protection. Sensitive plants characteristically occur in large numbers locally or in a wide geographic area, but require specialized habitats. These are often negatively impacted by land management ground disturbances, although some sensitive plants show a positive response to disturbance. Managed plants are those which are found in less specialized habitats, or in larger numbers, and need to be monitored to assure that they do not become listed as sensitive.

For sensitive plants, the assessment area can be divided into two categories: 1) the areas with potential or indicator habitat for a species, and 2) the areas with known plant populations. Field inventories and Forest, State and Federal data base searches have revealed indicator habitat and populations for sensitive and/or managed plant species in the Elk Creek watershed area.

Of the 33 sensitive species of concern on the Klamath National Forest, the three species in Figure 27a have known populations or suitable habitat located within the Elk Creek Watershed.

FIGURE 27a KNOWN OR POTENTIAL SENSITIVE PLANT POPULATIONS

SPECIES NAME	HABITAT	DISTRIBUTION AND RARITY	MANAGEMENT SENSITIVITY
Eriogonum hirtellum, Gamath Mountain buckwheat	Serpentine outcrops or gravelly slopes and ridges. 2,000-6,500'.	Locally endemic, Northwest Siskiyou County near Humboldt County and Oregon borders. 29 populations known on the Klamath National Forest.	Some historic populations have apparently been destroyed by past logging activities.
Lewisia cotyledon var. heckneri, Heckner's lewisia	Rock outcrops, more or less mesic environment. Low to mid elevations.	Trinity, Siskiyou and Humboldt Counties. 3 populations on the Klamath National Forest.	Generally easy to protect as rock outcrop habitat is easily recognized.
Lewisia cotyledon var. howellii, Howell's lewisia.	Rock outcrops more or less mesic environment. Low to mid elevations.	Shasta County to Southern Oregon. 60 populations on the Klamath National Forest.	Generally easy to protect as rock outcrop habitat is easily recognized.

In addition, the Elk Creek watershed contains habitat or known populations for three species listed in Table C-3 of the ROD. These plants are listed as species of late-successional forest habitats that will require special management and are listed in Figure 27b.

FIGURE 27b KNOWN OR POTENTIAL MANAGED PLANT POPULATIONS

SPECIES NAME	HABITAT	DISTRIBUTION AND RARITY	MANAGEMENT SENSITIVITY
Allotrope virgata, sugar stick	Closed canopy, mature and old-growth forests. Sea level to 6,000'.	Pacific NW, to British Columbia, Idaho, Montana. Wide distribution common, but in small isolated populations. >10 populations on the Klamath National Forest.	Tolerance to disturbance unknown, information lacking or incomplete. Need to document known populations.
Cypripedium fasciculatum, clustered lady's slipper	Shady sites within mature to old-growth forests. 300'-6,000'	Uncommon but widespread. Pacific NW to British Columbia, Montana, Colorado. >50 populations on the Klamath National Forest.	Tolerance to disturbance unknown. Information lacking or incomplete. Approved Species Management Guide.
Cypripedium montanum, mountain lady's slipper	Shady sites within mature to old-growth forests. 600'-6,500'	Uncommon but widespread. Pacific NW to Alaska, Montana, Wyoming. >50 populations on the Klamath National Forest.	Tolerance to disturbance unknown. Information lacking or incomplete. Approved Species Management Guide.

FUNGI

Recent scientific investigations in the Pacific Northwest have underscored the importance of mycorrhizal fungi in the ecosystem. These fungi profoundly influence plant growth through effects on uptake, storage and cycling of nutrients, development of soil structure and suppression of root pathogens (Molina and Amaranthus, 1991). Although many mycorrhizal fungi may be associated with any one host tree, it is suspected that these distinct mycorrhizal fungi play different and complimentary roles in the overall physiology of the tree. Mycorrhizal fungi are often an important food source for forest animals, providing

a key component in food webs that relate to the health and vigor of both plant and animal communities (Maser et. al., 1978). Protecting the functional biodiversity of these beneficial fungi is essential to maintaining ecosystem health and resiliency (Molina and Amaranthus, 1991; Amaranthus et. al. 1990.)

Some research suggests that habitat modification from logging may affect fruiting of some mushroom species (O'Dell et. al., 1992). In some compositionally simple forest types such as lodgepole pine, death of the host tree may lead to elimination of the fungus from the affected areas. In more complex forest types such as Douglas-fir/tanoak or Douglas-fir/live oak, the hardwood tree species which are extremely resilient to disturbance may act as reservoirs of mycorrhizal fungi for innoculation of new conifer seedlings (Perry et.al., 1989). Besides surviving tree roots of hardwoods, shrub species with similar disturbance survival strategies may also act as reservoirs of mycorrhizal fungi. Large logs may also insulate mycelia from drought or harvest effects.

Fungal responses to disturbance are complex. Interspecific competition may shift in favor of one species over another after a disturbance event. Armillaria root disease is a common disease in conifer ecosystems. Soil isolates from a recent wildfire location in central Oregon showed an increase in Trichoderma spp., which are strongly antagonistic to Armillaria species (Reaves, et. al., 1990). This suggests that light to moderate understory burns are beneficial for controlling Armillaria root disease.

A 1994 survey of Haypress Research Natural Area found eleven species from the Survey and Manage species list (Table C-3) of the Record of Decision for the President's Plan (Steiger, 1994). Similar habitat is found in the headwaters of Elk Creek. This survey was done in the spring so the fall flora is not likely well represented.

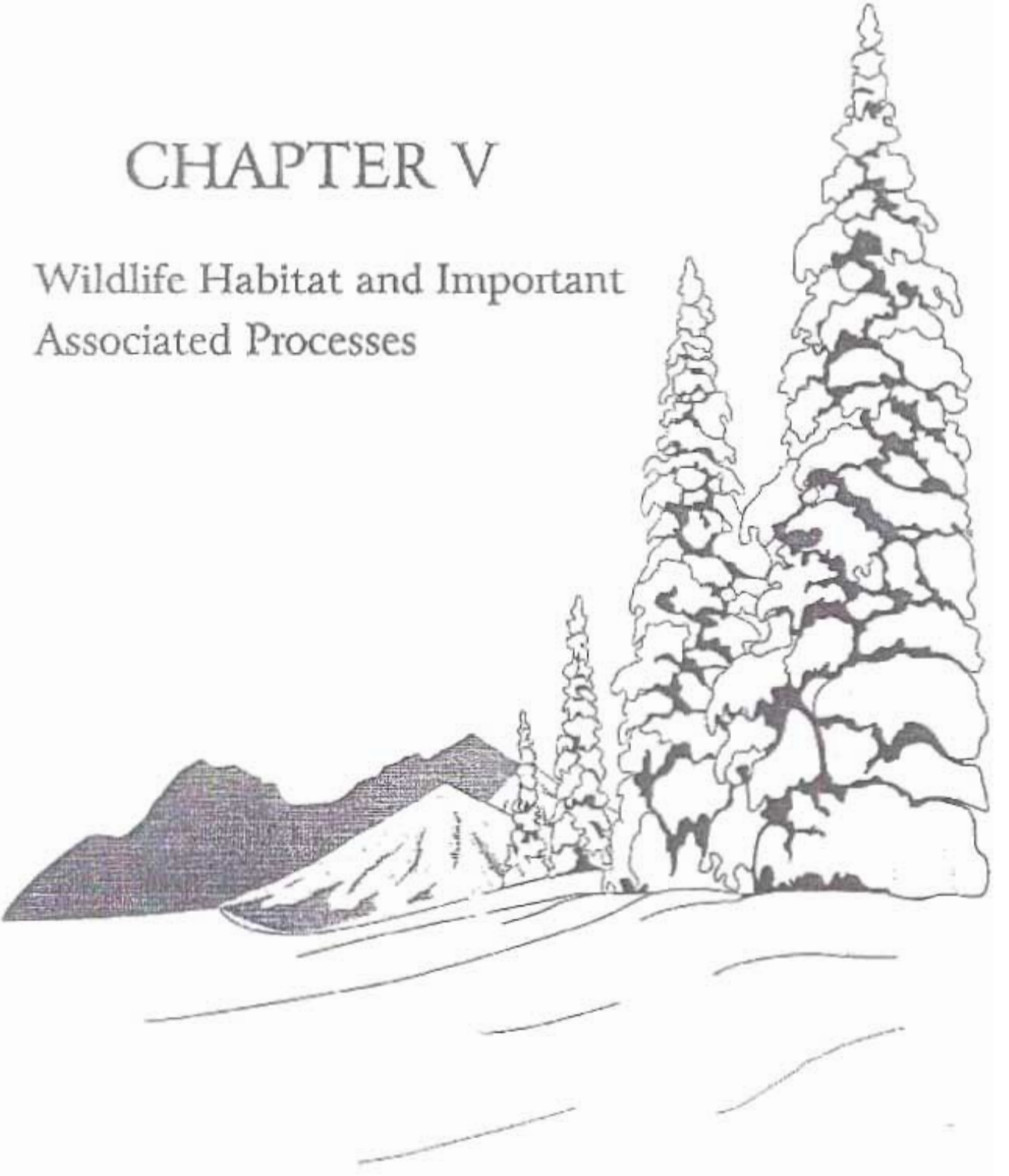
LINK BETWEEN VEGETATION AND WILDLIFE

Different animal species utilize different forest conditions and combinations of forest conditions. Many of these relationships can be displayed using the Wildlife Habitat Relationship model. Generally, higher diversity in forest types translates to higher wildlife diversity since there is a wider range of habitats. But, because each wildlife species tends to have different-sized home ranges and have different needs for types of vegetation conditions and patterns, there is usually no best condition for all at any given point in time. Since the total primary plant productivity of the forest's food web is finite, increasing the amount of habitat that favors one species or group of species often disfavors another species to some degree. Understanding the interactions between the animals and their habitats makes it possible to predict the response of populations to changes in their habitat and to plan our actions over time so that we can provide types and patterns of vegetation that achieve (or maintain) the diversity of habitats needed by our range of fauna.

Known populations are protected during management activities. Undiscovered populations have the potential of being detected by proposed management activities. Files of the botanical surveys completed within the assessment and project areas are located at the Happy Camp Ranger Station.

CHAPTER V

Wildlife Habitat and Important Associated Processes



WILDLIFE HABITAT

INTRODUCTION

Wildlife abundance and distribution is largely influenced by habitat. Wildlife habitats are determined by the distribution of vegetation communities on the landscape, by their structure and by the mix of species within a community. Although all of these are important to some species of wildlife, most species respond more to vegetation structure than to plant species composition (Thomas et al, 1990).

The Elk Creek drainage supports a variety of wildlife species, representative of animals found throughout northwestern California. It may be especially diverse because of the range of habitats found within the 60,780 acre watershed from small intermittent streams to high mountain meadows in the Marble Mountain Wilderness Area. All seral stages are represented here with a corresponding complement of wildlife species.

For this analysis, wildlife species have been grouped into guilds using home range size and general habitat use as parameters, as defined below. The purpose is to design an analysis that will address habitat needs for any species. As issues change in the future and different species are highlighted, the document and data would still be applicable.

Migratory: This includes those species that change locality seasonally for feeding or breeding. Except for elk moving up in elevation during the warm summer months most of the migratory species in this area are birds.

Home Range: Home range is the area, usually around a home site, over which an animal normally travels in search of food, a mate and to care for young.

Large Home Range: A large home range is larger than 100 acres in size. Many birds and mammals have large home ranges.

Small Home Range: A small home range is less than 100 acres in size. Amphibians and reptiles usually have small home ranges.

Detailed maps and discussion on seral stage distribution and trends across the watershed are presented in the previous chapter of this document, *Vegetation Communities*.

Early Seral: This habitat generally includes the grass/forb, shrub/seedling, and pole stages as described in the Vegetation section. It often develops after a disturbance and may never reach late seral conditions, if disturbance is frequent, such as fire.

Late Seral: This habitat includes early and late mature and old-growth forest. Early mature forest was included in this habitat to be consistent with the definitions of late seral habitat in the ROD (1994).

Riparian: This habitat is adjacent to and influenced by streams and wet areas. In the Elk Creek watershed, riparian vegetation changes subtly from the streamside areas to upper slopes; the changes occurring in the understory, shrub, and ground cover vegetation. Overstory conifer and hardwood species largely remain the same from the upper slopes to the stream banks. Mapping this habitat using aerial photographs is difficult without extensive field verification. Although riparian habitat would be a subset of the Interim Riparian Reserves (see the Fish and Water Quality section).

those Reserves will be used in this document to loosely describe the distribution of riparian habitat within the watershed. Interim Riparian Reserves cover approximately 12,313 acres of the watershed or 20% of the watershed. More detailed description of the riparian conditions can be found in the *Aquatic System* section of the document.

Figure 28 is a list of habitat associates and indicator guilds. These associations will be used throughout the analysis to describe wildlife relationships.

Figure 28 WILDLIFE GROUPS AND ASSOCIATED SPECIES

Group	Species
Migratory/early seral	Elk, Nashville warbler
Migratory/late seral	Vaux's swift, tree swallow
Migratory/riparian	Yellow-rumped warbler
Large home range/early seral	Grey Fox, Ringtail
Large home range/late seral	Goshawk, pileated woodpecker, spotted owl
Large home range/riparian	Raccoon, mink
Small home range/early seral	Blue grouse, rufous-sided towhee, western skink
Small home range/late seral	Northern flying squirrel, douglas squirrel
Small home range/riparian	Killdeer, American dipper, Pacific giant salamander and most other amphibians

There are several species found in the watershed which have special and unique habitat needs. They are recognized as threatened, endangered, or sensitive based on current population estimates and threats to their habitats. Federally listed Threatened and Endangered species include: northern spotted owl, marbled murrelet, bald eagle and peregrine falcon. Forest Service Region 5 Sensitive Species include: goshawk, willow flycatcher, fisher, western pond turtle, great grey owl and marten. This analysis will identify opportunities to improve habitat for these species where appropriate.

The **Watershed Analysis Guidelines** (1994) include specific questions about peregrine falcon, bald eagle, spotted owl, and amphibians. These questions are addressed in the Appendix.

INTERACTIONS

There are 14,610 acres (24%) of early seral stage habitat within the Elk Creek watershed. Early seral stages provide habitat for many wildlife species including those identified in Figure 28 above. Several migratory bird species, small mammals, and reptiles utilize early seral stages for reproduction, forage, and cover.

Early seral stages are also important components of big game habitats. They provide areas of forage and also hiding cover. Maintaining areas within the landscape in early seral stages is important for perpetuating big game species, particularly deer and elk.

There are 43,534 acres (72%) of late seral stage habitat within the Elk Creek watershed. It provides important habitat for species such as goshawk, marten, fisher, several small birds, bats, and some amphibians and reptiles.

Late seral stage habitats also provide a wide range of habitat components for several species. Elk and deer use it as optimal cover as it provides forage and cover during temperature extremes and seasonal storms. For species such as goshawk, spotted owl and fisher it serves as reproductive, foraging, and cover habitat through all phases of their life cycles.

The concept of particular animals being associated with particular seral conditions must also consider animals that have a preference for very specific combinations of seral conditions. Some animals are generalists while others have relatively narrow ranges of suitable habitat conditions. Early seral stages such as shrub fields or seedling stands may be foraged in common by several species, but required conditions for nesting, hiding, or protection from severe weather may be very different. Some animals are very specialized, and may not be favored by mixtures of vegetation types, such as birds that are adept at opening cones to get seeds or insects having very little success at foraging in a shrub field.

An increase in habitat quality for one species or group may be to the detriment of another in varying degrees.

As stated earlier, the primary factor that determines the occurrence and abundance of wildlife is the link to its vegetative habitat base. The habitats are very dynamic, however, particularly if we expand the time frame that we consider.

To illustrate how dynamic the vegetation/habitat is, a comparison has been made between current habitat conditions and conditions 50 years ago. We have compared habitat using vegetation information from 1994 photo interpretation with information derived for 1944. 1944 was chosen because a complete aerial photo set exists for Elk Creek taken that year which is an invaluable check for modeling accuracy. The comparison is based on habitat of elk and spotted owl. These two animals have very different habitat needs. The spotted owl is associated with late seral stage habitat. The elk, which have been successfully reintroduced, utilize early seral stages for foraging and late seral elements for cover. One observation made during this comparison was that the multiple-canopy mature forest that is presently considered old-growth was not very well represented in 1944. Much ingrowth of hardwoods and understory has occurred during the last 50 years, presumably due to fire exclusion, creating that multiple-canopy condition where owls seem to be thriving.

For comparison purposes, the present standards for density and size of forest cover that comprise the combination of nesting, roosting, and foraging habitat for spotted owls was applied to the 1944 vegetation information. Figure 29 illustrates a comparison of spotted owl habitat between 1944 and 1994. The nesting, roosting, and foraging habitat are lumped together on this map. The green shows an increase in spotted owl habitat since 1944. The yellow shows areas of habitat reduction since 1944. The graph indicates that there has been a net increase in habitat available to owls today. This representation is only of known changes in distribution of forest type and seral stage thought to be significant to spotted owls, and not information about actual populations or distribution of owls.

Figure 30 presents a comparison of habitat values for elk, using the Wisdom et al. criteria that is a standard model for elk habitat quality. It is sensitive to arrangement and size of early seral areas for forage and later seral stages for hiding and thermal cover. This comparison is based on vegetation change only, roads are not factored into the model. The creation of increased early seral condition by the disturbances of the last 50 years caused by fire and harvest has resulted in an overall increase in elk habitat value. The net value for elk habitat is very high in this watershed, which is affirmed by the successful reintroduction of a healthy, expanding herd in the last ten years.

We can only suspect how the animals themselves may have influenced the habitats within the drainage prior to recorded history. Roosevelt elk were once (and are again) common in this area and likely influenced the vegetation and were, in turn, influenced by the fire regime.

PEOPLE/WILDLIFE

Humans interact with wildlife species in a variety of ways. The most prevalent interaction is hunting. Deer are hunted during the fall for approximately two months prior to the onset of winter weather. Elk are currently not hunted as they have only recently been reintroduced into the Elk Creek landscape. Hunting is an important recreation to the local population, as well as to people who hunt here from outside of the Happy Camp community.

The extirpation of Elk as well as the grizzly bear and wolf resulted from hunting. There are no indications that changes in vegetation or habitat conditions influenced the status of these animals.

Recreation - bird watching, hiking, enjoyment of seeing animals in their native habitats are common activities in the Elk Creek watershed.

Roads, in the sense that they cause disturbance to wildlife through their use, can reduce habitat usage by wildlife. Big game, in particular elk and deer, learn to associate roads that receive hunter traffic with danger, with hunted elk being the most averse to open roads followed by deer to a somewhat lesser degree. Open road density increased greatly between 1950 and 1992, but is presently decreasing due to road closures. (See Opportunity section) The State Department of Fish and Game manages the hunting of game animals, while the Forest Service is responsible for the management of the habitat. Hunting of elk will probably be allowed on a limited basis in the future, and since many of the early seral stage areas that provide high quality forage were the result of past harvest and fire salvage efforts, they tend to have road access. The present trend of reducing open road mileage will have a resultant increase in habitat effectiveness (Lyon, 1983).

ELK CREEK WATERSHED

Spotted Owl Habitat 1944 vs. 1994

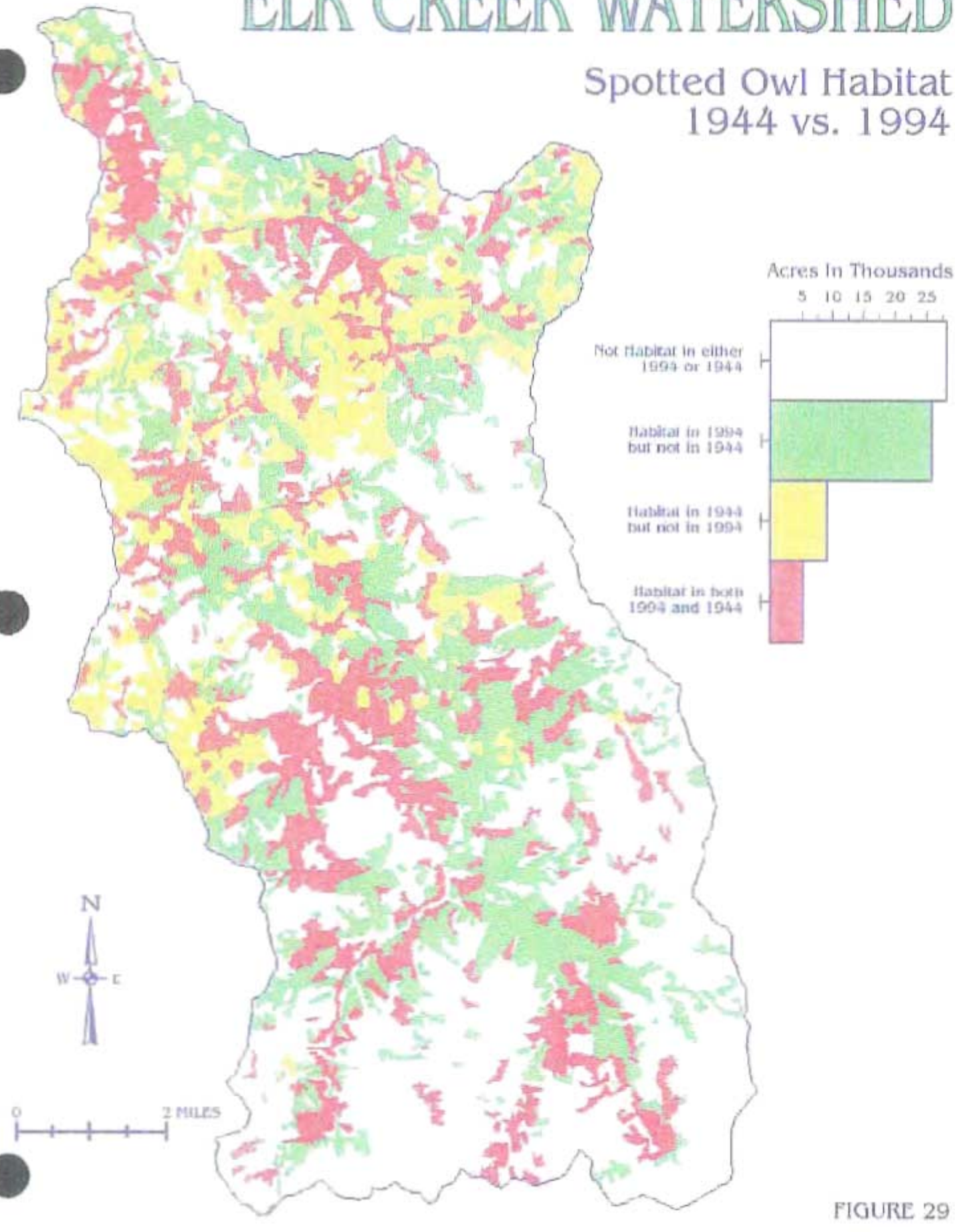


FIGURE 29

ELK CREEK WATERSHED

Elk Habitat Values 1944 vs. 1994

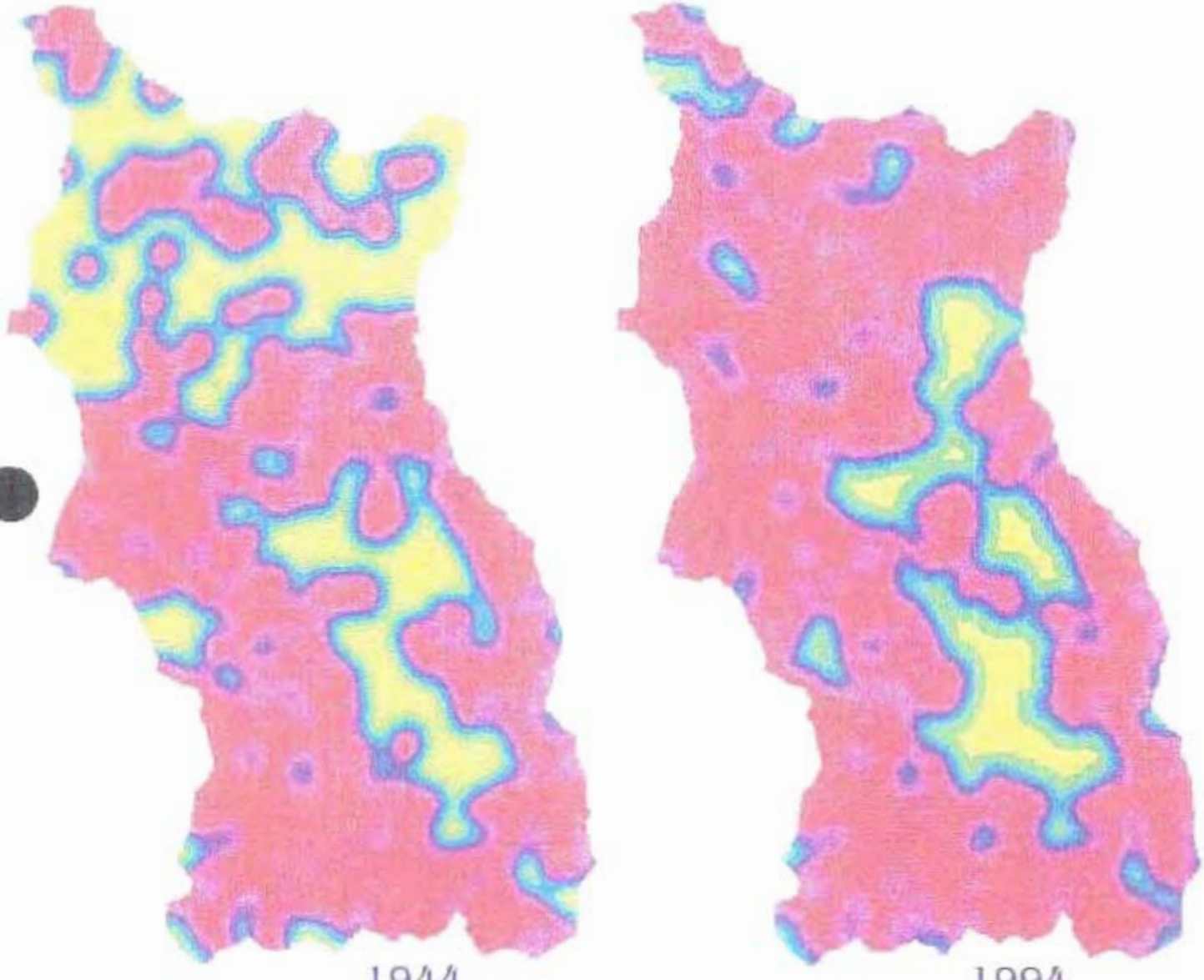
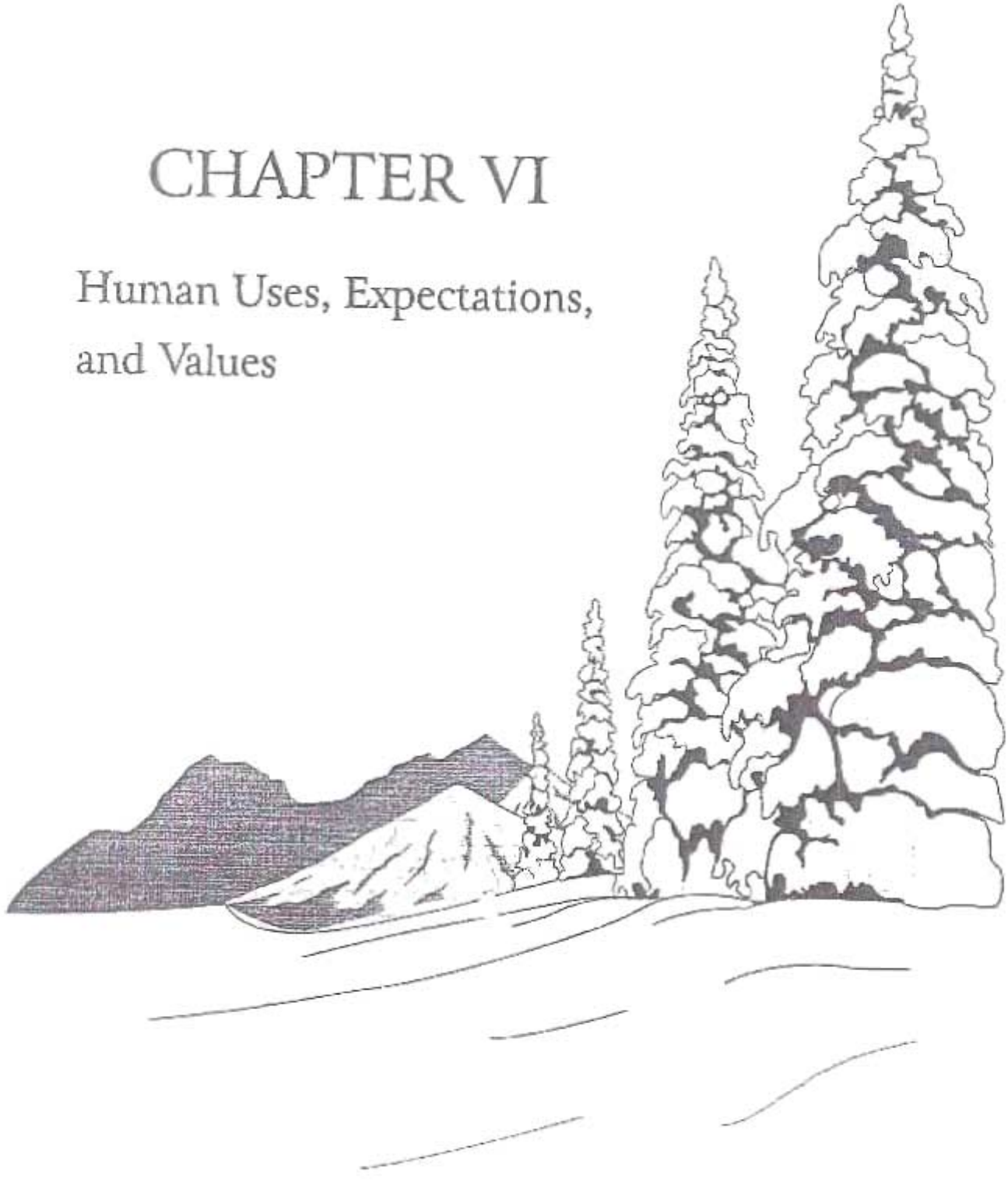


FIGURE 30

CHAPTER VI

Human Uses, Expectations, and Values



HUMAN USES, EXPECTATIONS, AND VALUES

People are a significant part of our forest ecosystems. They live, work, play, and derive material and non-material goods and services from the forests. Their attitudes, behavior, and knowledge affect ecosystems in both direct and indirect ways. Thus, forest management systems that alter the structure and processes of the biological component will ultimately alter the human system that interacts with it. Conversely, the way in which people are organized and the processes through which they make decisions will lead to alterations in the forest ecosystem (FEMAT, 1994).

WATERSHED FEATURES

People have developed and designed the following features in the Elk Creek watershed, for both their use and enjoyment. The Administrative Features Map, Figure 31, illustrates the pattern and locations of these features.

Roads

The Elk Creek watershed contains approximately 157 miles of road. The roads are distributed in the central and northern sections of the drainage. Of these roads, five miles are under Siskiyou County jurisdiction and 152 miles are under Forest Service jurisdiction. This includes two miles of private road. There are no roads in 40% of the drainage, which is designated as wilderness. Approximately 18 miles of road are located within riparian reserves.

The road density varies from zero to eight miles of road per square mile. Average road density within the portions of the watershed outside wilderness is 2.75 miles per square mile. Road densities are displayed in Figure 32. These densities include all roads. Permanent and seasonal closures are not considered for this road density analysis. California Fish and Game recommends a road density of no more than 1.5 miles of open road per square mile. Permanent and seasonal closures benefit wildlife and reduce erosion problems.

Elk Creek Road (7C001 and 16N05) is the main access road into the watershed. It starts in Happy Camp and ends at the Norcross trailhead. The lower portion of this road is chip sealed and it is open year round. This road serves residents of the watershed as well as recreational visitors, and provides access for resource management activities. It is maintained to provide a moderate degree of user comfort and convenience at moderate travel speeds.

All other roads in the watershed are maintained at lower levels. Nearly 20% of the roads (30 miles) are seasonally open and maintained for travel by a prudent driver in a standard passenger car. Fifty-two percent of the roads (81 miles) are maintained as roads seasonally open for use by high clearance vehicles. Traffic is normally minor, usually consisting of one or a combination of administrative, permitted, dispersed recreation, or other specialized uses. Twenty-one percent of the roads (33 miles) are intermittent service roads not maintained for use.

Road surfaces in the watershed vary with considerations of soil type, slope stability, steepness of grades, proximity to stream courses, and patterns of use. Approximately 7% (11.8 miles) of the roads are chip seal surfaced, 46% (15.70 miles) are aggregate surfaced, and 47% (79.7 miles) are native soil.

Year round access to the watershed is provided by 20 miles of surfaced roads. Seasonal access is provided by 119 miles of road which are closed to vehicular traffic during the wet weather season. The remaining 18 miles of road in the watershed are closed by structural barriers and/or vegetation.

ELK CREEK WATERSHED

ADMINISTRATIVE FEATURES

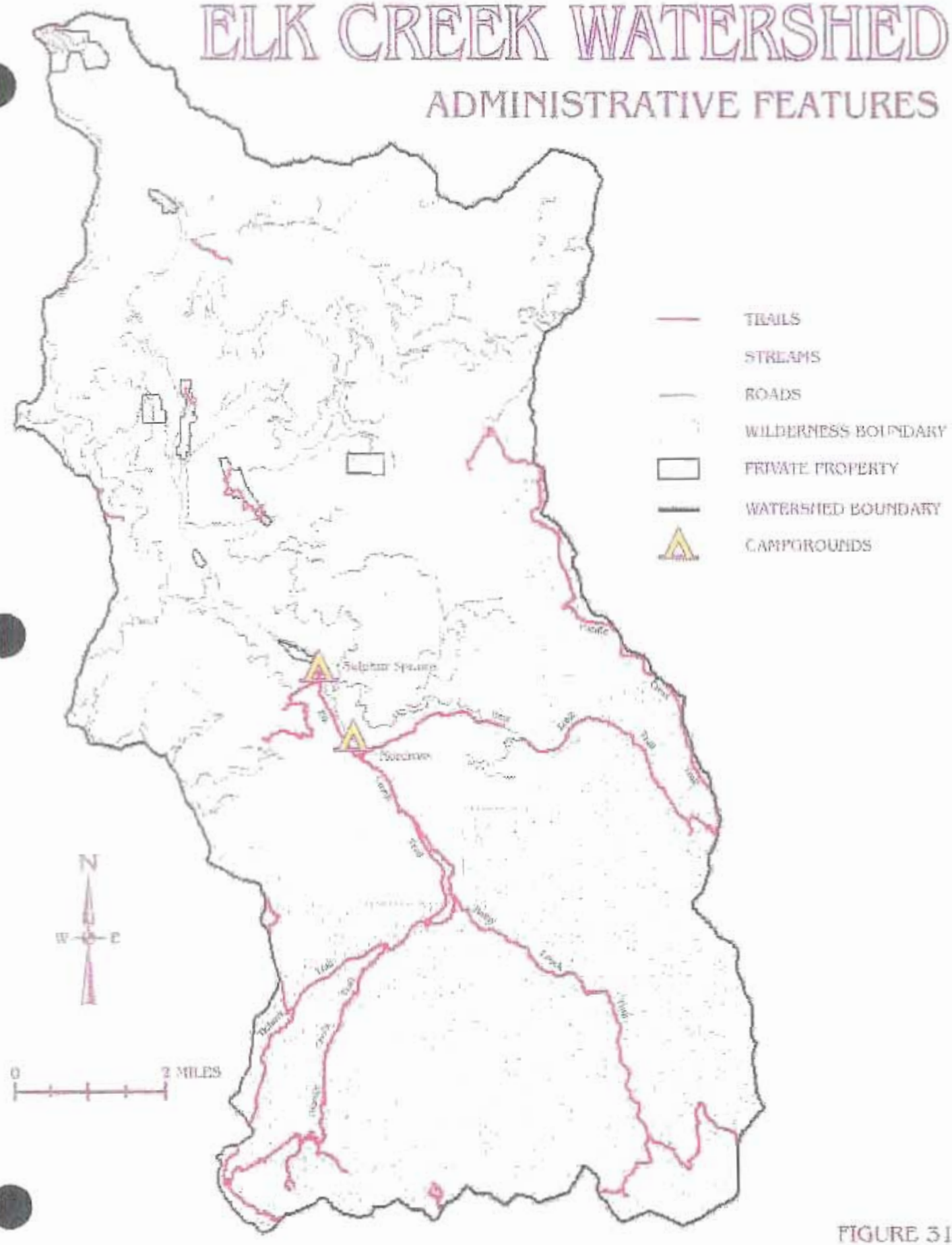


FIGURE 31

ELK CREEK WATERSHED

ROAD DENSITY

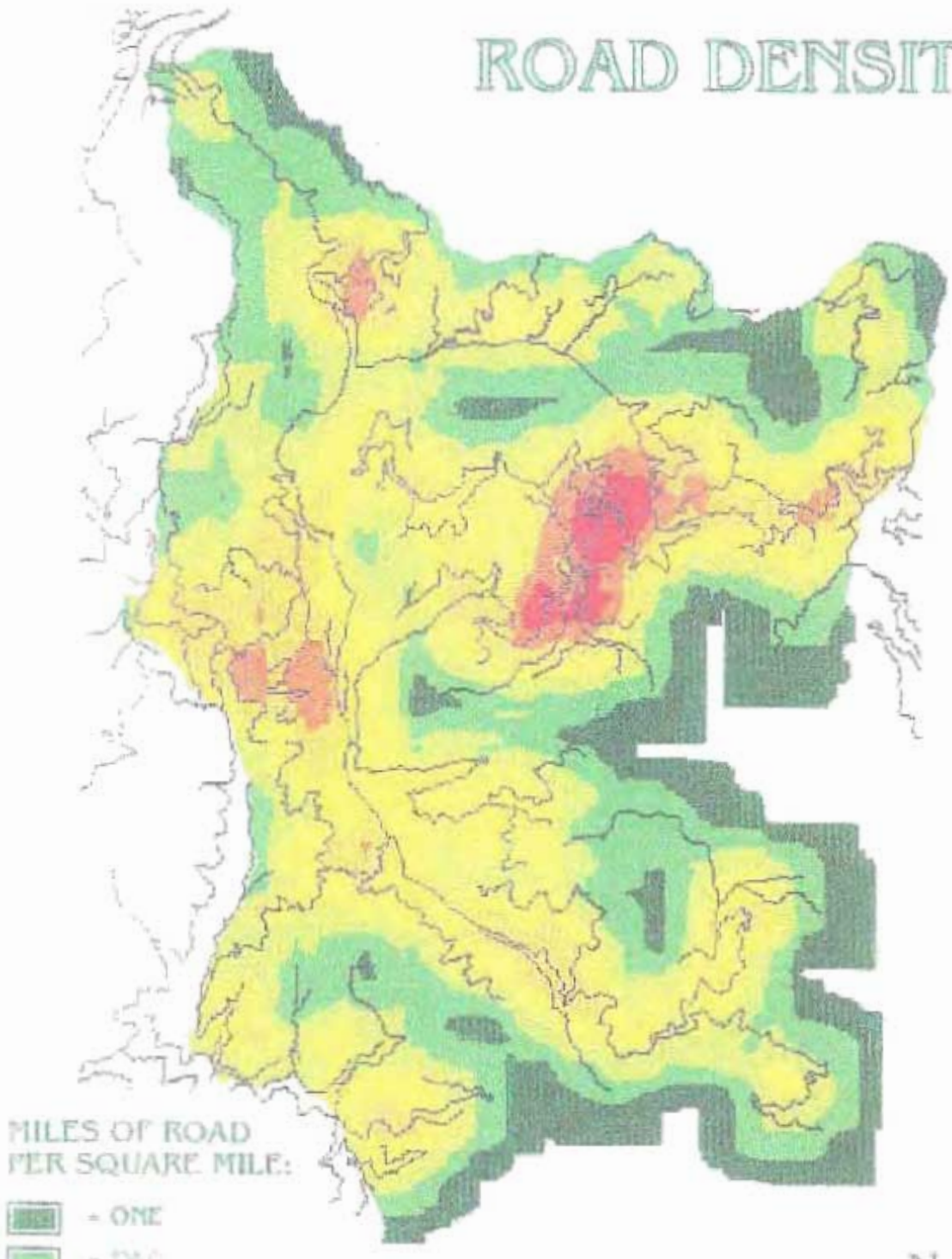


FIGURE 32

Trails

There are eight designated hiking trails that cover a distance of approximately 45 miles. The trails include: the Pacific Crest, Bear Lake, Elk Creek, Rainy Creek, Granite Creek, Tickner, Johnsons Hunting Ground, and the Town Trail. The majority of these trails (65%) are within the Marble Mountain Wilderness Area.

The recreation staff has estimated that all trails in the watershed combined receive about 7,000 recreational visitor days (RVD's) of use annually. On the average during the summer season, there may be about 20 to 25 people out on the 45 miles of trail. More people (mostly local residents) hike on the town trail than in wilderness areas, but the hike is only one hour or less in duration, whereas, wilderness hikes usually last at least 24 hours. The Granite Creek trail to the Granite Lakes is the most heavily used trail within the Happy Camp District's portion of the Marble Mountain wilderness.

Recreation Sites

Within the Elk Creek watershed, the two developed campgrounds are Sulphur Springs and Norcross. Both are trailheads to the Marble Mountain Wilderness. Each has six campsites and toilet facilities. Norcross campground has a corral and loading ramp available for horsepackers.

Each of the two campgrounds receives about 1000 RVD's of use annually. On average, during a six month season from May through October, there may be two groups comprised of two to three people staying in each campground. Norcross gets more day use, whereas, people often stay over night at Sulphur Springs.

There are also approximately ten dispersed campsites primarily used by mining enthusiasts. They are located adjacent to the main stem and the east fork of Elk Creek.

Wilderness

The 23,500 acres of wilderness within the watershed is only ten percent of the total Marble Mountain Wilderness (approximately 215,000 acres). The Elk Creek watershed has four popular trailheads for wilderness access: Sulphur Springs, Norcross, Bear Lake, and Johnsons Hunting Ground, all on the northern boundary of the wilderness area.

The Marble Mountain Wilderness Area continues to gain popularity among visitors and local residents. The lack of developed features (aside from access trails) and limited human activity makes the area appealing for day hiking, camping, wildlife viewing, backpacking and equestrian day use and packing. People appear to seek out the wilderness area to gain an experience that includes a certain degree of solitude and a chance to observe and interact with the natural environment without the distraction of other human activities. Current use of the Marble Mountain Wilderness Area, from access points in the Elk Creek drainage, is moderately low as is the impact created from the recreationists.

Private Property

The private property totaling 644 acres (less than one percent of watershed) is mostly concentrated near the town of Happy Camp with a few parcels scattered further south.

INTERACTIONS

Figure 33 is a graphic illustration of the human interactions within the watershed. There are many aspects and perspectives to how people relate to the watershed. Interests vary greatly from spiritual to recreational to commodity emphasis.

Contemporary Native American Use

Important contemporary-ceremonial use areas are located in Elk Creek and surrounding watersheds. Any management activity that could affect these sites will be managed through close consultation with the Karuk Tribe in order to protect these areas. The Historic Preservation Act of 1966 and other congressional mandates further provide for federal protection of cultural resources.

Animals, plants, and significant physical settings influence contemporary use. Some tribal members adhere more closely than others to traditional customs. Many tribal members have strong concerns about changes affecting areas their family used for centuries.

Modern land changes have affected the relationship between traditional use and available resources. Changes affecting traditional resources include management of the land by the Federal Government as a National Forest, logging, road development, mining, and commercial collection of forest products. Other issues relate to permit procedures, land use restrictions, chemical pollution, and conflicts between ceremonial and visitor users.

As part of the ecosystem management process, the Karuk Department of Natural Resources participated in the landscape design process. They have emphasized the need for more information and consultation in order to more adequately identify important ancestral and contemporary use within Elk Creek areas.

The Karuk Tribe and Klamath National Forest have developed government to government agreements to effectively work together on important Karuk ancestral and contemporary issues. As demands are placed on federal lands, traditional use issues will continue to emerge.

Timber

Since the 1950's, timber has been the main commercial interest in Elk Creek. Approximately 9,833 acres have had some harvest activities over the last 40 years. Of these acres, 7,445 were clear cuts and other types of regeneration harvest, 1,327 acres have been partial cuts, and 1,060 acres have had light salvaging. From the total, 1,130 acres were harvested (mostly regeneration cuts) as a result of fire damage. Figure 34 shows where different types of harvest were implemented in the Elk Creek watershed.

Using 40 thousand board feet (MBF) per acre for clearcuts, 12 MBF per acre for partial cuts and 5 MBF per acre for light salvaging, approximately 320 million board feet has been harvested from the Elk Creek watershed over the last 40 years. This includes volume salvaged after the 1987 wildfires. The past land base for harvest activities included all forested lands outside wilderness. This covered approximately 30 thousand acres. To compare growth to harvest rates using 200 board feet per acre per year, this area has been growing approximately six million board feet per year.

HUMAN INTERACTIONS

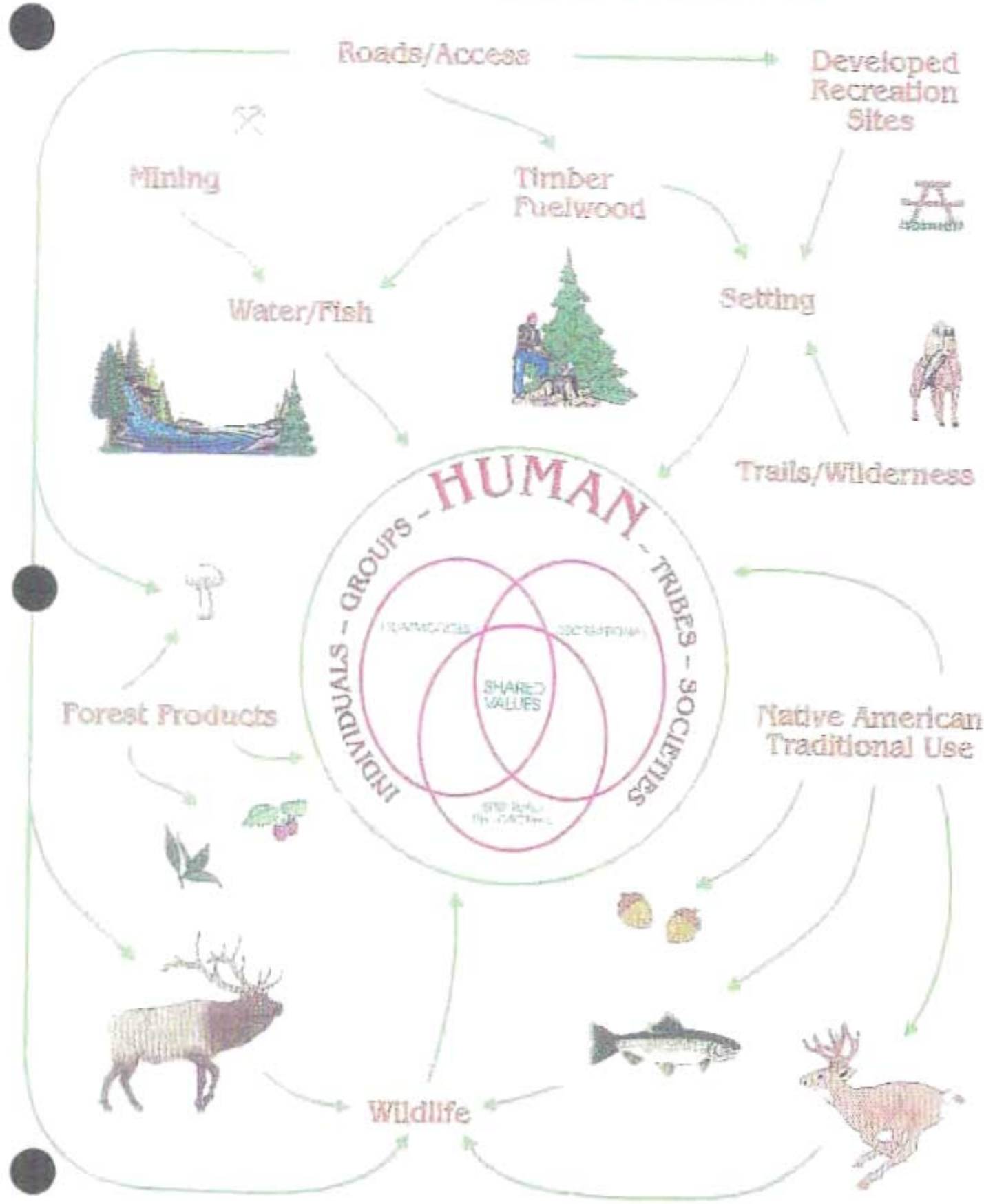


FIGURE 33

ELK CREEK WATERSHED

Harvested Areas

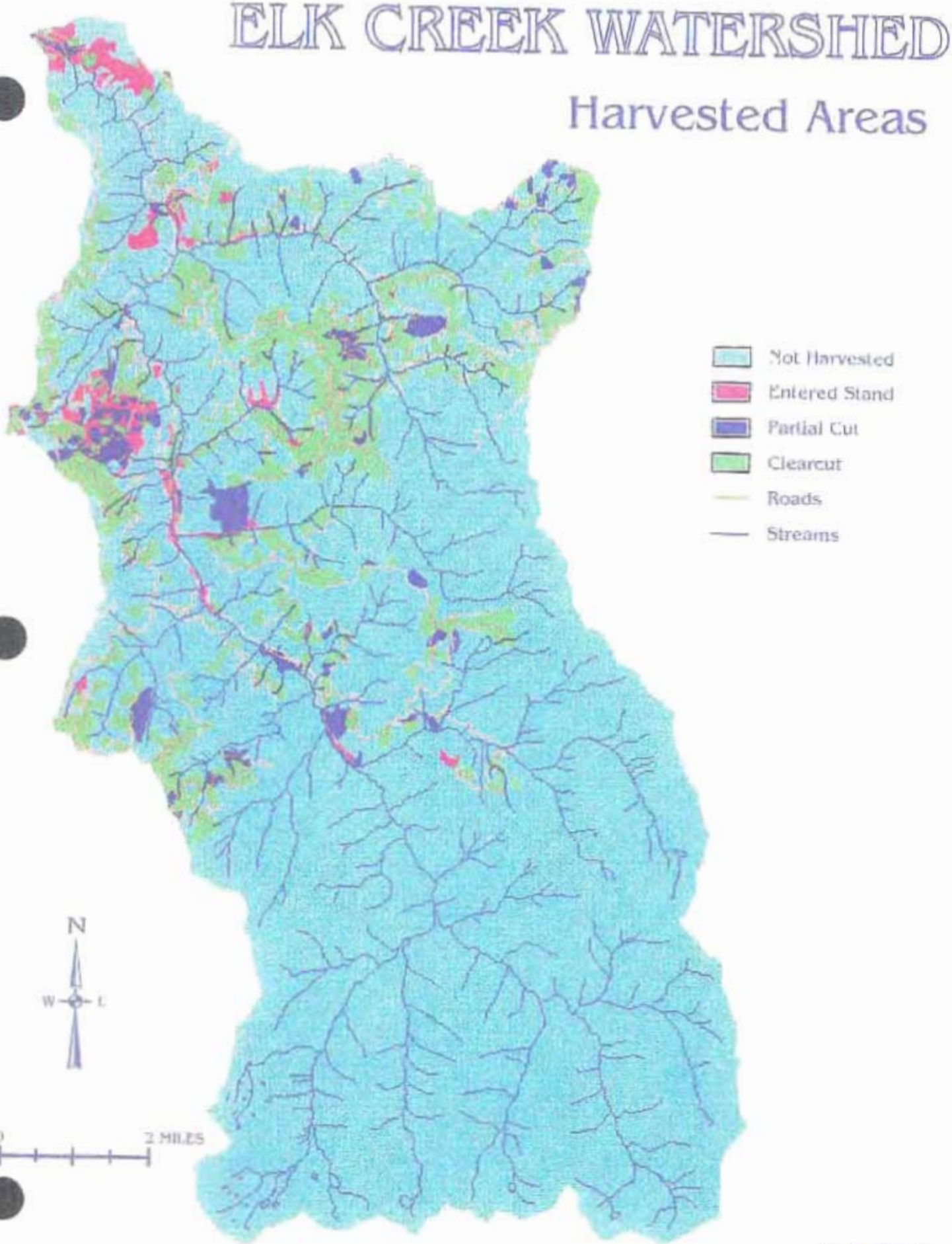


FIGURE 34

Within the watershed, 20,619 acres of Forest Land are in matrix. These are lands where timber commodity production is not excluded by other objectives. These acres include stands of mature timber as well as plantations that would be available for intermediate harvests over the next 15 to 50 years. Assuming a growth rate of 200 board feet per year, this area is growing approximately four million board feet per year. Availability of timber from these plantations is dependent on plantations reaching merchantable size without being killed by fire or disease. After the 1987 fires, 1,280 acres of plantations were burned badly enough that they had to be replanted.

Although ecosystem management objectives direct forests to manage in terms of outcomes instead of output, commodity production is still important.

Timber related jobs drew people into the community, provided income for a tax base, and allowed for residents to earn an adequate income while living in this remote, rural area. Using statewide data compiled for the Timber Sale Program Information Reporting System (TSPIRS), it is estimated that every job created is worth $42,000 to the economy as a whole. Approximately 60% of this income would be in the form of wages and salaries paid to the local area. The remainder of the income (profits and rents) may not all be paid to local residents.

In September, 1994, the last remaining lumber mill in Happy Camp was closed and offered for sale. One of the major factors cited for the closure was the decrease in the supply of Federal timber. The mill employed 80 people and was the largest single employer in the area excluding the Forest Service. Because employment opportunities are quite limited in Happy Camp, many families may have to leave the area. It is expected that local retail service businesses and schools may have to cut back on their employees with the reduction in business after the mill closed.

It is largely the present condition of limited employment opportunities that makes timber related employment so important to the community. Information derived from 1990 Population Census for the Klamath River area, encompassing Happy Camp, indicates that the most important industries employing people are manufacturing of durable goods (mostly lumber and wood products), agriculture and natural resources (mostly government), and the retail trade. The median family income was $27,039. Thirteen percent of all persons live below the poverty level. Unemployment generally runs two to six percent above the state average. This is common for primarily rural areas lacking economic diversification. The unemployment rates show seasonal fluctuations due mainly to the intermittent nature of natural resource based work. Recently, unemployment rates have been as high as 18% during some winter months.

Forest Products

Mushrooms are the most significant commercial use of non-timber forest products. The variety often picked is the tanoak mushroom which often grows in association with tanoak trees in the Elk Creek landscape. This commercial use affects traditional use by local Native Americans. Other interactions within the community include the influx of mushroom buyers and pickers from outside the area and an opportunity for residents to pick and sell mushrooms. Tanoak mushrooms sell for $10 to $75 per pound. An individual can pick ten gallons or more per day if he/she can locate good areas. Elk Creek has not been a high use area for mushroom picking. However, the use rate may have been influenced by the decision to administratively restrict picking in portions of the watershed.

Other special plant products that are collected in small quantities are boughs, trees, shrubs, cedar posts and conifer cones. Other potential products do exist, but do not have wide commercial use. These things include burls and stumps of hardwoods, foliage, berries, seeds, wildings (live trees and shrubs transplanted as ornamentals), vines, lichens, ferns, herbs, and mistletoe.

Various forest products have also been historically important to the Karuk Tribe. The Tribe relied on ample supplies of salmon, acorns and mushrooms for subsistence. Beargrass and hazel were the most commonly used basket making plants. These resources continue to be highly valued by tribal members.

RECREATIONAL USE

Hunting and Fishing

Deer are the main game animal hunted in Elk Creek although bear, quail, grouse, and other birds or small animals are also hunted. Legal hunting seasons are in the fall and are for six to eight weeks ranging from September through December.

The Elk Creek landscape is the most popular area on the Happy Camp District for deer hunting. Before the 1987 fires, the area received moderate use. Since the fires, the hunting pressure has increased many times from its previous levels. Articles written in sporting magazines publicized the large fires and the increased deer forage and populations. This encouraged additional people from out of the area as well as more local residents to hunt there.

Most hunting is done within one-half mile of road access. Most people hunt in burned areas or harvest units where the best forage is available. The areas that receive the most use are Titus Ridge, Johnsons Hunting Ground, Cougar Creek, and Stanza Creek. The Sulphur Springs area is a natural mineral lick for deer and attracts some hunting. At the present time, elk hunting is not allowed in the Elk Creek drainage.

Since game taken from the National Forest land cannot be sold commercially, all use is considered recreational. The standard method for tracking recreational use is by using an RVD, which is equal to 12 hours of use by one person. The District recreation staff estimates that the hunting use in the Elk Creek Watershed is equal to 5,940 RVD annually. Most of the non-local hunters interviewed in 1994 were from the Crescent City, Redding and Sacramento areas. These people often buy extra supplies in town and may spend some nights in one of the motels in town.

Fishing activity in Elk Creek is relatively light since salmon fishing is not allowed and the steelhead populations are declining. Size limitations (cannot keep any trout over 14" long) also discourage recreational fishing.

General Recreation

The road system provides ease of access to the riparian areas in Elk Creek and allows people to use the main stem of Elk Creek and its tributaries for a number of opportunities. Forest visitors tend to use this area for most of their recreational activity, as well as for access to the Marble Mountain Wilderness Area. The main stem is most popular for fishing, swimming, picnicking, bike riding, and recreational mining, both by local residents and Forest visitors. The numbers of users currently recreating in the watershed create a very limited impact on the riparian habitat and the quality of water, with the exception of dredge mining.

Mining

The main stem of Elk Creek and the East Fork of Elk Creek are open for dredge mining activity from July 1 through September 15. Over the past five years, an average of eight to ten plans of operation for dredge

mining for gold have been submitted for this area. It seems that most mining is recreational and people spend a week or two each year working on their claims. A few mining enthusiasts do spend a number of weeks on their claims and depend on the income from the activity to supplement their livelihood.

The California Department of Fish and Game completed an environmental impact report in July of 1994, which examined effects and proposed regulations to minimize impacts to fish and other resources from dredge mining activity. The season of use (presently July 1 through Sept. 15) is based on the avoidance of conflicts with the reproductive and migration activities of fish and amphibians. The effects on water quality were also examined. Impacts include turbidity caused by re-suspending streambed sediments and pollution caused by spilling of gas and oil used to operate dredges. The turbidity impact on water quality caused by suction dredging depends on many factors, including the types of fines in the substrate, the size and number of dredges relative to stream flow and reach of stream, and background turbidities. However, effects from elevated levels of turbidity and suspended sediment normally associated with suction dredging as regulated in the past in California appear to be less than significant with regard to impacts to fish and other river resources because of the level of turbidity created and the short distance downstream of a suction dredge where turbidity levels return to normal. Regulations for Elk Creek and its tributaries allow for dredges with an intake nozzle of no larger than six inches.

HISTORIC RANGE OF VARIABILITY

Human use in Elk Creek drainage has varied in both type of use and numbers of users over the last one hundred years. During the early part of this century, the watershed was occupied and used by many more residents than the current number. Mining and grazing along with homesteading created a significant impact on the riparian areas in the Elk Creek watershed during these years, and is still apparent in certain areas today.

Prior to the second World War, the primary management activity on National Forest lands was fire suppression. Unknowingly, suppression activities resulted in the most significant disturbance in recent history to the watershed. The severity of the fires during the 1980's, created by excessive fuel loading from years of suppression, impacted the vegetation and habitats in a significant portion of the watershed.

Another very significant factor that changed the range of activity following World War II, was the active management by the Forest Service for timber production and removal. The impacts of timber activity are visible in nearly all of the roaded areas of the drainage, with the Wilderness Area being the exception.

The current and most recent efforts to ecosystem management on National Forest lands are changing and will continue to change the degree of activity and human use in the Elk Creek watershed. Activities are now being planned and decisions made by a more diverse group of participants and professionals with the objective of meeting multiple goals and providing for a wider range of products than ever before.

SCENERY

Natural appearing scenery benefits humans directly through scenic appreciation, enriching the quality of life, and indirectly through revenues generated by recreational use and tourism. Scenery is most enjoyed near streams, lakes, meadows, high peaks, along trails and roads, in campgrounds, or at wildlife viewing areas.

Forest scenery is measured and categorized to conserve the scenic legacy of National Forest Landscapes. Guidelines are based on a National Visual Management System. Landscape provinces have distinct scenic characteristics. Marble Mountain Wilderness areas, streamside areas and rocky bluffs in Elk Creek are classified as having high scenic value. Remaining areas in Elk Creek are aesthetically pleasing but more typical of the province.

WILDERNESS

Nearly 40% of the watershed is located in the wilderness area where only natural ecological events and recreational human influence continue to shape the landscape. Wilderness areas display sequences of dramatic variety. Panoramic vistas of avalanche paths, meadows, alpine lakes, rock formations, and diverse vegetation are especially attractive. Across the wilderness a continuous mature tree texture reaches up into rocky alpine ridge settings. Recent wildfire patterns are noticeable, especially in the Johnsons Hunting Ground area.

HIGH ELEVATIONS

Roaded high elevation settings also offer visitors panoramic views of forested mountains, often framed by attractive foreground conifers. Within managed areas, dark continuous mature tree areas contrast with areas of lighter colored vegetation. At high elevations, the contrasts from logging activities within the drainage and beyond are more prominent.

MODERATE ELEVATIONS

Forested backdrops characterize intermediate elevation settings. Roads and logging management contrasts are evident. Areas of mature tree character are frequently interrupted by previously logged areas. Multi-storied pines and hardwoods are more numerous on south slopes. Inner gorges and north slopes support a more continuous vegetation pattern. Fire patterns strongly affect the vegetation character.

LOWER CANYONS

Lower elevations feature canyon-riparian settings. Alders buffer stream courses. Developed areas such as campgrounds, main access routes, and private lands retain a rural atmosphere. Land developments only moderately alter scenic settings. Logging contrasts are not as noticeable in most of the low elevation corridors. Attractive streamside settings accompany most access travel routes.

INDUCED PATTERNS

Prior to 1850, natural processes and frequent fire regimes were dynamic forces perpetuating the scenic ecosystem. The indigenous Karuk shaped scenery by manipulating fire to their advantage. Based on historical photos and records, forests were more open and park like than today. From 1950 to 1980, more emphasis was placed on harvesting timber on public lands, modifying scenic conditions through logging and road development.

Dramatic effects on vegetation character resulted from a 26,000 acre wildfire in 1987 and timber salvage activities created numerous openings. Approximately 16% of the watershed has experienced some level

of timber harvest activity since 1940. Management contrasts are dispersed due to roads and varied logging locations. The East Fork of Elk Creek has experienced the most significant disturbance. Logging contrasts near Johnson Creek are also strong.

The degree to which previous management activity retained natural appearing scenery has a direct effect on scenic quality of the landscape as a whole. The result is a diverse appearing landscape where logging contrasts moderately interrupt the area's natural scenic landscape continuity, but where wilderness settings remain pristine. Long term effects of recent fire events and human induced patterns will eventually result in a more diverse landscape because of multi-storied tree stand successions.

AIR QUALITY

Air quality within the assessment area is good except for brief periods during prescribed fire burning or periods of on-going wildfires. Air quality in adjacent areas is also generally good. Areas which have longer periods of poor air quality are the populated inland valleys of Southwest Oregon and Northern California, when periods of stagnate air trap pollutants, particularly in the winter months.

The Clean Air Act (1977 amendment) identified the Marble Mountain Wilderness as a Class 1 area where only a very small amount of air quality deterioration is permissible. The goal is to prevent any future impairment and remedy any existing impairment from human-caused air pollution. Visibility is the main criteria for determining air quality in the wilderness.

Of all the current management practices on the Klamath National Forest, prescribed burning has the greatest impact on local air quality. This impact is only temporary in nature and, unlike major stationary emitting facilities such as factories or electrical generation plants, it is difficult to quantify on a site specific basis.

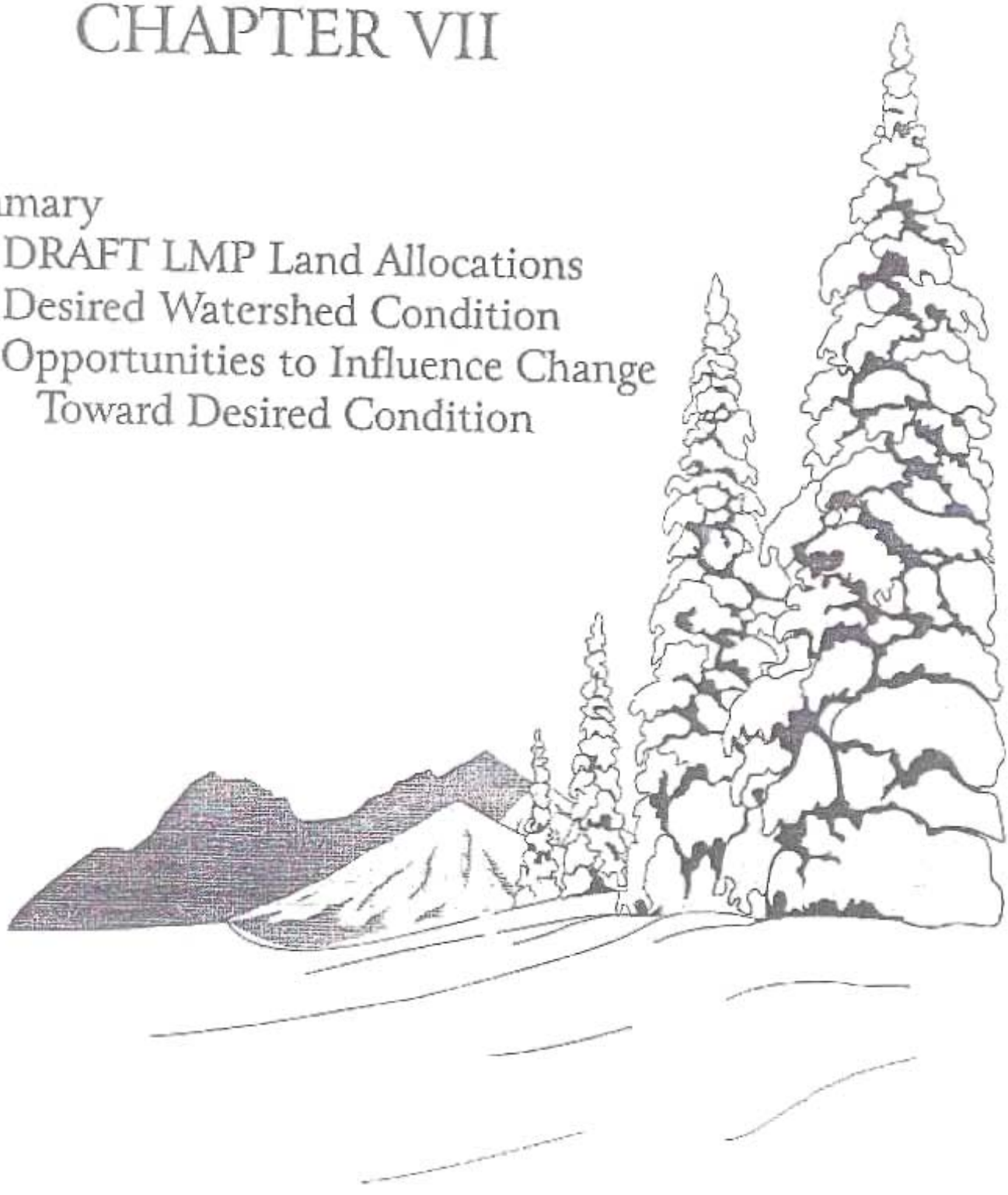
CHAPTER VII

Summary

DRAFT LMP Land Allocations

Desired Watershed Condition

Opportunities to Influence Change Toward Desired Condition



SUMMARY

This chapter describes the desired conditions and identifies opportunities to achieve desired conditions. Desired conditions for the vegetation communities are described by land allocation. Desired conditions for the other issue areas are described more in terms of those issues.

The Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl reflects agreements made between the public and the Forest Service. As previously mentioned, the Forest selected alternative will be consistent with the ROD and incorporates public comments received on the Draft Plan.

The goals, objectives and desired conditions identified in this chapter are consistent with forest-wide desired conditions. Details unique to Elk Creek are summarized as well as general conditions described in the Draft Forest Plan. Provided here is information more refined as that which appears in the draft plan and less refined than that needed for analysis of projects. The opportunities displayed, result from a comparison of existing conditions, objectives and desired conditions. Management actions that bring existing conditions closer to desired conditions are identified as opportunities.

FOREST-WIDE GOALS

Forest-wide goals provide general management direction. The four categories of goals are sustainability, environmental health and community stability, active stewardship, and participative management. These goals cannot be viewed independently. They must support each other's aims and should be considered in collective context. To achieve these goals the Forest will:

- collectively pursue ecosystem sustainability through integrated resource objectives;
- manage for a diverse and productive environment by utilizing or managing components of naturally occurring processes to implement management actions and managing for the long-term, broad scale stability of local communities;
- manage with the highest standards of stewardship by working to meet the needs of the Nation for wood, minerals, water, forage, wildlife, recreation, and other resources and;
- actively cooperate and coordinate with Federal, State, local agencies, governments, and Indian tribes.

The desired condition of the forest must consider ecological principles and processes. An ecosystem approach fully integrates disciplines and methods applied in resource management. Ecological processes include people, their demands, and effects as components of the ecosystem.

RIPARIAN HABITAT

Desired vegetation conditions for the Riparian Reserves have been described in the *Riparian Habitat* section of this document. The following describes desired conditions for the aquatic environment and identified opportunities.

AQUATIC CONSERVATION STRATEGY OBJECTIVES

This strategy was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems contained within them on all public lands. This strategy was adopted as part of Option 9, the selected alternative of the President's Plan. This conservation strategy employs several tactics to approach the goal of maintaining the "natural" disturbance regime. The following are specific objectives identified in the Aquatic Conservation Strategy.

1. Maintain and restore the distribution, diversity, and complexity of watershed and landscape scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

2. Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian dependent species.

3. Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

4. Maintain and restore the water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include timing, volume, rate and character of sediment input, storage and transport.

6. Maintain and restore instream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high and low flows must be protected.

7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

The maintenance and improvement of aquatic habitat in Elk Creek will be guided by the desired future conditions displayed in the draft Land and Resource Management Plan and a comparison with existing conditions. For fisheries, these desired conditions include goals for water temperature (maximum summer, 69 degrees Fahrenheit), riffle embeddedness (maintain 20% average in riffle areas), fine sediment (15% average in spawning areas), primary pools (minimum three feet deep every three to six bankfull widths), and coarse woody material (average 20 large wood [2 x 50 feet] per 1,000 feet).

The rainy climate, rapid uplift of the mountains, thick soils made from rocks with low resistance to weathering and extensive road system contribute to the relatively high erosion rate in the Elk Creek basin. Intense storm related sediment production is approximately double what it would be if the watershed were undisturbed. Roads are the primary, and most feasible to control, source of the increase in sediment production. Fish, and other aquatic organisms, are sensitive to increased sediment production. Soil engineering (mechanical properties of soil) and engineering geology (distribution of rock and soil and physical processes on the landscape) provide strong technology for stabilizing soil and so reducing sediment production.

Culverts within Elk Creek were not designed to meet recurrent interval storms of 100 years with debris as desired today. An opportunity exists to fail-safe these culverts to insure that diversion down an existing road does not occur if the culvert plugs. This could be accomplished by placing a rolling dip below any culvert where such a diversion possibility exists.

After a travel and access management plan has been completed to determine the long range road network in Elk Creek, the potential watershed restoration opportunities will emphasize reduction of surface erosion from Forest roads and stabilizing unstable cut and fillslopes.

The following features of road and slope character can be managed to improve stability.

1. Surface drainage (drainage design)

2. Sub-surface drainage (trench drains)

3. Soil strength (compaction, structural reinforcement)

4. Mass distribution (buttressing, excavation to relieve driving force)

The mitigation measures may be incorporated in original construction, often at substantial savings in cost, or retro-fit. The following is a sample of measures prescribed for existing roads in the upper East Fork basin.

1. Install 18" cmp cross drain at draw, 16N28, SE 1/4, Sec. 33, T16N, R8E, $1000

2. Construct dip in road to prevent stream diversion if cross-drain fails 45N19 NW1/4, Sec. 4, T15N, R8E, $500

3. Pull back landing fill from steep slope, hydraulic excavator, 45N56Y, NW1/4, Sec. 3, T15N, R8E, $3500

4. Construct 50' x 7' trench drain to stabilize road fill at spring 15N03, NW1/4, Sec. 9, T15N, R8E, $1000

5. Construct two fabric reinforced fills at stream crossing 15N03A, NW1/4, Sec. 4, T15N, R8E, $2500

There are few opportunities to stabilize natural landslides. Access is generally poor and wild landslides are difficult to control. Stabilization is attained at the cost of loss of vernal ponds or other unique habitat values.

Elk Creek watershed has many roads in and adjacent to riparian reserves. Coarse woody material in the reserves is often prevented from reaching the creek because it lands in the road instead of falling into the creek. Once on the road, these logs are usually bucked for travel access of removed for other uses, such as firewood.

To improve recruitment of coarse woody material, trees that are a hazard to the road or those that fall on their own need to be placed below a forest road to allow the logs to remain in the riparian reserve and potentially reach the creek.

VEGETATION COMMUNITIES

Desired vegetation conditions vary by land allocation. General desired conditions for the land allocations are described in the introduction (Figure 4). This description focuses on those allocations where opportunities have been identified to apply management actions that work towards desired conditions.

MATRIX - GENERAL FOREST

Vegetation elements are likely to change in size, shape, composition, or arrangement due to management activities. Desired condition objectives include maintaining a range of seral stages.

Goals and Objectives - Provide a programmed, non-declining flow of timber products, sustainable through time. Maintain conifer stocking levels and high growth rates commensurate with the capability of the site to produce wood fiber. Intensively manage young regenerated stands to maximize growth potential.

Manage activities to maintain stand vigor and resilience to disturbances such as wildfire, insects and disease. Emulate ecological processes and stand and landscape patterns where possible.

Within harvest units, maintain the structure, composition and ecological function of the area. Provide for snags and hardwood habitat to help maintain viable populations of wildlife species that require these structural components.

Desired Condition - These areas will be a mosaic of vigorously growing forest stands made up of a variety of species. The composition of individual stands will vary considerably depending upon the forest type and seral stage development. Although openings with hardwoods, shrubs, grasses and forbs will be apparent, forest stands will consist primarily of conifers.

Stand structure will be variable. Generally, the forest will look younger than the surrounding areas, but will blend with the surrounding landscape. Stand sizes will vary with topography and landscape pattern of the surrounding area. Clearcutting, which leaves no residual structure, will be infrequent. Regeneration openings will generally retain clumps of green trees (15% to 20% of the stand) and individually scattered green trees (two to five per acre of average stand diameter).

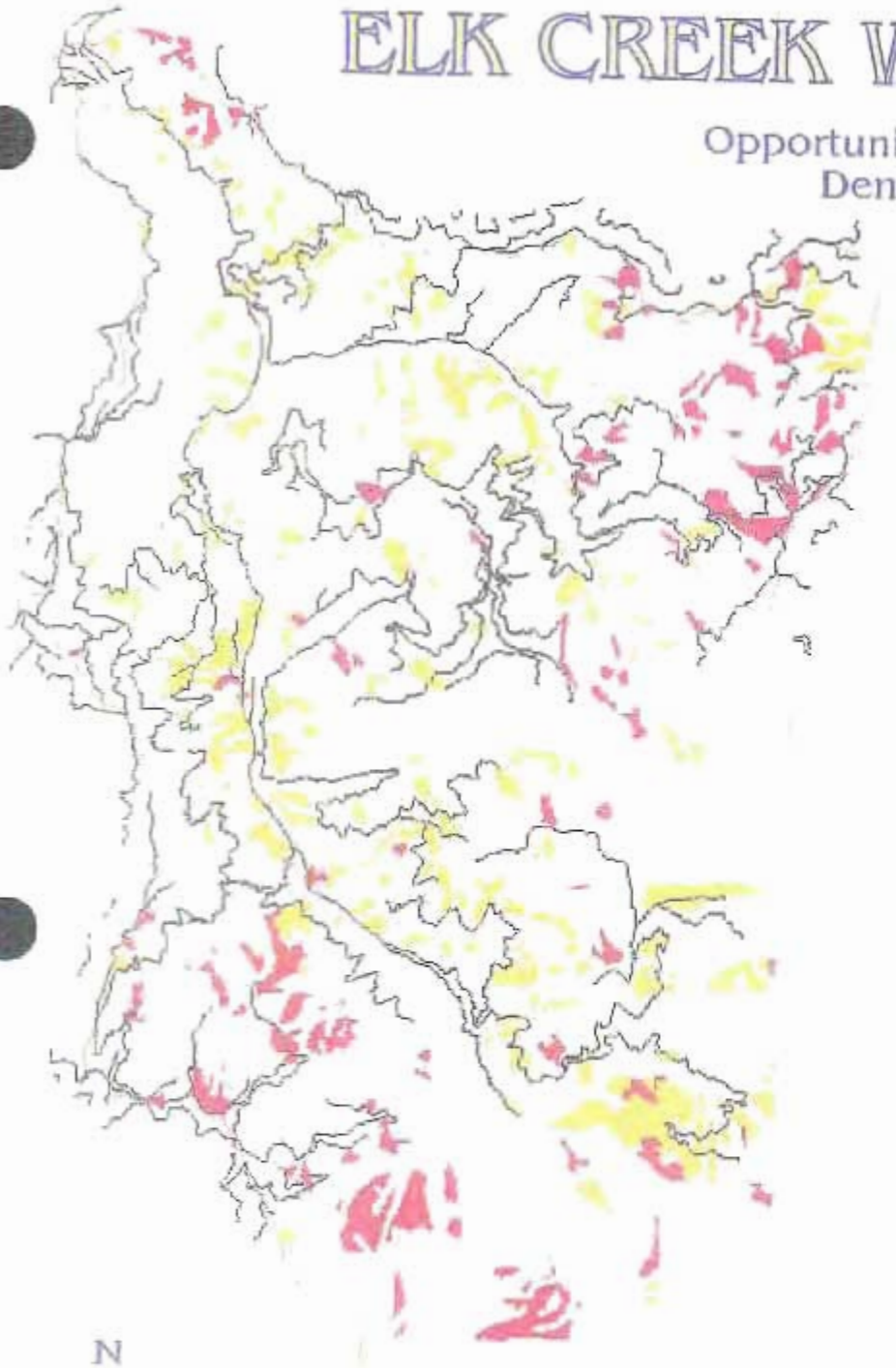
On the geologically sensitive areas, management actions will be modified as needed to maintain slope stability. When implementing stand management activities, prescriptions would retain the composition, amount and arrangement of reserve trees that best met slope stabilization objectives. Size, shape, and arrangement of openings would also be designed to minimize landslide potential.

In the interactions section, we discussed the significance of vegetation density to forest stability.

Managing stand density increases the likelihood that a later seral condition will be achieved. Figure 35 depicts areas where the crown closure of all trees, both hardwoods and conifers, is between 70% and 100%, and a heavy component of mature conifer overstories is also present. Two density levels of large conifer overstory are shown. The areas shown in red have a very dense overstory of large conifers and competition is likely to elevate mortality. The areas shown in yellow have an overstory of large conifers and crown closure is 40% to 70% including other trees, primarily hardwoods. These other trees occupy the remainder of the growing space so that the sites are fully occupied. The competition between overstory

ELK CREEK WATERSHED

Opportunities Where Overall Stand Densities Are Very High, With Moderate to High Density of Large Overstory Conifers



Overall crown density at least 70% (hardwood plus conifer) **and** Overstory of large conifer trees

- 70% or more
- 40-70%
- Roads
- ECW Boundary

N

W E

0 2 MILES

FIGURE 35

trees is less on those sites, but is still significant. On other sites, which are not depicted, the primary density pressure is between hardwoods and conifers, with conifer-to-conifer competition being a minor factor.

The fuels component must also be considered in density management. Stand density can be acceptable from the standpoint of competition, but still increase risk of mortality from fire.

The most useful tools for managing stand density in this setting includes thinning and prescribed burning. Thinning reduces competition and enhances achievement of late seral conditions while providing economic benefits. Prescribed burning reintroduces fire back into an ecosystem as a natural process. Fire treats the fuels which lowers the risk of a more severe stand replacing fire. Fire also reduces understory competition. Figure 36 shows where opportunities have been identified to apply prescribed fire.

Salvage in areas where mortality has already occurred can reduce risk of stand replacing fire by reducing fuels. The economic benefits of the timber can be realized while revenues from timber sales can be used to apply prescribed fire. Figure 37 shows areas of conifer mortality where salvage can be considered.

MATRIX - RETENTION, PARTIAL RETENTION, AND MODIFICATION

Matrix Retention - Areas classified under scenic retention would provide highly attractive forests from all viewing distances. Management activities would not be noticed by the average, casual forest visitor.

Matrix-Partial Retention - Partial Retention areas would retain near natural appearance where human activities may be evident but remain subordinate to the natural characteristic landscape.

Matrix-Modification - Management activities may dominate the natural characteristic landscape but activities must utilize naturally established patterns of form, line, color and texture to appear as a natural occurrence when viewed in foreground and middleground distances.

MATRIX - RECREATIONAL RIVER

Goals and Objectives - Protect and enhance the outstandingly remarkable anadromous fisheries value for which the river was designated, while providing for public recreation and resource uses that do not adversely impact or degrade those values.

Manage recreation activities to assure that the character and quality of recreation use will not cause adverse impacts on the resource values for which the river was designated.

Desired Condition Statement - The river area may be developed for the full range of agricultural and forestry practices, may show evidence of past and on-going timber harvest and may include some residential, commercial, or similar development. The waterway should remain generally natural and riverine in appearance.

ELK CREEK WATERSHED

Prescribed Fire Opportunities

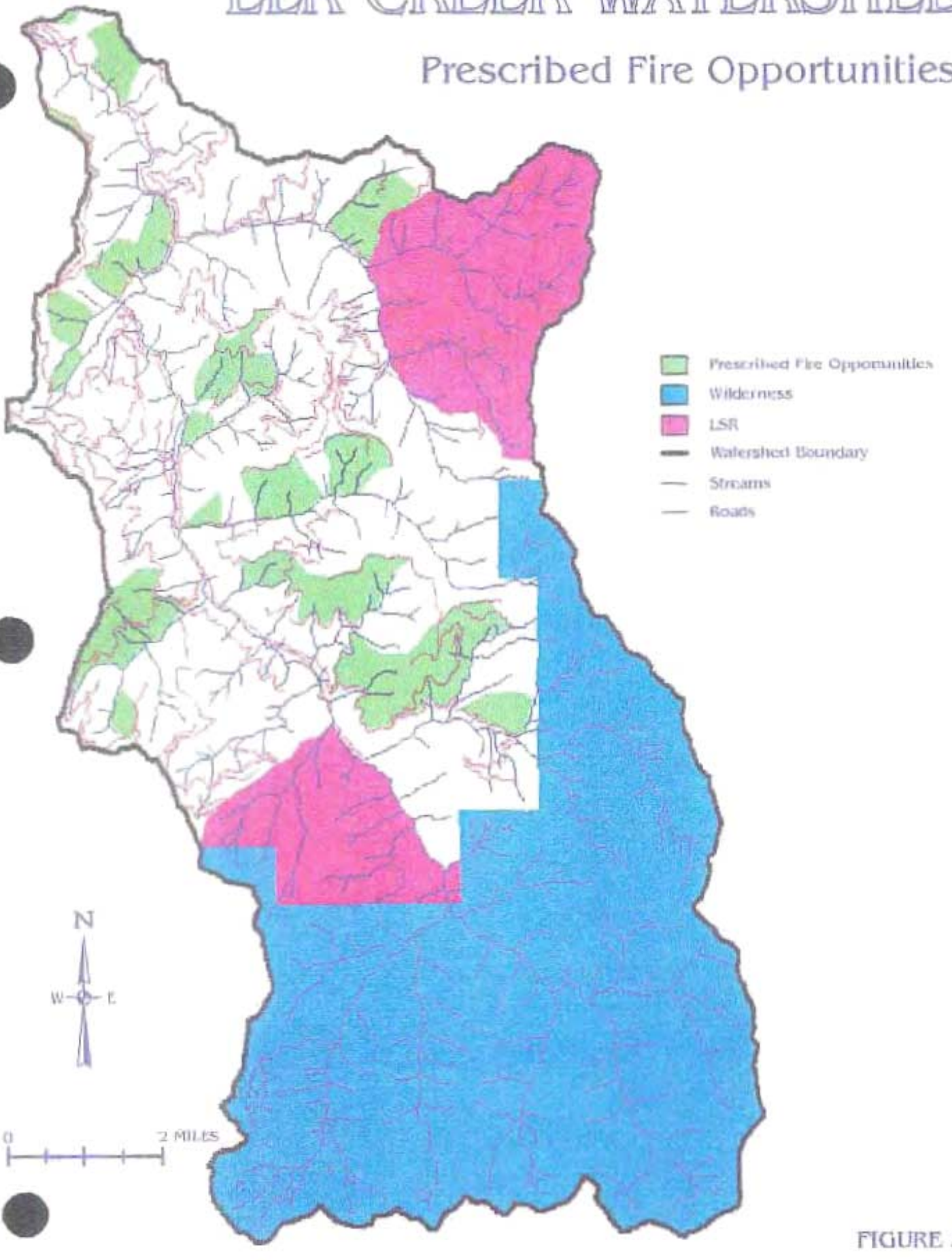


FIGURE 36

ELK CREEK WATERSHED

Areas of Conifer Mortality Outside LSR and Wilderness

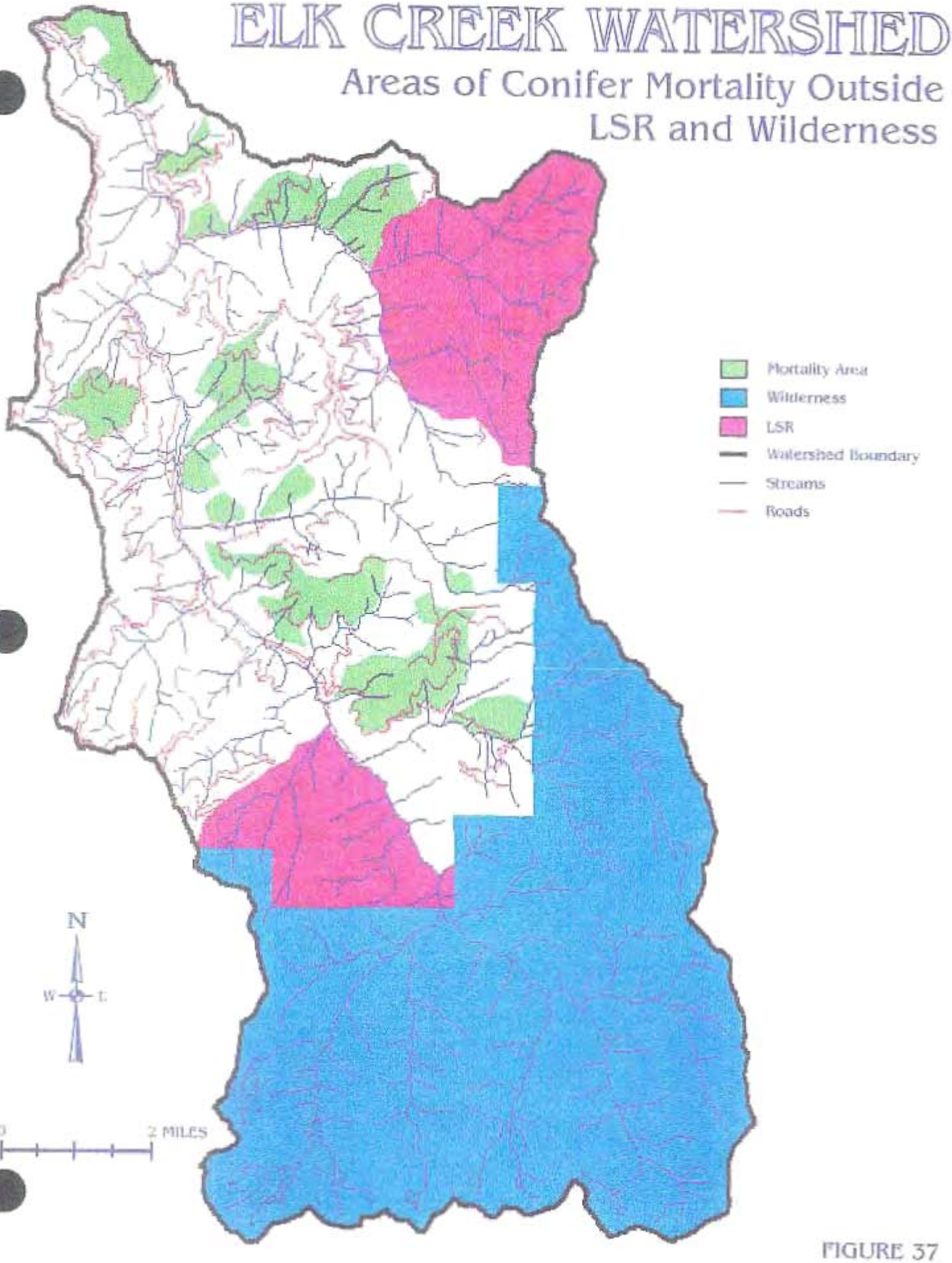


FIGURE 37

LSR

Goals and Objectives - Manage these areas in order to contribute to the recovery of threatened and endangered species dependent on late successional forest characteristics. Habitat within these areas is to be maintained in a condition which is suitable for spotted owls. Management activities, including silvicultural practices and prescribed fire, designed to maintain, improve or accelerate the development of suitable spotted owl habitat should be implemented.

Desired Condition - Achieve and maintain multi-layered forested habitat with large overstory trees, snags and down logs. The "local definition" of spotted owl habitat should be regarded as a minimum for specific habitat attributes. The description includes overstory trees with an average dbh of less than 18 inches, total canopy closure of less than 60%, and at least two large snags and logs per acre. These are minimum standards. Vegetation manipulation should focus on exceeding minimum standards and sustaining those conditions.

Opportunities exist to reintroduce fire into stands in LSRs to maintain and protect late successional conditions where they exist. Introduction of fire into stands without late successional characteristics can help the stand achieve those characteristics.

RIPARIAN RESERVES

This watershed analysis has not identified any reasons to reduce Riparian Reserve widths as identified in the ROD. Criteria for site-specific decisions can be found in the *Riparian Habitat* section of this document.

Goals and Objectives - Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

Maintain and restore habitat to support well distributed populations of native plant, invertebrate, and vertebrate riparian dependent species.

Desired Condition - The vegetation communities within forest and rangeland riparian zones contain native and desirable non-native species where processes are functioning within the site specific natural range of variability. A multi-layered, vegetation canopy would be present in forested riparian management zones (RMZ), the exception being where the soils are shallow or unproductive. In meadow areas, overhanging banks with herbaceous and/or shrubby vegetation will provide the canopy. An overstory of conifers to provide shade and thermal cover to the streams and lakes should be the dominant species. An intermediate layer of deciduous vegetation provides thermal buffering, nutrient cycling and bank stability. On the ground, a mixture of brush, grass, forbs, sedges, etc. provides for bank stability and integrity, sediment filtering and habitat characteristics necessary to contribute to the viability of riparian-dependent species.

The riparian plant community includes all ages and sizes. Plants are at various stages of their growth, some young and some old. Some of the mature and decadent conifers have broken tops and large pieces of wood have fallen into the streams and lakes. Log jams are distributed along the stream channel. Other conifers nearing decadence will eventually recruit woody material to the channel.

Opportunities have been identified to plant conifers and place coarse woody material in the riparian reserve where deficits have been identified.

WILDERNESS

A major component of the landscape is in Wilderness. The goal within the wilderness is to "manage forest cover to retain the primeval character of the environment and to allow ecological processes to operate freely" (FSM 2323.5, 1990).

Fire has significantly influenced the natural range of variability in the past and it is desirable for fire returns to play a role in creating similar vegetation patterns, as long as it does not threaten wilderness or adjacent land values. Wilderness management goals contain recommendations that natural ecological processes should predominately shape wilderness ecosystems and that human disturbances will be substantially unnoticeable. The goal is to manage for stand conditions that are resilient to the fire regime and disturbance processes described in the historic range of variability. Reintroduction of fire as a natural process needs to be done gradually to avoid undesired consequences.

Opportunities exist to reintroduce fire as a natural process. A wilderness plan and fire management plan are needed to implement a prescribed fire program.

WILDLIFE HABITAT

Most of the desired conditions for wildlife habitat are described in the vegetation section.

An LSR assessment needs to be done for the LSRs in the Elk Creek watershed.

HUMAN USES, EXPECTATIONS, AND VALUES

The human community is an integral component in resource management. Forest-wide goals also address the human community through development of partnerships, environmental education, public involvement which allows for a useful exchange of ideas and information, and the promotion of economic stability in local communities.

An aspect of economic stability includes economic diversity. The Forest has the responsibility to promote the development of nontraditional, forest-based resources that could contribute to the economic stability of the area. Some nontraditional commodities may include: harvest of wood fiber (biomass), fishing and wildlife viewing, mineral extraction and recreational opportunities. The importance of a visually pleasing setting to support local economic development strategies that focus on recreation opportunities or tourism should be highlighted.

Traditional commodity extraction such as timber harvest is also important. The Forest Service mission includes providing a sustainable flow of renewable resources. These practices need to be planned in harmony with other resource management goals.

Human uses and consumption, or the lack of, can have varying influences on the character of the landscape. Forest-Wide Goals and Objectives also include specific goals which address human values and uses.

- Develop a program that supports the communities' efforts to diversify, strengthen and attract natural resource-oriented activities and businesses which will strengthen rural economies.

- Offer a wide range of recreation attractions and opportunities that are responsive to the demands of multicultural, traditional, and nontraditional recreation users.

- Make nontraditional products available, such as Prince's pine, mushrooms, acorns, florist materials, bitterbrush seed, and medicinal vegetation. Integrate the use and availability of these forest products with historic forest products.

- Market forest products such as wood fiber (biomass), poles, boughs, Christmas trees, house-logs, etc., and make them available on an as needed basis consistent with management area objectives.

- Manage to increase the availability of products utilized by Native Americans including, but not limited to, beargrass, salal, and oaks.

- Schedule a programmed, sustained timber harvest compatible with the goals of the management area.

- Expect moderate timber yields from Partial Retention management areas and high timber yields from General Forest management areas.

- Management areas with no scheduled program of harvest may still utilize timber harvest as a method of achieving management area objectives.

- Manage a recreation mining program in conformance with the California Department of Fish and Game Environmental Impact Report (EIR) and formalized suction dredge regulations.

Timber (economics): It is desirable for the local community to benefit from extraction of wood products from the Elk Creek Watershed. Forest ecosystems must be maintained in a condition that is sustainable so that wood will be available for human use. A balance can be achieved between the need for raw materials nationally and internationally and well functioning ecosystems and amenity values in Elk Creek.

Historically, the Karuk Tribe of California relied on ample supplies of Salmon, acorns, large game such as deer and elk, and other gathering materials. These items continue to be very important to sustaining tribal practices. Traditional ceremonial areas and important settings associated with religious use continue to be highly valued.

Maintaining those values in the Elk Creek watershed that are important to the Karuk Tribe is a desired condition. Opportunities exist to continue working with the tribe to make sure those values are maintained or enhanced. Some vegetation manipulation can be done to improve acorn production and growth of gathering materials. Opportunities have also been identified to improve fish habitat. Maintenance of large game habitat is balanced by objectives to increase late successional habitat.

Hunting (recreation and economics): Maintain habitat for big game in a condition that will support herds that can be hunted. Habitat maintenance opportunities also achieve other objectives. Prescribed burning and silvicultural treatments are methods to accomplish habitat maintenance. Within five years, there will be limited hunting of Elk on the District. Hunting continues to support service businesses in Happy Camp.

Forest Products: Expand the use of products that can be harvested at sustainable levels.

RECREATION

Several opportunities exist to enhance the recreational character of the Elk Creek Watershed. These opportunities could provide a number of benefits including improvement of the recreational quality for the local residents and visitors and educating people about the environment and resource management. The following is a list of opportunities that have been discussed as part of the landscape analysis.

- Designation of a mountain bike loop route from the Elk Creek bridge, up China Grade road to FS road 45N85. From Fryingpan Ridge there are several options to return to East Fork of Elk Creek Road. The shortest loop is approximately 13 miles long. Elk Creek Road is presently the most popular stretch for mountain biking. The routes could be signed and published in the Forest Service mountain biking guide.

- Construction of a foot trail along the old mining ditch that runs parallel to Elk Creek Road and adjacent to Elk Creek. The trail could begin somewhere near the trailhead of the Town Trail and run two to four miles south on Elk Creek. The ditch is nearly intact and gold dredgers working in the area have already converted sections of the ditch into trail. Planning for the trail would include measures to keep hikers from impacting Elk Creek in a way that might adversely affect the town's water supply. The Town Trail in this area is well used by local residents and this additional section of trail would offer an extended hike on a more level grade.

- Development of a picnic facility at Doolittle Creek Falls (often referred to as Cougar Creek Falls). An undesignated camp site now exists in this area and along the east side of the creek. Use in the area is not actively managed. Picnic tables could be added and measures taken to divert heavy use away from the creek. A foot path exists to the Doolittle Creek Falls that could be improved as a trail.

- Replacement and addition of trailhead signs at various locations. A new sign is needed on the Bear Lake trail where it joins road 15N06 describing the way up to Bear Lake or down to Norcross. Additional signs could be added showing directions to Johnsons Hunting Ground Trail and Cold Springs.

- Development of an interpretive center for the Roosevelt Elk reintroduction program. The center would be a small outdoor facility utilizing plats or billboard type information and could be located either at the District Office or at Norcross. The center could discuss the reintroduction and the role elk play in the Elk Creek landscape.

- Placement of interpretive signs at Sulphur Springs Campground which discuss the physical and geological makeup of the Sulphur Springs.

- Placement of interpretive signs along Elk Creek explaining aspects of the fisheries improvement projects. Signs could be placed at one of the created habitat structures or at the spawning channel.

There are also a number of opportunities available to provide economic benefit to the local community, as well as achieve other land management goals such as stocking control and plantation management.

- Increasing the availability of fuel wood for the community. Consideration of government contracts for removal of wood to roadside locations in areas where thinning or fuel reduction would be

desirable. For example, yarding dead hardwoods from fire areas to roads and allowing free access for organizations that would give wood to senior citizens.

- The community (through the Karuk Tribe) has received a community development grant for a feasibility study to identify possible business opportunities in the Happy Camp area. The District can support this effort by providing ideas and sharing resource information for any natural resource related ideas. Ideas that have surfaced thus far include utilization of small sized conifers, hardwoods,and brush for such things as furniture, pole buildings, or other building products. It is possible that Happy Camp could draw enough people from outside the area to support a recreation center and sports store that included expert instruction and tours for white water sports, hiking, mountain biking, ecology tours, etc.

- Native American resources development projects. The District could coordinate projects that utilized the Karuk people to propagate, burn, and enhance materials important to their cultural heritage (bear grass, hazel, ferns). Funding could be tribal and government agency provided.

- Promotion to encourage eco-tourism. Possibilities include developing brochures and other types of advertisement on opportunities for viewing wildlife and forest ecosystems in a remote area that is relatively pristine and exempt from urban influences. The District could develop and provide educational tours.

- Continuation of efforts at structuring contracts so that individuals and small groups in the local area can bid on and compete for work. This can be done with timber sale, reforestation, plantation maintenance, and watershed restoration contracts.

ROADS

Goals and Objectives - A transportation system that meets the Forest and public needs.

Desired Condition Statement - A transportation management schedule that effectively and efficiently provides the necessary access to the area while meeting the desired road density and Forest Plan objectives. Maintenance of surplus or infrequently used roads in a self-maintaining condition (Level 1) to reduce watershed and wildlife impacts and to reduce road maintenance costs. Roads not part of the long-term transportation needs will be closed, stabilized and returned to a natural state.

- Reduction or no net increase in road mileage.

- Roads used for trailhead access are maintained to accommodate recreation users.

- A transportation network that effectively and efficiently allows the transport of commodities to available markets. The system should be economical, safe, and environmentally sensitive.

Opportunities - Develop and implement a Travel and Access Management Plan that will meet the Aquatic Conservation Strategy objectives.

The plan will include a thorough inventory and assessment of system roads. Key considerations will include, but not be limited to:

- road densities as they pertain to wildlife, sedimentation, riparian reserves, soil types, and other risk factors;

- roads within riparian reserves;

- current and future use patterns relating to timber harvest, administration, recreation, private land, etc.;

- updating Objective Maintenance Levels;

- traffic regulation;

- identification of roads that should be upgraded, maintained in present status, downgraded, or decommissioned;

- identify and prioritize restoration projects on roads that pose the greatest risks to riparian and aquatic ecosystems;

- reduction of existing system and non-system road mileages and;

- reduction of existing maintenance levels in line with the Forest Plan.

SCENERY

Wilderness will continue to appear unaltered. Scenic locales along streams, recreation sites or in heavy use areas would retain a high degree of natural scenic identity where subtle changes may occur, but clearly remain subordinate to natural established patterns. Ground and vegetation disturbance would be minimal in areas having such scenic sensitivity.

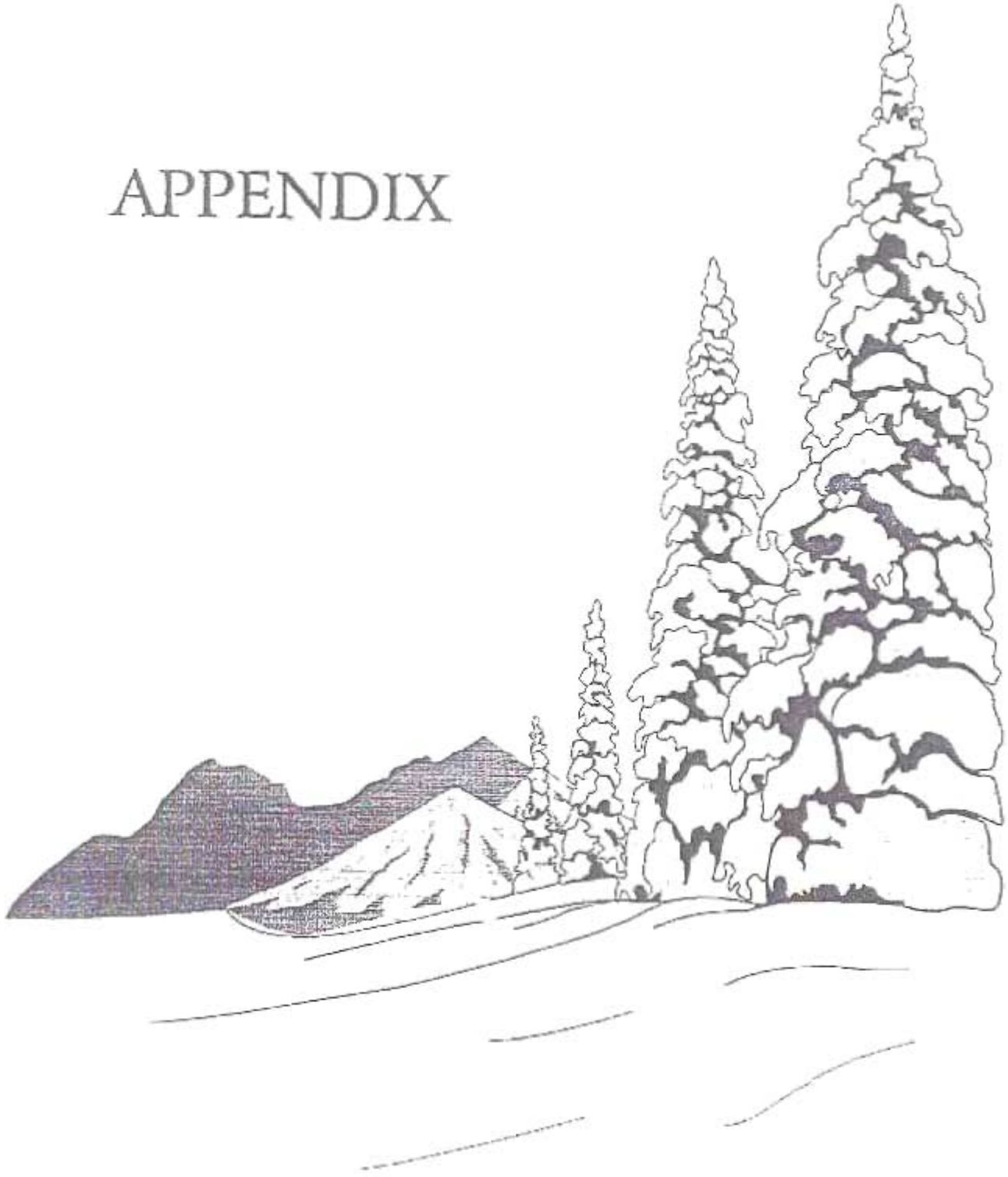
Within the drainage, a similar variety of canopy patterns will exist. Most management undertakings that change scenic quality will remain subordinate to the natural landscape character. Ridges will naturally appear more open than inner canyon gorges. Riparian areas will retain more dense vegetation patterns.

In areas with scenic sensitivity, future timber removal will display patterns of near natural forest character utilizing understory tree removal, group selection, or edge modification logging practices. Where appropriate treatments will favor mature, or mixes of multi-storied tree sizes, including retention of shrub and ground covers. In the long term, prescribed fire and harvest treatments will eventually create a more open forest overall.

Areas with lower scenic sensitivity may experience more noticeable management. In these areas, (portions of East Fork, Doolittle and Bear Creek drainages), alterations might dominate the characteristic landscape but changes such as openings, shapes, sizes and edge characteristics would still mimic naturally established landscape patterns.

Opportunities to reduce strong logging contrasts include reshaping openings, altering edge characteristics, and doing understory treatments to create more open forest canopy conditions. Site specific contrasts may be enhanced near Johnson Creek by thinning the edge of existing fir stands adjacent large openings.

APPENDIX



RESPONSES TO QUESTIONS ON ENDANGERED SPECIES ACT CONSIDERATIONS FOR WATERSHED ANALYSIS

An interagency memo (see below) on watershed analysis guidelines has requested that the following questions be answered for each watershed analysis. A response specific to the Elk Creek watershed follows each question.

SOURCE: Interagency memo, dated June 13, 1994, Appendix C, page C7-12, *Endangered Species Act and Other Species Considerations*

NORTHERN SPOTTED OWL

Question - Are spotted owl activity centers located within the watershed?
Response - Yes

Question - If so, how many and in what *ROD* land allocations are they located?
Response - There are 8 owl activity centers. Figure A1 shows the acres of activity center in each ROD allocation. The percent of each allocation inside or outside activity centers is illustrated as well as the percent of the total watershed in the right column and across the bottom.

Figure A1 ACRES AND PERCENT OF SPOTTED OWL ACTIVITY CENTERS IN EACH ROD ALLOCATION

ROD ALLOCATION	INSIDE ACTIVITY CENTERS		OUTSIDE ACTIVITY CENTERS		WATERSHED TOTAL	
CATEGORY	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT
WILDERNESS	3,335	17	25,283	49	22,618	39
ADMINISTRATIVELY WITHDRAWN	1,297	7	2,042	5	3,339	5
RIPARIAN RESERVE	2,595	14	2,240	5	4,834	8
LSR	1,803	9	5,818	14	7,621	13
MATRIX	9,407	51	13,796	25	20,619	34
PRIVATE	369	2	301	1	648	1
TOTAL	18,380	100	41,400	100	60,780	100

Figure A2 describes the status of each activity center and which ROD land allocations they are located in.

Figure A2 SPOTTED OWL ACTIVITY CENTER STATUS

ACTIVITY CENTER	FIRST RECORD	BEST INFORMATION			LAST SURVEY	
IDENTIFICATION #	YEAR LOCATED	YEAR LOCATED	RESULTS	YEAR OF LAST VISIT	RESULTS	ROD ALLOCATION
277-SK038	1978	1992	OCCUPANCY	1994	OCCUPANCY	MATRIX/RIPARIAN RESERVE
245-SK418	?	1992	REPRODUCTION	1994	NO RESPONSE	MATRIX/RIPARIAN RESERVE
276-SK157	?	1992	OCCUPANCY	1994	PRESENCE	MATRIX/RIPARIAN RESERVE
276-SK156	?	1992	OCCUPANCY	1994	NO RESPONSE	MATRIX/RIPARIAN RESERVE
1227-SK259	?	1990	OCCUPANCY	1992	NO RESPONSE	WILDERNESS
263-	-	1991	OCCUPANCY	1992	NO RESPONSE?	MATRIX/RIPARIAN RESERVE
1213-SK008	?	1990	REPRODUCTION	1994	PRESENCE	LSR
229-SK129	1991	1995	REPRODUCTION	1994	NO RESPONSE	MATRIX/RIPARIAN RESERVE

Question - Which of these are currently above "take" thresholds and which are below and when were the activity centers located?
Response - All of the activity centers are above "take" thresholds at the .7 and 1.3 mile radius. See figure A2 for year centers were located.

Question - Has a 100 acre core area been designated around each activity center located in matrix lands?
Response - Yes, all five matrix territories have a 100 acre core delineated.

Question - How many acres of nesting, roosting, and foraging (NRF) habitat are there in the watershed?
Response - The following definitions were used to map suitable owl habitat.

Nesting Habitat: Nesting habitat consists of the low to mid-elevation conifer or conifer/hardwood dominated stands with canopy closure of 70 percent or greater. Other stand characteristics include: old-growth or late mature seral stage, dominated by large trees usually multi-storied, and moderate to large amounts of snags and coarse woody material. Dominant hardwoods are tanoak and madrone (as opposed to harsh live oak sites), and dominant conifers are Douglas-fir, white fir, and sugar pine (as opposed to Jeffrey pine, knobcone pine, or red fir sites).

Foraging Habitat: Foraging habitat consists of the mid to late seral stands which don't meet one or more of the criteria for nesting habitat. These stands are in the Douglas-fir, white fir, ponderosa pine, tanoak, or black oak ecological series. Foraging habitat was identified using the following criteria:

1) Old-growth or later mature stands with 40 percent or greater canopy closure for all tree species including hardwoods. Primary species are either Douglas-fir or white fir with canopy closure of all species at 40-70 percent or primary species is not Douglas-fir or white fir and canopy closure of all species is 40-100 percent.

2) Mid mature stands with all species canopy closure between 40 and 70 percent

3) Pure hardwood stands if not live oak dominated.

Potential Habitat: Potential habitat consists of stands of trees of a vegetation type used by spotted owls that is not currently suitable, but is capable of growing or developing into suitable habitat in the future. In general, potential habitats are stands in the earlier successional stages of forest types used by spotted owls (USDI 1992). Ecological series is: Douglas-fir, white fir, tanoak, or black oak (ponderosa pine would not have the potential to grow into suitable habitat). Potential habitat falls into one of the following scenarios:

1) Mid mature stands that do not meet criteria for foraging habitat.

2) Early mature stands with 70 percent or greater canopy closure for all species.

Dispersal Habitat: All other forested stands that have 40 percent canopy closure or greater, are at least 11 inches DBH, and don't meet the above criteria.

Figure A3 shows acres of nesting, roosting, and foraging (NRF) habitat in the watershed. Map A shows the distribution of spotted owl habitat over the watershed.

Figure A3 Habitat Conditions by ROD Allocation

SPOTTED OWL HABITAT	WILDERNESS		ADMIN WITHDRAWN		RIPARIAN RESERVE		LSR		MATRIX		PRIVATE		TOTAL	
CONDITION	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%	ACRES	%
FORAGING	5,264	22	438	13	1,258	26	2,393	31	5,127	25	75	12	14,597	24
NESTING	1,183	5	338	10	1,487	30	999	13	3,606	17	44	7	7,638	12
POTENTIAL	1,121	5	101	38	113	2	182	2	707	3	50	8	2,254	4
DISPERSAL	3,039	13	917	27	562	11	674	11	2,883	14	143	22	8,417	14
NOT HABITAT	13,003	55	1,543	40	1,504	30	3,193	42	8314	40	316	49	27,674	46
TOTAL	23,618	39	3,339	5	4,934	8	7,621	13	20,618	34	648	1	60,780	100

Question - What percentage of the watershed is this?
Response - Suitable habitat covers 36% of the watershed (See Figure A3).

Question - Which of these stands have been surveyed to protocol (two years) and which were not?
Response - Since 1991, surveys for the northern spotted owl have assessed 29,710 acres (48.9%) of the 60,780 acres in the Elk Creek drainage. Two areas, Buckhorn and Chick, were surveyed to the two-year protocol with 1991 surveys and then as part of the Shoehorn surveys of 1992. These two areas account for 8.48% of the Elk Creek drainage. The remaining survey areas, 24,535 acres (40.4%), were completed for one year (three or more visits in a single year) of the two-year protocol during 1992. Map B shows the areas surveyed.

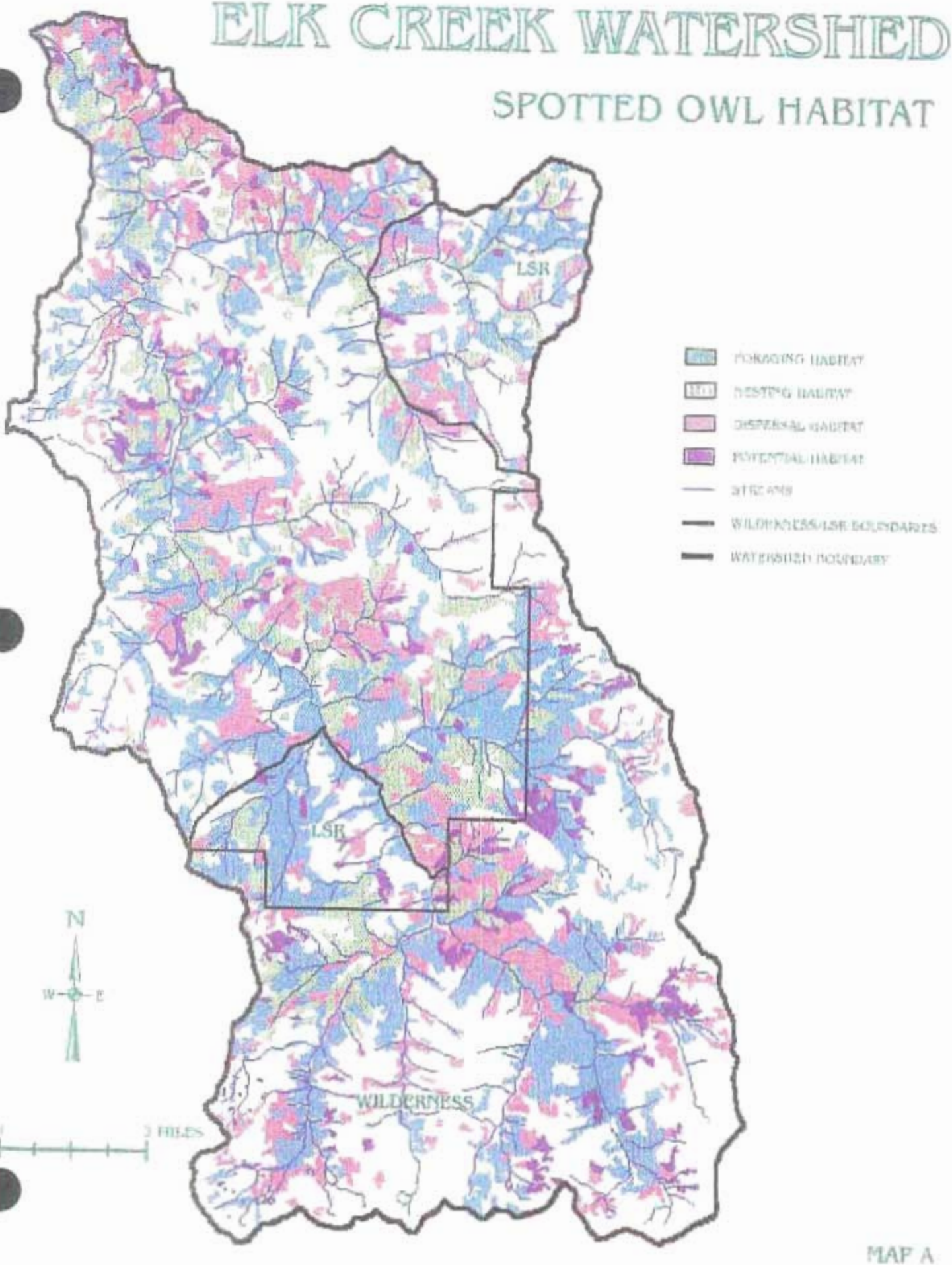
The surveys conducted from 1991 through 1994 have been of various intensities, ranging from three to six visits per year. Eight activity centers have been identified in spite of the varying survey intensities. These activity centers have been surveyed as historical sites during various seasons since their detection.

Question - What is the amount of NRF habitat in each *ROD* land allocation within the watershed?
Response - Suitable Habitat (NR) Acres by ROD allocation is as follows: LSR = 3,392; Matrix = 8,733; Wilderness = 6,457; Riparian Reserve = 2,755; Other = 895 (see Figure A3).

Question - Does any portion of the watershed contain LSRs?
Response - Yes, a small portion of LSR RC439 and a large portion of RC353 are within the watershed for a total of 7,621 acres.

ELK CREEK WATERSHED

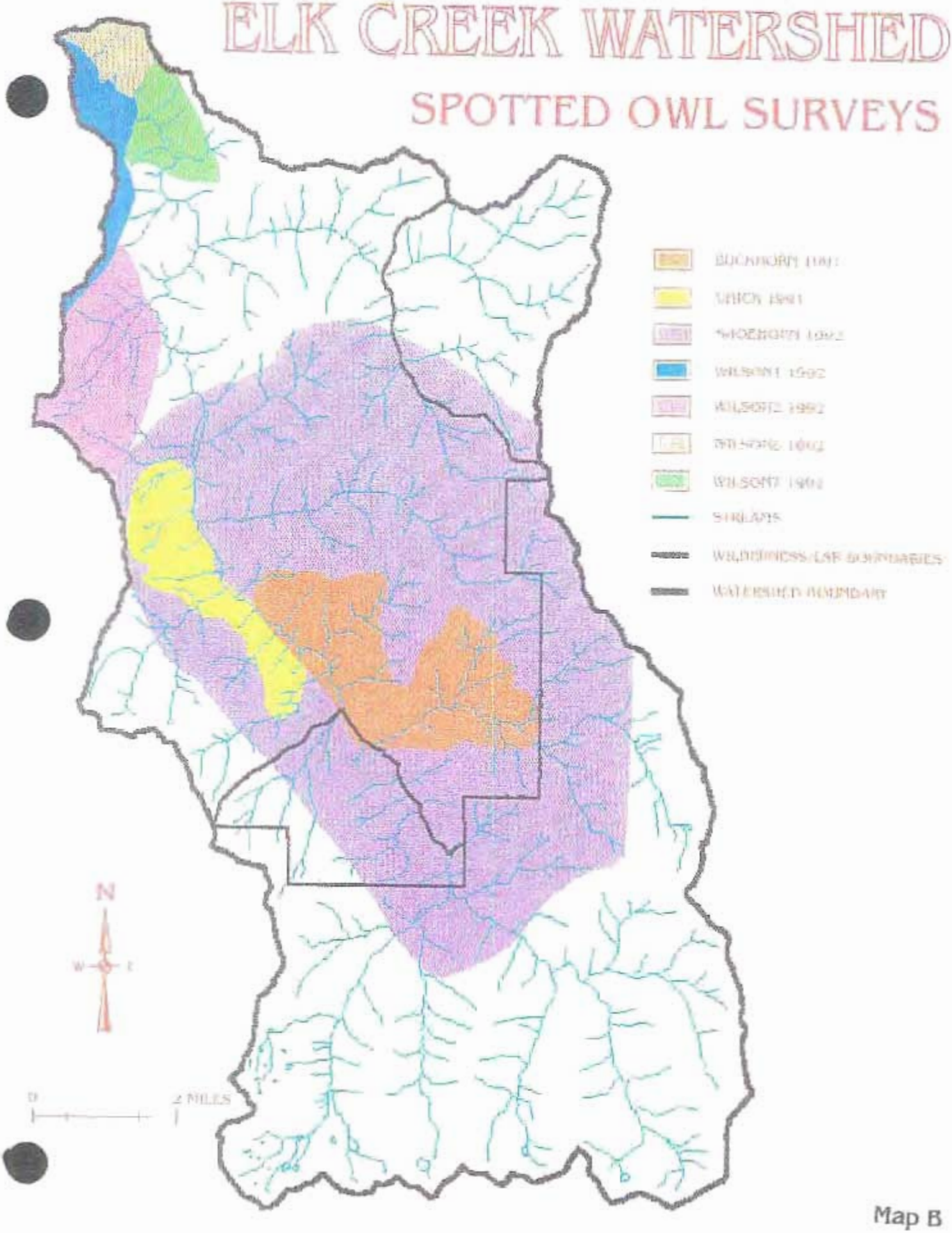
SPOTTED OWL HABITAT



MAP A

ELK CREEK WATERSHED

SPOTTED OWL SURVEYS



Map B

Question - What percent of the total watershed is this?
Response - The LSR land totals 7,621 acres, or 13% of the watershed.

Question - What are the current totals of NRF habitat and capable habitat in the LSR?
Response - 3,554 acres, or 46% of the LSRs (see Figure A3).

Question - What is the amount of dispersal habitat (11-40 and above) in each ROD land allocation within the watershed?
Response - See Figure A3.

Question - Is distance between LSRs (those over 10,000 acres) greater than four miles?
Response -No.

Question - If so, then what is the amount of dispersal habitat on Federal lands for all 1/4 townships between the LSRs?
Response - Not applicable.

Question - What percent of the total Federal lands in these 1/4 townships is this?
Response - Not applicable.

Question - How much (% and total) of the dispersal habitat is in Riparian Reserves, Admin. Withdrawal (which provide long-term protection), Congressionally Reserved, 100 acre cores, and smaller (<10,000 acres) LSRs?
Response - Total dispersal habitat is 8,417 acres, 14% of the watershed. Dispersal habitat in Riparian Reserves is 562 acres, 7 %; in admin withdrawal there are 917 acres, 36%. The 100 acre cores were established by setting a radius that included at least 100 acres of suitable habitat. Approximately 14% of these areas are dispersal habitat which is 70 acres less than one percent of the dispersal habitat.

Question - Is this total greater than 50%?
Response - Yes.

Question - Describe, if present, the natural barriers to dispersal.
Response - Open hardwood and shrub stands on southfacing slopes.

Question - Is connectivity, or dispersal habitat, sufficient to allow movement?
Response - Connectivity is sufficient within the landscape and from this landscape to adjacent ones.

Question - How much critical habitat has been designated within the watershed?
Response - In the watershed, 3,780 acres are within CA-17.

Question - How much of this total overlaps with LSRs?
Response - All is within an LSR.

Question - For areas that do not overlap, how much is currently NRF habitat?
Response - Not applicable.

Question - And how much is capable?

Response - Not applicable.

Question - How many activity centers are located in this non-overlap area of CHU?
Response - Not applicable.

Question - How many are currently above "take"? How many below? (use acres established by FWS for .7 and 1.3 mile radius)
Response - Not applicable.

Question - What role does this non-overlap critical habitat play in this watershed in relation to the reasons for the designation of the CHU?
Response - Not applicable.

BALD EAGLE

Question - Are occupied bald eagle activity areas (nesting, foraging, winter roosts, or concentration areas) located within the watershed?
Response - No. Bald eagles are known to forage within lower Elk Creek drainage. There is a known nest approximately three miles from the mouth of the creek along the Klamath River. It is located outside of the Elk Creek watershed. This site produced one young in 1994. It was originally found in 1991 and was successful that year. In 1992, there was no evidence of use. In 1993, the original nest blew out of the tree. The current nest site is within 1/2 mile of the old nest site. It is unknown if the birds used the current site in 1992 and 1993. A management plan for this site has not been written.

Question - If so, what type and how many?
Response - Not applicable.

Question - What *ROD* land allocations are they located?
Response - Not applicable.

Question - Describe reproductive history based on monitoring data.
Response - Not applicable.

Question - Has a final site-specific protection/management assessment been developed for each site?
Response - Not applicable.

Question - Does this watershed analysis corroborate the findings of the management assessment?
Response - Not applicable.

Question - Has an assessment been made as to whether there are potential bald eagle activity areas (nesting, foraging, winter roosts, or concentration areas) located within the watershed?
Response - There are potential bald eagle activity areas within the Elk Creek drainage. There is potential for nesting within approximately one mile surrounding the mouth of Elk Creek. There is private land and Matrix within this area.

Question - If so, what type?
Response - See above.

Question - How many?
Response - See above.

Question - What ROD land allocations are they located?
Response - Matrix and private.

Question - Have these areas been surveyed to protocol to determine they are unoccupied?
Response - The area has not been surveyed. Incidental sightings of the resident pair (described above) have occurred within the drainage.

Question - Describe historical bald eagle occurrence and nesting within the watershed.
Response - There is no historical information on bald eagles within the watershed.

Question - What is the status of the watershed as it relates to the Recovery Plan? (target territories, including beyond watershed boundaries) Does the watershed and the surrounding area meet objectives of the Recovery Plan?
Response - Only a portion of the Elk Creek drainage would contribute to the recovery goals outlined within the Pacific Bald Eagle Recovery Plan (1986). The area within one mile of the Klamath River would provide nesting opportunities and could be described as a Target Area for recovery. The Plan describes the river itself as the focus of recovery for the bald eagle with 4 Target Recovery Territories identified.

Question - If not, then are there capable eagle activity areas located within the watershed?
Response - There are no capable areas within the watershed. Components currently exist in the lower portions of the drainage which could potentially provide nesting and foraging areas.

Question - If capable activity areas are present, what type are they?
Response - Not applicable.

Question - How many?
Response - Not applicable.

Question - What ROD land allocations are they located?
Response - Not applicable.

Question - What type of project or enhancement could develop sites into potential or occupied sites?
Response - Restoring anadromous fish runs during all seasons of the year.

Question - If present, describe significant habitat within the watershed that is not under Federal ownership.
Response - Private lands do not have significant habitat for the eagle.

AMPHIBIANS

Question - Have any amphibian inventories been done on a project or watershed level?
Response - Limited amphibian inventories have been done within the Elk Creek watershed. Sites were sampled for tailed frogs (*Ascaphus truei*), Olympic salamanders (*Rhyacotriton olympicus*), and Del Norte salamanders (*Plethodon elongatus*) in 1989 throughout the Klamath National Forest by PSW (Pacific Southwest Forest and Range Experiment Station) - Redwood Sciences Lab. One site was sampled in the Elk Creek watershed (East Fork of Elk Creek) for Del Norte salamanders with no results.

Question - What species does the literature suggest may be present?
Response - The home range of several frogs and salamanders is within the watershed: northwestern salamander, Pacific giant salamander, rough-skinned newt, ensatina, black salamander, western toad,

tailed frog, Pacific tree frog, northern red-legged frog, foothill yellow-legged frog, Del Norte, and long toed salamander.

Question - Are sensitive species and *ROD* Table C-3 species present or do they possibly occur?
Response - The Del Norte salamander and Siskiyou Mountain salamander are listed in Table C-3 in the ROD. The Siskiyou Mountain salamander is listed as a Candidate 2 species and is considered to be Sensitive by Region 5.

Question - Have intensive or extensive inventories been conducted in adjoining drainages/sub-watersheds?
Response - During the 1994 field season, a project began in cooperation with the PSW - Redwood Sciences Lab, BLM (Bureau of Land Management) - Medford District, the Rogue River National Forest, and other partners. The objectives are to determine the range of the Siskiyou Mountain and Del Norte salamanders (extensive surveys) and determine habitat parameters at specific population locations (intensive surveys).

Question - If so, can those inventories be extrapolated to this watershed?
Response - The Del Norte is likely to be found within the drainage. The Siskiyou Mountain salamander has not been located south of the Klamath River nor west of the Seiad Creek drainage. Although suitable habitat can be found within the Elk Creek drainage it is unknown whether this animal resides there.

Question - Are endemic species known to occur in the general geographic region?
Response - No.

Question - Are exotic species known or suspected to be in the watershed? (e.g. bullfrogs)
Response - Bullfrogs are numerous within the Klamath River watershed and are likely to be found within the lower reaches of Elk Creek. It is unknown how far within the drainage bullfrogs can be found.

PEREGRINE FALCON

Question - Are any cliffs located within the watershed? (rock wall >50 feet)
Response - Yes, there are several known cliffs within the Elk Creek watershed.

Question - Are any cliffs present that are historic (pre-1975) or traditional (post-1975) peregrine eyries?
Response - None of these cliffs are known to have historic or traditional use by peregrine falcons.

Question - For past projects near historic cliffs, have mitigation measures for habitat been considered?
Response - Not applicable.

Question - At these historic cliffs, have surveys to protocol (Pagel 1992) been accomplished for at least two years prior to the activities?
Response - Not applicable.

Question - For traditional cliffs, have surveys/monitoring been conducted to determine nest site occupancy and reproductive status?
Response - Not applicable

Question - Has a draft or final site management plan been created?
Response - No.

Question - Is this plan based on site specific and PNW sub-population nesting ecology?
Response - Not applicable.

Question - Have the cliffs located been rated or monitored for falcon potential or presence?
Response - The cliffs have not been rated or monitored for peregrine falcon potential or presence within the watershed. The Klamath National Forest has identified the need to monitor and rate new cliff sites for peregrine falcon activity and it is included in the Five Year Wildlife Plan currently being developed.

Question - If cliffs are un-rated, have surveys been accomplished to protocol?
Response - Not applicable.

Question - Describe site habitat variables within a three mile radius of historic and traditional nest sites. (cliff parent material, distance to water/riparian, vegetative habitat, seral stages, human activities)
Response - Not applicable.

GRAY WOLF

Not applicable. Species not in the State or province.

GRIZZLY BEAR

Not applicable. Species not in the State or province.

MARBLED MURRELET (Zone 1 and 2)

Question - Is the Elk Creek watershed in marbled murrelet Zone 1 or 2?
Response - About half of Elk Creek watershed is in Zone 2, none is in Zone 1.

Question - Have surveys been conducted in Elk Creek to locate marbled murrelets?
Response - No.

Question - Where have the closest marbled murrelet detections been in relation to Elk Creek?
Response - Runaway Point and Spees Peak detections in 1994 are approximately 10 miles northwest of Elk Creek on the west edge of Zone 2.

Question - How does the watershed meet the recovery goals for the marbled murrelet?
Response - The southern half of Elk Creek habitat is good. Since this is at the edge of their range (east side of Zone 2) murrelets are not expected in Elk Creek. Presence is uncertain until surveys are conducted.

Question - Are marbled murrelet occupied sites located within the watershed?
Response - Not known; surveys have not yet been conducted?

Question - Has the 0.5-mile radius management area been delineated for each occupied site?
Response - Not applicable

Question - Within the 0.5-mile radius management area, what stands are currently marbled murrelet habitat?

Response - Not applicable

Question - What stands are recruitment habitat (stands that are capable of becoming marbled murrelet habitat within 25 years)?
Response - Early mature stands are 9% of the watershed.

Question - What stands are non-habitat?
Response - Everything but mid to late seral stage and old-growth. Total acres of non-habitat is approximately 22,700 acres or 37% of the watershed.

Question - Do stands of potential marbled murrelet habitat exist within the watershed?
Response - Yes, 63% of the watershed.

Question - What stands of habitat within the watershed have not been surveyed?
Response - No surveys have been conducted.

Question - Is there recruitment habitat (described in the ROD) within the watershed?
Response - Yes.

Question - What will be the percent of the watershed that will be suitable marbled murrelet habitat in the future (25, 50, 100, 200 years)?
Response - In twenty-five years, 72% of the watershed will be suitable marbled murrelet habitat. Suitable habitat 50, 100 and 200 years from now is likely to remain around 72%.

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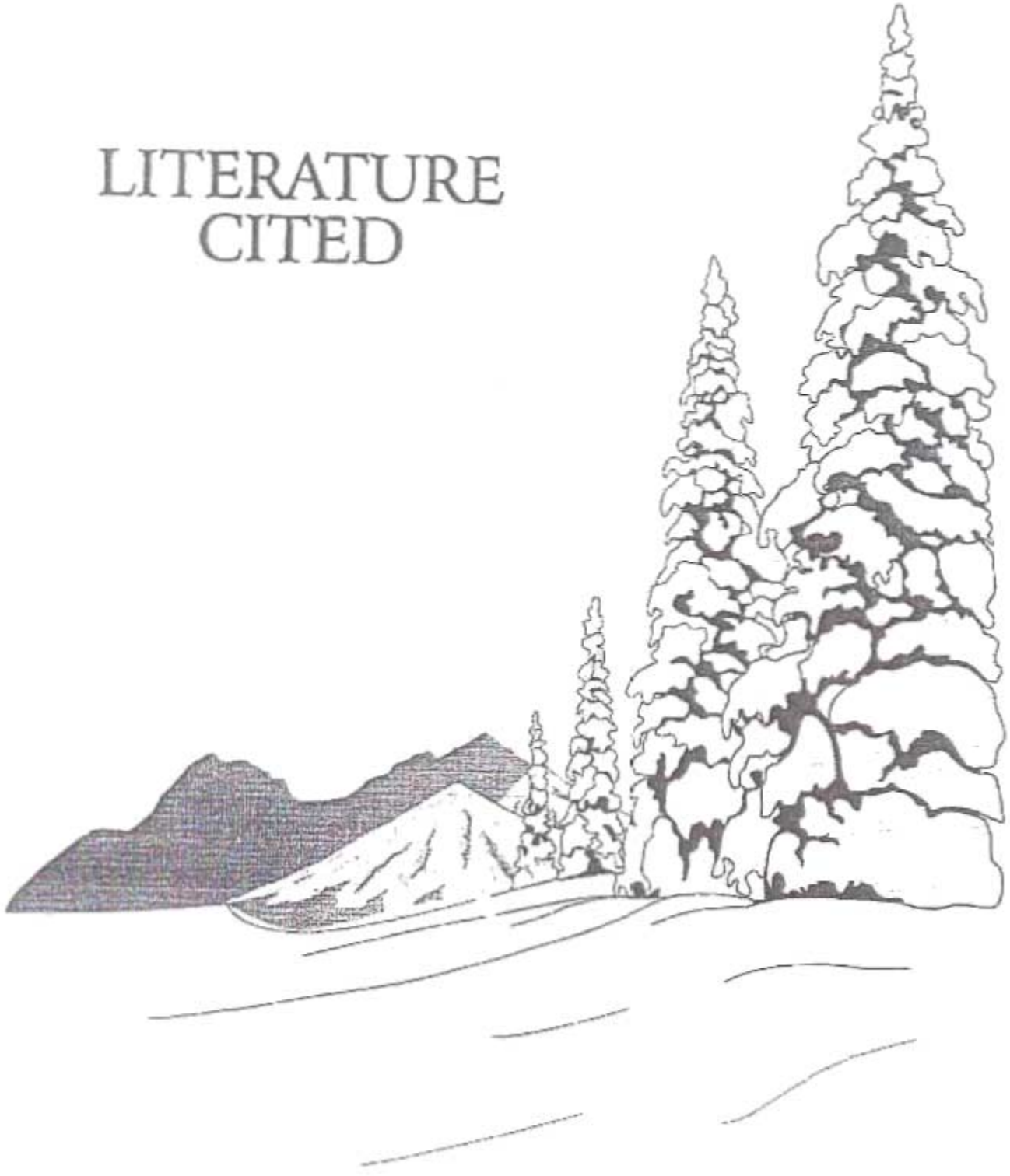

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