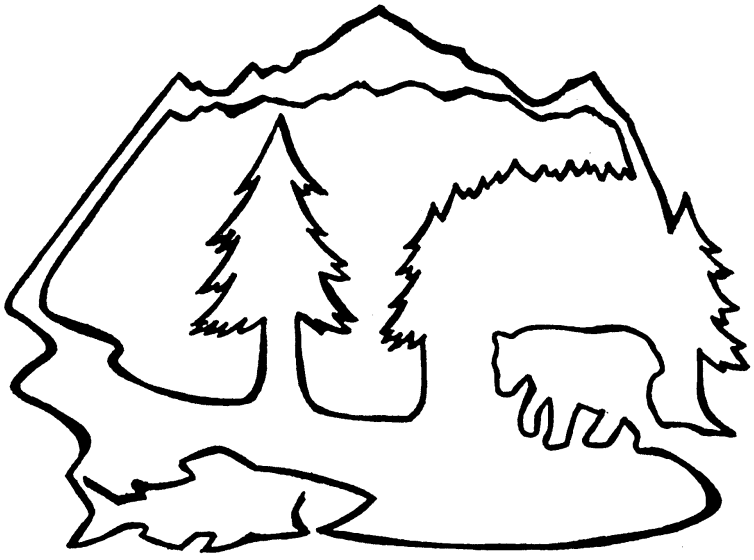
United States Department of Interior
Bureau of Land Management
Arcata Resource Area

Bear Creek Watershed Analysis

May 1995



Executive Summary

This Watershed Analysis was initiated and prepared from direction provided by the Record of Decision of the *Final Supplemental Environmental Impact Statement for Amendments to the Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (also known as The President's Northwest Forest Plan and FEMAT). This document is intended to be consistent with, and help further, the strategy for protection, recovery, and multiple use management of old-growth forest ecosystems outlined in the President's Forest Plan. Watershed Analysis is one of four components detailed in the Aquatic Conservation Strategy in the President's Northwest Forest Plan. The result of this Watershed Analysis should be ecosystem management at the watershed scale.

Bear Creek is the third largest tributary to the Mattole River, located in Humboldt County in northwestern California. Bear Creek is a 13,820 acre watershed located within the King Range National Conservation Area. The watershed can be stratified into the South Fork, the North Fork, and the mainstem. Approximately 65% of the watershed is public land administered by the Bureau of Land Management (BLM) Arcata Resource Area Office. Approximately 30% of the watershed was never homesteaded and thus was always public land, the remaining public land was acquired by the BLM after passage of the King Range Act in 1970. Most of the acquired public land was formerly owned by large timber companies which had logged the land prior to exchanging it with the BLM.

The watershed is located near the Mendocino Triple Junction, an area of intense tectonic uplift, where three tectonic plates collide and cause regular, and sometimes damaging, seismic activity. The geology of the watershed is comprised of sedimentary material uplifted from the ocean floor and is prone to instability. Due to the intense rates of uplift, the topography of the watershed is quite steep. The climate consists of warm, dry summers and cool, wet winters with heavy precipitation. Average rainfall exceeds 100 inches per year and varies with elevation.

Humans have inhabited the watershed for the past 4,000 to 6,000 years. Indigenous people collected plant materials and burned areas but had little lasting impact on the landscape. Europeans settled in the area near the confluence with the Mattole River beginning in the 1890s where the town of Ettersburg now sits. At this time the land near the lower mainstem was logged and burned to clear the land for livestock grazing. Later, a few settlers started to inhabit the alluvial valley in the upper South Fork, and a few other settlers had homesites scattered throughout the watershed. These people hunted, trapped, raised livestock, maintained orchards, and grew small gardens. In the early 1900s, tan bark harvesting was a booming industry in the area and it is assumed that tan oaks were cut and peeled in the watershed, especially near the area where the main road to the town of Shelter Cover crosses the watershed. Small scale logging began in the area in the 1930s. At this time, the watershed was still a remote and isolated place.

The invention of modern machinery, especially tracked bulldozers, made the steep and isolated land more accessible. After World War II, large scale logging occurred on

the private lands in the watershed. Numerous roads and countless skid trails were built without consideration for subsequent erosion hazards. At this time, active fire suppression began in the region with state and federal agencies implementing a policy of immediate fire suppression. Logging and fire suppression quickly altered habitat for terrestrial wildlife over a large scale. Two large floods in 1955 and 1964 in this heavily roaded landscape caused massive erosion throughout the region and severely altered habitat for aquatic species.

Since the 1960s the number of people inhabiting the watershed has doubled, but the population is still quite small. The number of people travelling to Bear Creek for recreation has increased, with the BLM actively managing the area for recreational opportunities. Several citizens groups within the Mattole Watershed, which were started in the 1970s and 1980s, are still actively working on restoring habitat for salmon and steelhead. These groups, in cooperation with the BLM, California Department of Fish and Game, and the California Conservation Corps have initiated several restoration projects within the watershed. Although much work has been done, much more restoration work is needed for long term recovery of aquatic and terrestrial species within the watershed.

This analysis was conducted by the staff of the BLM Arcata Resource Area. An interdisciplinary team was formed to complete this analysis. In keeping with the intent of the President's Northwest Forest Plan, other federal and state agencies were contacted to provide input to this analysis. Information was gathered from BLM files, state agencies and other federal agencies, the Mattole Restoration Council, and through interviews with watershed residents. The interdisciplinary team developed issues and key questions for the analysis. As a summary of this Watershed Analysis, these issues, key questions, and answers to those key questions are provided below.

Summary of Issues and Key Questions

I. Issue: Roads and transportation system

Questions:

1. Which roads in Bear Creek watershed are necessary to keep open for purposes of BLM and private landowners?
Answer: The only roads that need to be kept open are the main roads currently maintained by either BLM or Humboldt County. These include: Kings Peak Road, Chemise Mountain Road, Paradise Ridge Road, Saddle Mountain Road, and King Range Road.

2. Which roads are not maintained to meet the objectives of the Aquatic Conservation Strategy? How can BLM change the maintenance of these roads so they are up to standards?
Answer: All roads listed above have some need of improved maintenance. For Humboldt County Roads, an agreement with the County must be sought after.

3. Which unnecessary roads, landings and skid trails are high priority for potential restoration projects?

Answer: A complete inventory of road-related sediment sources must be made prior to prioritizing a list of restoration projects. Until this is complete, further investigation of the sites identified by Horn (1992), with emphasis on remaining inner gorge roads, will be necessary for prioritization. Improvements to Chemise Mountain road are identified, and potential work on Paradise Ridge Road is also identified.

4. What considerations should BLM take into account when developing the Transportation Plan required by the ROD?
Answer: Roads should be maintained, and when necessary, re-designed to allow for proper drainage without concentrating water or diverting water from established channels. In areas of highly erosive soil (as found on Paradise Ridge) roads should be designed as to not cause any concentration of water, or if feasible, closed.

II. Issue: Habitat for wildlife, especially endangered species

Questions:

1. What is the current distribution and abundance of Late Seral / Old Growth Douglas (LSOG) Fir Forest?
Answer: Currently, approximately 2,135 acres of LSOG is present and is highly fragmented into 21 stands. The largest stand currently present is 735 acres. In 1948, approximately 6,700 acres of LSOG were present in three stands with the largest stand consisting of 3,168 acres.

2. What is the potential distribution and abundance of Late Seral / Old Growth in 25 to 50 years?
Answer: With manipulation, approximately 1,700 acres of logged land and hardwood stands in the northern lobe of the watershed can grow to LSOG within the next 50 years. This would connect with approximately 1,900 LSOG acres in the North Fork and bring the total in the watershed to 3,800 acres.

3. Could BLM accelerate the development of LSOG? If so where are the opportunities?
Answer: In lands that BLM acquired that had been previously logged and not re-planted with Douglas-fir, and old hardwood stands,the potential exists for silvicultural treatments to accelerate the development of LSOG characteristics.

4. How will the LSOG potentials in Bear Creek mesh with species recovery strategy?
Answer: It is unclear, at this time, exactly how the LSOG in Bear Creek fits into the overall strategies for recovery of species. A broader scale analysis of LSOG availability and fragmentation is required to answer this question.

5. How will management of LSOG species affect deer populations? What is the role of managed fires?
Answer: Deer, and other lower seral stage wildlife (such as rabbits quail) will experience some decrease in habitat quality of approximately 4,000 acres.

This decrease could be mitigated to some extent by prescribed burning in approximately 1,100 acres of chaparral.

III. Issue: Anadromous fish habitat and populations in Bear Creek

Questions:

1. How has anadromous fish habitat changed since 1950?
Answer: Habitat quality for fish and other aquatic species has been dramatically reduced since 1950. Intensive logging and road construction during the 1950s and 1960s coincided with two large flood events (1955, 1964) and resulted in catastrophic erosion. This erosion has altered the characteristics of the stream channel. Currently, Bear Creek seems to be in recovery from these changes and conditions are improving.

2. What is the relative importance of Bear Creek to the fish populations in the Mattole River?
Answer: Bear Creek is the third largest tributary to the Mattole and provides approximately 19 miles of spawning habitat and some high quality rearing habitat. Relative to the rest of the Mattole tributaries, Bear Creek seems to be in good shape. No quantitative estimates of fish production have ever been made.

3. What role can road rehabilitation play in restoration of fish habitat in Bear Creek?
Answer: Many miles of abandoned roads are present throughout the watershed. With the next major flood, the potential exists for further catastrophic erosion similar to the 1955 and 1964 floods. Road rehabilitation can reduce this potential and can reduce the chronic inputs of fine sediment which is harmful to fish reproduction.

4. How have fish populations changed since 1950?
Answer: No quantitative estimates have been made. From interviews with long time watershed residents, it appears that fish populations have declined dramatically since 1950.

5. What activities can BLM undertake to improve fish habitat in Bear Creek?
Answer: Rehabilitation of abandoned roads, working with Humboldt County to pave Chemise Mountain road (a source of fine sediment), working with Humboldt County to improve maintenance of Kings Peak Road, planting streamside landslides that have not re-vegetated naturally.

IV. Issue: Water Quality as it relates to beneficial uses

Questions:

1. Do any toxins remain from mining activities at Queen's Peak Mine?
Answer: No toxics are present at the Queen's Peak Mine site.

2. Do high levels of fecal coliform in South Fork. Bear Creek impair beneficial

uses? How can BLM control this?
Answer: Fecal coliform levels measured in 1993 by BLM personnel were well below levels established by the North Coast Regional Water Quality Control Board,

3. What role does Bear Creek play in Mattole water temperatures?
Answer: Limited information exists on Bear Creek or Mattole River water temperatures. The Mattole River is know to have warm temperatures that have reduced survival of fishes. Bear Creek water temperatures were most likely elevated after the logging, floods, and fire. In 1972, a temperature of 79° was measured in South Fork Bear Creek. As the channel and riparian zone has recovered from these disturbances, the water temperature is most likely decreasing.

V. Issue: Developed and dispersed recreation

Questions:

1. Are any existing developed campgrounds inconsistent with the Aquatic Conservation Strategy or other standards and guides in the ROD?
Answer: Both Wailaki and Nadelos campgrounds are located within the Riparian Reserve of South Fork Bear Creek. A visit to these campgrounds showed that some increased erosion is associated with visitor impacts. It is recommended that corrective measures, such as increased visitor education, occur.

2. Are existing pedestrian and equestrian trails consistent with the objectives of the Aquatic Conservation Strategy,and other standards and guides the ROD?
Answer: In most cases, trails have little impact on Bear Creek. However, increased sedimentation due to horse traffic along Chemise Mountain trail is suspected.

3. What considerations should BLM take into account when planning future recreation facilities?
Answer: Several items are recommended in to reduce the impacts of recreation on attainment of the Aquatic Conservation Strategy objectives. Designing trails to avoid numerous switchbacks is one of the recommendations.

VI. Issue: Livestock grazing

Questions:

1. What is the extent (number of animals, types of animals and number of acres) of historic grazing in the Bear Creek watershed?
Answer: No information is available. Most likely, more sheep and cattle were grazed in the past than currently.

2. What is the extent of current grazing?
Answer: Since almost all grazing occurs on private land, little information is

available. One BLM allotment is in the watershed and currently has very little grazing.

3. What have been the effects of grazing on the vegetation? the streams?
Answer: Little information is known. Compaction and exposure of soil helps to cause increased erosion but its effects on the stream are unknown.

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I. Introduction

Background

The Bureau of Land Management (BLM) has emphasized the importance of ecosystem management in recent years in response to the growing need to manage whole systems rather than individual species. From both an economic and environmental perspective, the need to protect species and habitats for their intrinsic value, as well as the need to slow the systematic Endangered Species Act listing of species, have become recognized as mutual objectives. With this recognition, the need surfaced to integrate conservation strategies across ownerships and jurisdictions and to develop effective interagency communication and other mechanisms for collaboration. In 1991, 10 original participating federal and state agencies in California developed a Memorandum of Understanding with the intent of facilitating interagency cooperation to meet these public needs. The MOU, known as "The Agreement on Biological Diversity", marked the first time that state and federal agencies agreed to work cooperatively in conserving biodiversity across administrative boundaries. It established an Executive Council to develop and adopt a coordinated regional strategy and authorized the establishment of bioregional councils specific to each region.

In April 1993, President Clinton commissioned an interagency scientific team to develop a set of alternatives for management of federal lands within the range of the northern spotted owl. This effort culminated in the report by the Forest Ecosystem Management Assessment Team (FEMAT) entitled *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* in July 1993 (Thomas, 1993). The report provides the scientific basis for ecosystem management in the Pacific Northwest. It addresses the species and habitat needs on a regional scale providing a multi-faceted conservation strategy from which basin-scale, watershed-scale, and eventually site-level restoration planning can be placed in a regional context. The scope of the report covered all federally-managed lands within the range of the northern spotted owl. The BLM and the USDA-Forest Service (USFS) manage the great majority of these lands.

The FEMAT report was utilized as a cornerstone in the development of the Final Supplemental Environmental Impact Statement (FSEIS) for *Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl.*. The Record of Decision (ROD) for this FSEIS was signed in April, 1994 (USDA FS and USDI BLM, 1994b). The ROD formalized ecosystem management as the land management policy in the Pacific Northwest.

The FEMAT Strategy

Though the movement toward ecosystem management as public land management policy originated from many sectors and from many confrontations between land use and development and the listing of animal species throughout the region, it was the listing of the northern spotted owl in the Pacific Northwest which provided the impetus to develop a regional strategy. Over a period of three years, court rulings stopped virtually all timber harvest from the public lands and national forests through injunctions.

The first strategy with a regional perspective for the northern spotted owl was the *Interagency Conservation Strategy* (ISC) (Thomas et.al, 1991). The strategy brought together all existing information on the life history, population status, and habitat requirements for the owl and integrated the guiding principles of conservation biology and island biogeography with existing information on status and life history. The strategy proposed a system of Habitat Conservation Areas to maintain viable owl population centers across a forest "matrix", and proposed standards and guidelines to guide management. The study remains as the fundamental reference regarding owl biology and recovery. The ISC strategy assessed the viability of other species under the system of management designed primarily for the recovery of the owl, but did not include significant consideration of the life history needs of other species within the range of the owl.

The U.S. Fish and Wildlife Service (USFWS), with regulatory responsibility under the Endangered Species Act, designated critical habitat for the owl and eventually developed a draft recovery plan. The recovery plan tiered off the biological principles of ISC report and adopted a similar series of land allocations. Standards and guidelines for forest management, silvicultural treatments, salvage guidelines, and other specific management guidance were presented in greater detail. The plan contained a more extensive treatment of other species consideration in the form of viability assessments but the northern spotted owl remained the focus.

Concurrent with the USFWS draft recovery plan, the USFS prepared an environmental impact statement (EIS) which adopted the ISC strategy as the preferred alternative. The response of the courts required that USFS update the information on owl biology subsequent to the ISC report and more importantly required an assessment of the needs of other species. The USFS addressed these needs in a viability assessment prepared by the Scientific Assessment Team, known as the SAT report. This report elevated attention toward aquatic communities, in particular, as they relate to anadromous fish, and set the stage for a comprehensive effort (FEMAT) to address all the species dependent upon the forest ecosystem in the Pacific Northwest.

As the key elements of ecosystem management evolved, emphasis shifted toward declining fish resources. Protection and improvement of aquatic and riparian ecosystems became key components of the FEMAT report. The report presents a broad strategy for maintaining or restoring the distribution, diversity, and complexity of watershed and landscape-scale processes and characteristics.

Aquatic Conservation Strategy

A significant part of the President's Forest Plan is the Aquatic Conservation Strategy. As defined in the ROD (USDA FS and USDI BLM, 1994b), there are nine objectives for the Aquatic Conservation Strategy. Four components of the strategy include:

1. Riparian Reserves: Lands along streams including unstable and potentially unstable areas where special standards and guidelines direct land use.
2. Key Watersheds: A system of large refugia comprising watersheds which are crucial to at-risk fish species and stocks and provide high water quality.
3. Watershed Analysis: Procedures for conducting analysis that evaluates

geomorphic and ecologic processes operating in specific watersheds. This analysis should enable watershed planning that achieves Aquatic Conservation Strategy objectives. Watershed analysis provides the basis for monitoring and restoration programs and the foundation from which Riparian Reserves can be delineated.

4. Watershed Restoration: A comprehensive, long-term program of watershed restoration to restore watershed health and aquatic ecosystems, including the habitats supporting fish and other aquatic and riparian-dependent organisms.

Intent of Watershed Analysis

The intent of watershed analysis is to develop and document a scientifically based understanding of the processes and interactions occurring within a watershed. This understanding, which focuses on specific issues, values, and uses within the watershed, is essential for making sound management decisions. Protecting beneficial uses, such as those identified by the states in water quality standards and criteria under the Federal Clean Water Act, is a fundamental motivation for watershed analysis. Because of the linkages between headwater areas, valley floors, and downstream users, watershed analyses should encompass the entire watershed - from the highest ridge to the mouth of the trunk river and including all ownerships.

From the "Agreement on Biological Diversity" through the series of attempts to comprehensively conduct conservation planning in the northwest, the once implicit impetus toward ecosystem-based management has become explicit. The ROD clearly directs federal agencies to manage ecosystems - all components and species - to protect and sustain the natural systems upon which society depends. The task requires an understanding of how the requirements of various species overlap and affect one another in an area. Watershed analysis provides a vehicle to efficiently identify and balance multi-species concerns. This requires an understanding of the interactions between land-use activities, the physical environment, and the biological environment in an area. The concept of watershed analysis is embodied in the FEMAT philosophy and is required before new management activities can take place in specific land allocations identified in FEMAT.

Watershed analysis is not a decision-making process like the National Environmental Policy Act (NEPA). It is an analytical process. Watershed analysis does not result in a formal decision document. It brings together information which can serve as a basis from which land managers and the public to develop a mutual understanding of processes at work in a watershed. From this information base, the legal decision-making process should be made easier.

Pilot Watershed Analysis

In an attempt to provide guidance for the analysis process, the FEMAT group drafted "A Federal Guide for Pilot Watershed Analysis". An initial group of watersheds throughout the northwest was identified as "pilots" to test the adequacy of the guide and provide input for its eventual revision. The pilot watersheds were selected on the basis of data availability, access, and the ability for the agencies to cooperatively complete the analyses. Bear Creek watershed

was chosen as a pilot watershed.

Context of Bear Creek

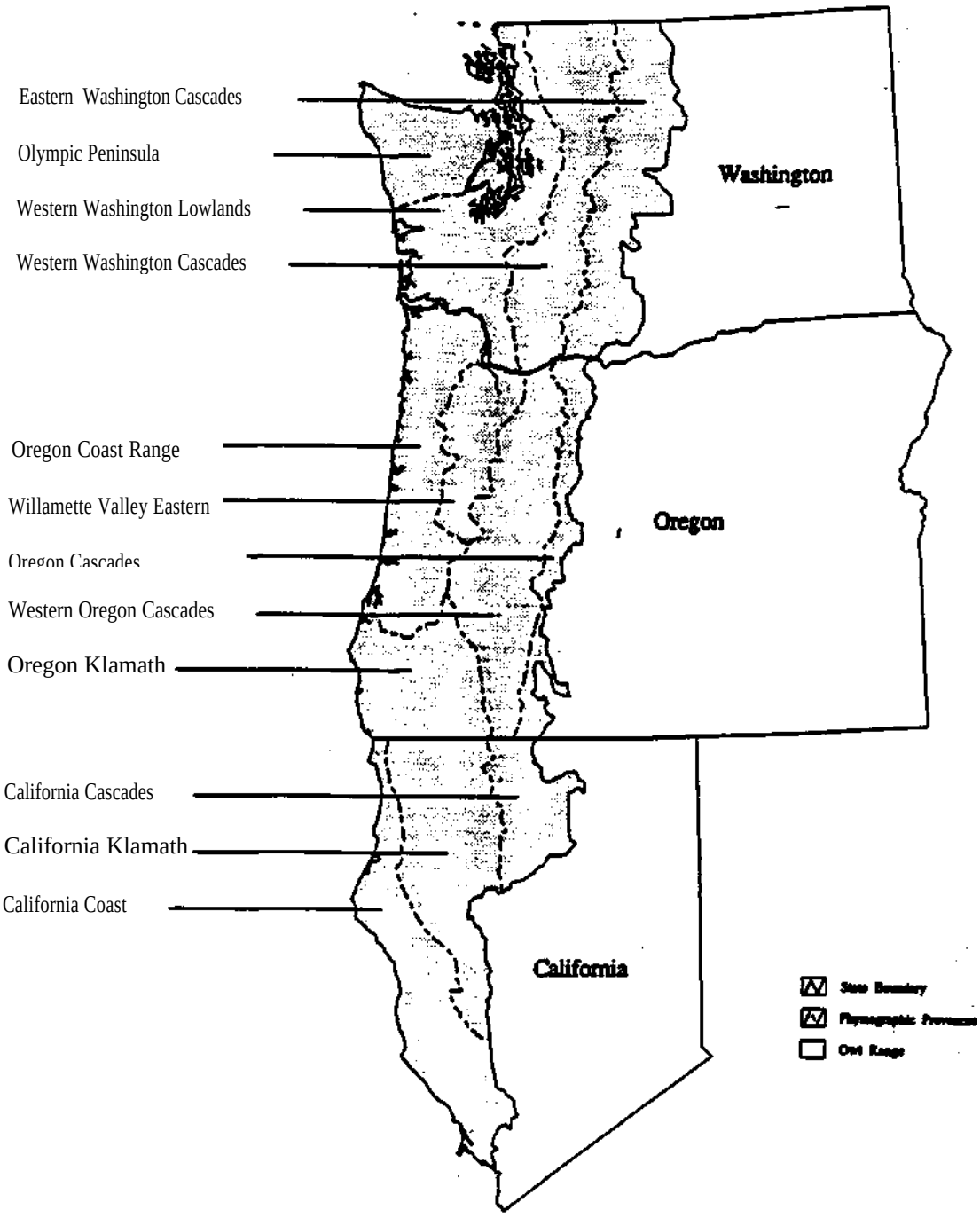
In the ROD, four Key Watersheds were identified in the Coastal Province public lands: Mattole River, South Fork Eel River, Cedar Creek (tributary to S. Fork. Eel), and Thatcher Creek (tributary to Middle Fork Eel). Bear Creek is a 13,820 acre tributary to the Mattole River and lies within the King Range National Conservation Area (KRNCA) (Figure 1). Along with adjacent Honeydew Creek, Bear Creek is comprised of predominantly public land in the Mattole basin. These are also the least-impacted (relative to other sub-basins in the Mattole watersheds) by historic and ongoing land use practices. Within the Mattole basin they are tributaries best suited as functional refugia for anadromous fish as well as for their high restoration potential in the Mattole basin. The Mattole River, in the context of northern California river systems, is a medium-sized river, the Sacramento, Eel, and Klamath rivers being the large-scale anadromous fish producers of the region. The Mattole is similar in size to the Smith River, Redwood Creek, Mad River, Van Duzen River, and the Russian River. The mainstem of the Mattole stores massive amounts of sediments contributed from higher gradient tributaries, a condition typical of northern California river basin reaches with large alluvial valleys. These stored sediments severely impact fish habitat quality and quantity in the mainstem. As with all Northcoast rivers, the Mattole River historically produced large runs of salmon and steelhead.

The entire King Range NCA (KRNCA) is allocated as Late Successional Reserve (LSR) in the ROD. The purpose of the LSR land allocation is to provide habitat for late-successional and old-growth related species including the northern spotted owl. LSRs are a derivative of the original Habitat Conservation Areas identified in the ISC report but included additional species and habitat considerations in their development, specifically aquatic and riparian-dependent species. The LSR associated with the King Range NCA and adjacent Gilham Butte is expected to act as a nucleus of habitat for 15 interacting pairs of spotted owls. The LSR takes on regional importance through its location. It lies on the coast and is the southernmost forested holding of public lands within the range of the owl (Figures 2 and 3). Point Reyes National Seashore, 175 miles to the south, contains only minimal forest acreage.

Social Context

The Mattole River basin contains a broad spectrum of economic and land use interests. The ranching, timber, and agriculture communities control major areas of private land managed for commodity production. Another significant population segment includes subdivided homesite parcels. Approximately 11% of the watershed is in public ownership. Some residents of the Mattole Valley have formed associations based on their watershed and have a strong identity with the basin in which they live. There is a significant component of the population which has recognized the effects of land use practices on the health of the watershed. They have observed major changes to the river system and a decline in values and resources associated with it. From this perception, a restoration culture emerged in the Mattole. Numerous groups have incorporated goals into their charter which address these lost values and resources. Taken as a whole, these groups address restoration opportunities and land use conflicts on a broad front. The Mattole Watershed Salmon Support Group

Physiographic Provinces within the Owl Range



25 June 1993

Figure 1 - Physiographic provinces within the range of the northern spotted owl. (Source: Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992))

(MWSSG) recognized the critically low numbers of returning spawning salmon and initiated a "stock rescue" program to avert the possible extinction of these runs. The program has released over a half million fish and continues to release native salmonid juveniles back into the Mattole today. The Mattole Restoration Council (MRC) is group of concerned watershed residents dedicated to a wide range of watershed restoration issues, among them are upland restoration, instream channel restoration, private land use practices, inventory, and monitoring. The MRC has successfully administered a wide variety of projects utilizing funding from many sources such as private grants, matching fund programs, and various federal and state programs. Both of these groups have been active since the early 1980s. The Mattole Watershed Alliance (MWA) was established in April 1991 to provide a forum for people from previously antagonistic groups to communicate more effectively. Among the accomplishments was the production of a guide to road maintenance for private landowners. At this time, the MWA is not holding meetings on any regular basis. In the Bear Creek watershed, the Bear Creek Watershed Association is dedicated to watershed-specific issues like rearing native juvenile salmon in the watershed.

The restoration impetus of the Mattole and of Bear Creek in particular creates an atmosphere conducive to the current focus on ecosystem management through watershed restoration. It provides a foothold for public / private cooperation and a starting point from which to assess and prioritize watershed conditions.

Analysis Issues and Process

To complete this Watershed Analysis, the Arcata Resource Area assembled an interdisciplinary team. The process the team used was based on the "Federal Guidelines for Watershed Analysis, April 1994". The process began by defining issues and developing key questions for each issue (Table 1).

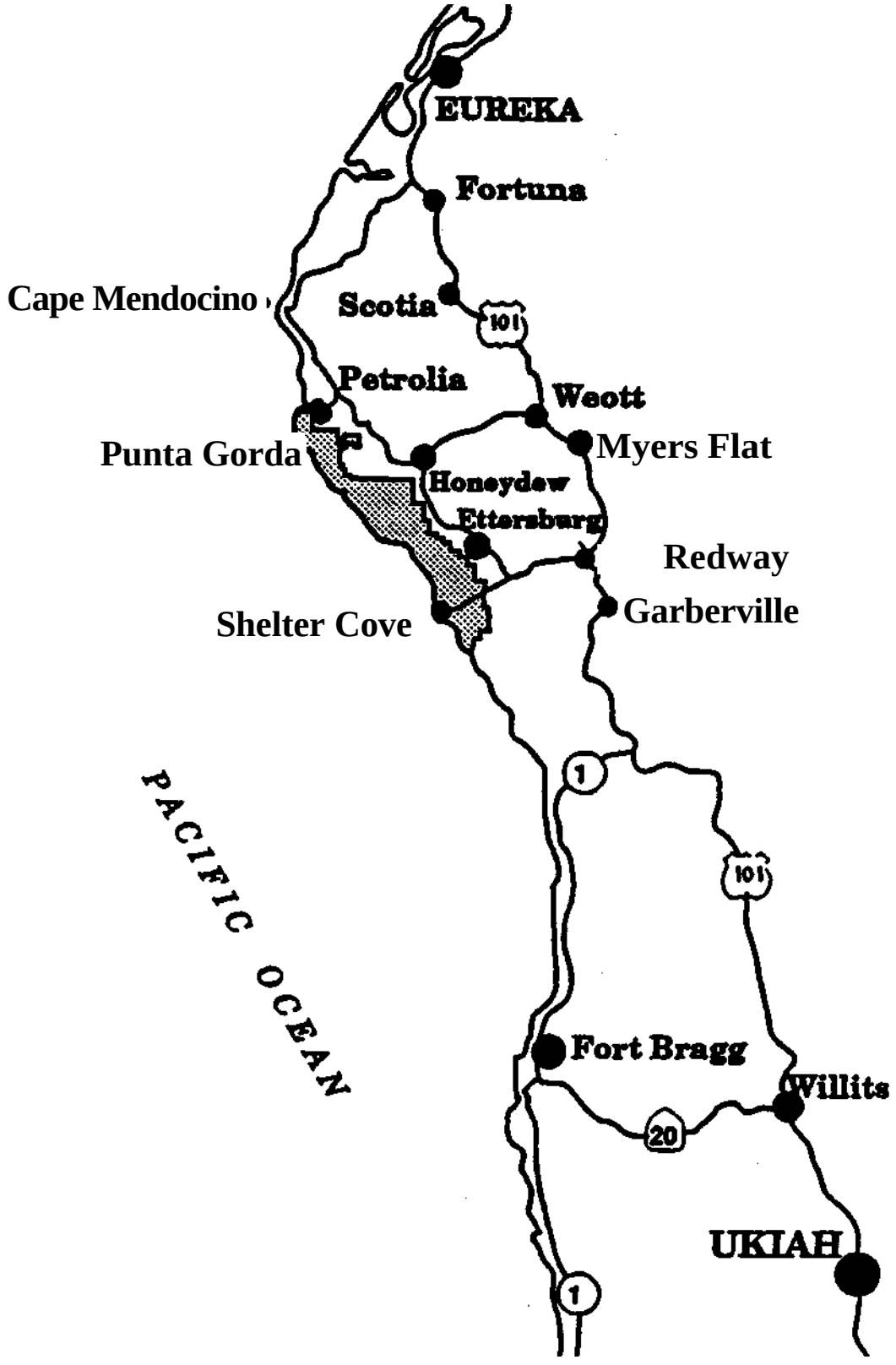


Figure 2 - Vicinity map of the King Range National Conservation Area.

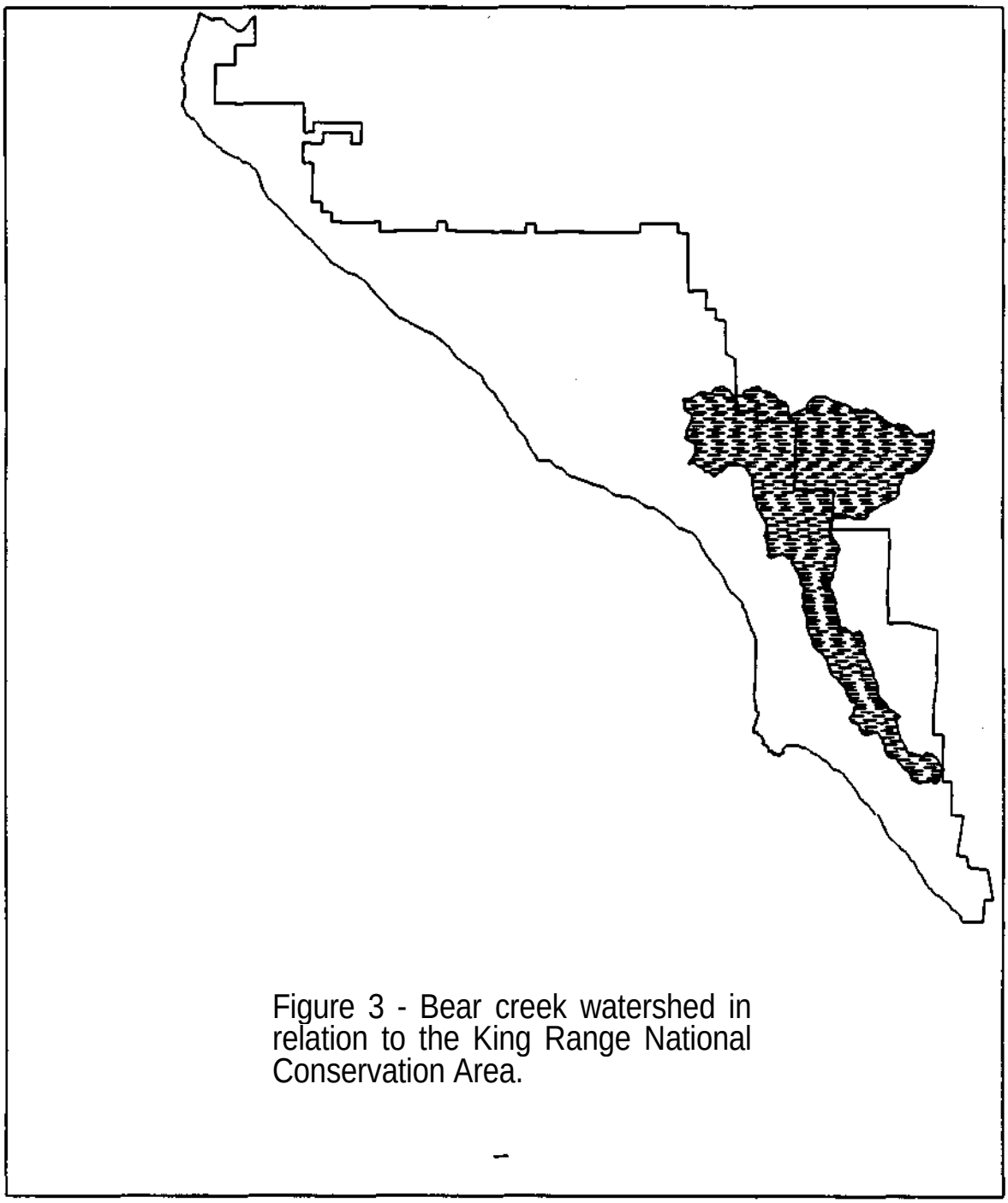


Figure 3 - Bear creek watershed in relation to the King Range National Conservation Area.

Table 1. Issues and key questions identified by BLM Arcata Resource Area interdisciplinary team for the Bear Creek watershed analysis, 1994-95.

I. Issue: Roads and transportation system
- Questions:
  1. Which roads in Bear Creek watershed are necessary to keep open for purposes of BLM and private landowners?
  2. Which roads are not maintained to meet the objectives of the Aquatic Conservation Strategy? How can BLM change the maintenance of these roads so they are up to standards?
  3. Which unnecessary roads, landings and skid trails are high priority for potential restoration projects?
  4. What considerations should BLM take into account when developing the Transportation Plan required by the ROD?

II. Issue: Habitat for wildlife, especially endangered species
- Questions:
  1. What is the current distribution and abundance of Late Seral/Old Growth Douglas Fir Forest?
  2. What is the potential distribution and abundance of Late Seral/Old Growth in 25 to 50 years?
  3. Could BLM accelerate the development of LSOG? If so where are the opportunities?
  4. How will the LSOG potentials in Bear Creek mesh with species recovery strategy?
  5. How will management toward LSOG species affect deer populations? What is the role of managed fires?

III. Issue: Anadromous fish habitat and populations in Bear Creek
- Questions:
  1. How has anadromous fish habitat changed since 1950?
  2. What is the relative importance of Bear Creek to the fish populations in the Mattole River?
  3. What role can road rehabilitation play in restoration of fish habitat in Bear Creek?
  4. How have fish populations changed since 1950?
  5. What activities can BLM undertake to improve fish habitat in Bear Creek?

IV. Issue: Water Quality as it relates to beneficial uses
- Questions:
  1. Do any toxins remain from mining activities at Queen's Peak Mine?
  2. Do high levels of fecal coliform in South ForkBear Creek impair beneficial uses? How can BLM control this?
  3. What role does Bear Creek play in Mattole water temperatures?

V. Issue: Developed and dispersed recreation
- Questions:
  1. Are any existing developed campgrounds inconsistent with the Aquatic Conservation Strategy or other standards and guides in the ROD?
  2. Are existing pedestrian and equestrian trails consistent with the objectives of the Aquatic Conservation Strategy, and other standards and guides in the ROD?
  3. What considerations should BLM take into account when planning future recreation facilities?

VI. Issue: Livestock grazing
- Questions:
  1. What is the extent (number of animals, types of animals and number of acres) of historic grazing in the Bear Ck watershed?
  2. What is the extent of current grazing?
  3. What have been the effects of grazing on the vegetation? the streams?

Once the key questions were developed, the team developed a list of data that were required to answer these questions. The team identified and collected data available from: BLM files, the California Department of Fish and Game, California Department of Forestry and Fire Protection, and the Mattole Restoration Council. The Arcata Resource Area contracted with

Bonnie Glantz, a journalist who lives in the South Fork Bear Creek, to interview watershed residents and other people who use Bear Creek or are familiar with Bear Creek. A total of 22 interviews were conducted and summarized (Appendix A). When information gathered from these individuals is used in this document, the name of the person who stated this information is mentioned. In addition, the team sought input from other federal agencies with a stake in this watershed analysis, including: U.S. Fish and Wildlife Service, National Marine Fisheries Service, Soil Conservation Service, Environmental Protection Agency, and the U.S. Forest Service. Each of these agencies reviewed the issues and key questions for Bear Creek and provided input as necessary to help guide this analysis. The North Coast Regional Water Quality Control Board and the California Department of Fish and Game also provided input and materials. U.S. Geological Survey quadrangle maps and aerial photographs from several decades were interpreted as a source of information.

As information was gathered, the initial issues and key questions were re-assessed periodically in light of recently identified information. The "Water Quality" issue was added after months of data gathering. Throughout the process key questions were refined and a few new questions were added.

Intended Use of this Analysis

This analysis attempts to summarize and interpret currently existing information pertinent to the identified issues. Unfortunately, not all the information needed to answer the key questions is currently available. The team identified information gaps during the analysis process. Information and monitoring needs are identified in Part V of this document.

The organization of this document follows what the team felt was a logical pattern. Part II identifies and describes the physical and biological processes that occur in the watershed along with the interactions of humans with these processes. Part III is and in-depth description of the issues that were identified along with a description of trends associated with each issue. Part IV makes recommendations for management based on the information found in Parts II and III. Part V lists needs for information and monitoring necessary to implement adaptive management in the watershed as outlined in the ROD (1994).

Although this analysis is not an action plan or a decision document, it should provide the watershed-scale information and recommendations necessary to make future management decisions consistent with the President's Northwest Forest Plan.

II. Physical and Biological Processes and Conditions

Physical Processes

Bear Creek is located in one of the most seismically active regions in North America, overlying the Mendocino Triple Junction. At the Triple Junction, the Gorda and Pacific Plates slide past one another as the Pacific Plate has a general northward motion. The junction of these three plates has resulted in major uplift along the North American Plate.

The area has some of the highest uplift rates in California. For example, at nearby Cape Mendocino uplift rates are ten feet per 1000 years (MRC 1989). The land rising out of the ocean here is some of the geologically youngest in North America. Three primary fault systems and countless subsidiary faults generate one to three small earthquakes per day and numerous earthquakes of magnitude 4+ each year. Recent evidence indicates that a major sheer zone runs up the Whale Gulch waterhsed, extends through Bear Creek and into the Honeydew Creek watershed (MRC 1995) The April 1992 series of earthquakes resulted in drastic changes to the landscape uplifting sections of coastline 1.4 meters and triggering numerous large landslides throughout the Mattole Basin (Dunklin 1992). Nearly all of these landslides were associated with road systems. The region experiences damaging earthquakes on the average of once every three years (Dengler et al. 1992).

This collision of tectonic plates and resulting uplift formed the King Range, a northwest-southeast oriented mountain range approximately 25 miles long averaging in height about 2000 ft with the summit Kings Peak at 4087 ft. The southern 12 miles of the King Range forms the western boundary of the Bear Creek watershed. The King Range is formed from an uplifted collection of deep water sediments consisting of marine volcanic material and serpentine (MRC 1989). Over geologic time, the rocks within the King Range have been severely folded, fractured, and weathered, causing the parent rock to be incompetent - meaning it breaks down easily and is subject to erosive forces. This parent material occurs along a coastal belt called the Franciscan Formation and consists of sandstone, shale, serpentine, and chert in a matrix of clay. Clay soils have low shear strength and high instability. This mixture is extremely erosion prone, the mixture of clay platelettes slowly absorbs and holds large amounts of water causing a loose cohesion between platelettes allowing them to slide over one another.

As a result of the processes of intense uplift and erosion, the watershed is generally quite steep. The stream network within the basin is dense, and the channels are well incised. Stream density for crenulated stream channels was calculated to be 14.09 miles per square mile. The only gentle terrain is found near the mouth of Bear Creek near the town of Ettersburg and in the upper South Fork in an alluvial valley.

Soils derived from the parent rock material are of three main groupings: conifer, chaparral, and grass-woodland. The distribution of this soil in the Bear Creek watershed follows the complex mixing of the parent material resulting in a heterogeneous pattern of soils.

The climate of the region is characterized as a Mediterranean climate with 90% of the precipitation occurring between October and April and an annual seasonal drought occurring between May and September (Figure 4). A typical year will have a cool, wet winter with a hot, dry summer. The majority of the precipitation falls as rain, although small amounts of snow fall and accumulate along the ridges and peaks which may persist for days to weeks. Occasionally, moderate snow falls on lower elevations and persists for days. The location of the King Range next the ocean results in orographic (terrain induced) uplift and causes intense and heavy rainfall during the winter. In nearby Honeydew Creek, annual rainfall exceeds 100 inches annually and occasionally exceeds 200 inches. The dominance of winter rainfall, compounded by the occurrence of large, intense winter storms, brings flood or near-flood events to the watershed frequently.

The climate in the King Range, as elsewhere in California, exhibits pronounced cyclical wet and dry patterns. A common topic of watershed resident interviews was the cyclical nature of the weather in the area. Vern Bonham describes the 1950s as a very wet decade, and the 1960s as having very predictable weather, which changed in the 1970s to a drier, erratic pattern. Lee French, who had resided near the mouth of Bear Creek his entire 88 years, remembers 160 inches of rainfall as an average winter in the "early days". Syd Green recalls the weather patterns changing about 20 to 25 years ago, bringing longer summers and drier winters.

The watershed is located between 1.5 and 4 miles from the Pacific Ocean which influences the air temperatures, wind patterns, and fog occurring in the Bear Creek watershed. The summer fog, characteristically present along the coastal areas of northern California, is absent from the King Range and Bear Creek watershed with the exception of localized areas of fog on the coastline and upper headwaters of the Mattole Basin and South Fork of Bear Creek. Evidence of strong, prevailing offshore wind patterns is found on ridgetop trees. "Flagging", or the wind-caused pattern of limb growth and development of ridgetop Douglas fir, points westward indicating an easterly flow. The steepness of the King Range, combined with wind patterns, keeps frequent fog from the basin and brings warmer inland air during the summer months (MRC 1989). In spring and fall, fog will occur in lower elevations while higher elevations remain clear. Average air temperatures range from a high of 95 F to a low of 30 F.

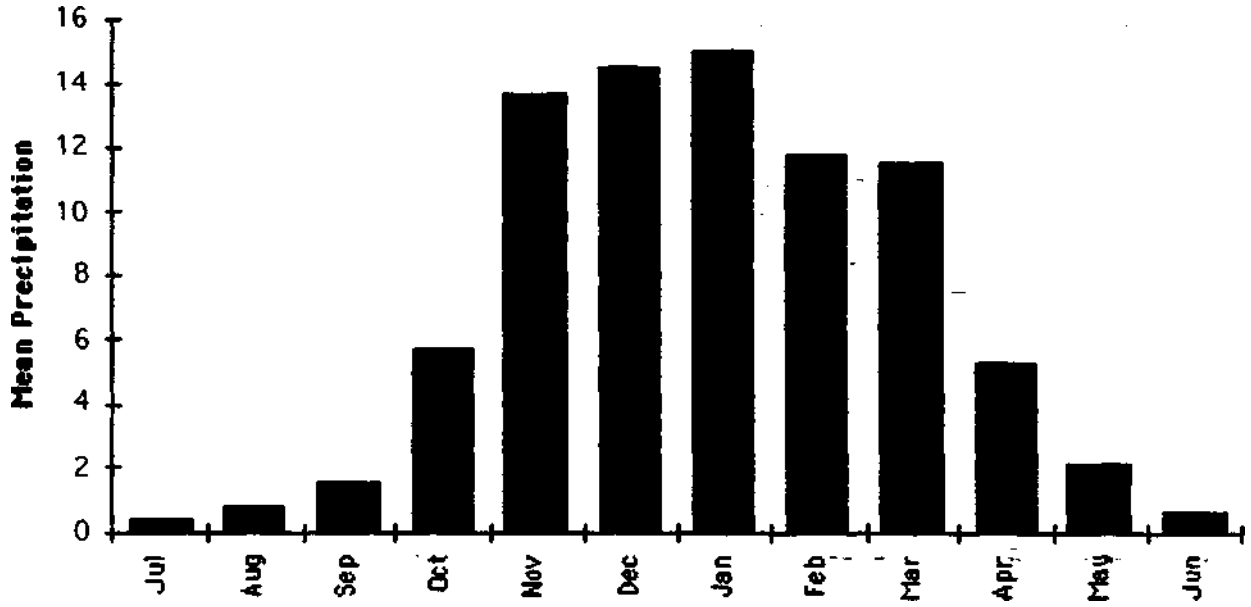


Figure 4. Mean monthly precipitation at Whitethorn, California.

Flora and Fauna

Flora

The array of vegetative communities found in the Bear Creek watershed, their seral stages, structural attributes and mix of plant species, are determined by a combination of physical, biological and disturbance factors. Physical factors affecting plant communities include soil, moisture, temperature, and topography. These physical factors interact together to enhance or buffer the effects of one another on plants. Soil depth, particle size and nutrients influence water holding capacity, available nutrients and ultimately the type and growth patterns of plants on a site. Moisture is important to plants only to the extent that the plants can use it. The seasonal wet and dry patterns in the watershed make the water-holding capacity of the soil a major factor in the moisture available to plants. The relatively moderate winter temperatures in the watershed allow the existence of plants that cannot tolerate long periods of below freezing temperatures. High summer temperatures cause high rates of evapotranspiration and on some sites desiccate plants and soils. Plants with waxy leaves, deep root systems or other adaptive mechanisms are able to occupy these sites where others languish. Topographic factors including slope, aspect and elevation have modifying effects on most of the other physical factors. North and east slopes stay cooler and moister because they do not receive as much direct summer sun that heats and desiccates south and west slopes and ridgetops. Steep upper slopes tend to erode and deposit top soil on lower gentler slopes making the lower slopes the areas generally having deeper soils.

The natural process by which the size and composition of a group of plants on a given site changes over time is called plant succession. This regrowth of plant communities progresses through "seral" stages, over time, until the climax (or final) stage is reached unless it is modified by disturbance.

Disturbance factors in the watershed are important in determining the development of a plant community toward climax, but more often they affect the structure of that community. Fires started by lightning and trees blown down by severe windstorms have always been a part of the natural cycle affecting the structure of plant communities. Severe rainstorms and earthquakes cause flooding and landslides that also alter plant communities. These disturbances, that at times appear catastrophic, are part of the natural cycle of plant communities that exist on otherwise undisturbed sites. Human-caused fires and timber harvest are two disturbance factors that have had a dramatic effect on the Bear Creek watershed by removing parts of the plant community and setting back plant succession over large acreages over a short time.

The weather patterns created by the unique combinations of topography and climate in the King Range have created a 150,000 acre patch of mixed evergreen forest along the northwestern California coast. The patch of mixed evergreen in the King Range is isolated

from the main body of this forest type which stretches up and down the coast range mountains. The Bear Creek watershed constitutes about nine percent of this patch. The King Range influences wind and fog patterns in the Bear Creek watershed to the point where the moist redwood forests, so characteristic of coastal areas both north and south of the King Range, are absent.

The mixed evergreen forest dominated the landscape of the Bear Creek watershed. Prior to European settlement, it is surmised that vegetative assemblages and seral stages of the mixed evergreen forest formed an intricate mosaic that occurred primarily in response to moisture available to plants and to lightning fires and indigenous people caused fires (Barbour and Majors). Large continuous stands of late-seral or old-growth (LSOG) forests that occurred in the Pacific Northwest were thought to be absent from this area (Barbour and Majors).

Processes of the physical environment and interaction of the functioning vegetation tend to support three general structural types in the mixed evergreen forests of Bear Creek. The first type is characterized by thick closed canopy Douglas-fir stands with stunted tanoak and madrone as a minor shrub layer that usually occur on deep soils near the cool moist bottoms of slopes where intense fires rarely occur and the fast growing conifers can reach their potential size. When stand-replacing fires do occur on these sites young conifers can compete aggressively with the hardwoods and can maintain dominance because of the good soil conditions. The second type is made up of giant Douglas-fir occupying an irregular upper canopy with a closed lower canopy of large evergreen broad-leaved species. This type is frequently found on the upper two-thirds of north slopes where moderate or low intensity fires or other disturbances periodically open up the canopy in small patches allowing conifers to grow up through the hardwoods. Low intensity fires in this structural type tend to creep around on the ground and burn up fuels that would otherwise build up to create intense stand-replacing fires. The third structural type of the mixed evergreen forest consists of evergreen broad-leaved woodlands made up primarily of tan oak and madrone. This type generally occurs on forest soils that are somewhat shallow and on sites that tend to be drier such as near ridge tops. Ridgetops tend to get more lightning fire ignitions. Also, fire ignitions that start further down slope almost always burn toward the top of the ridge. Fires appear to be frequent enough on these sites to eliminate any conifers before they can grow large enough to survive even moderate fires. Young Douglas-firs are extremely susceptible to fire. The tan oak and madrone sprout after burning and dominate the site, however, they rarely become mature trees.

Douglas-fir, tan oak and madrone are the most consistently occurring species in the mixed evergreen forest with big-leaf maple, canyon live oak and California laurel more or less occurring sparsely throughout the type.

Douglas-fir-tan oak-madrone plant assemblages contain Pacific yew and bigleaf maple in

moist drainage bottoms and around side-hill seeps. Sugar pine, chinquapin, and canyon live-oak occur in the mixed evergreen assemblages on drier sites. The Bear Creek watershed and the King Range contain a small population of sugar pine that is isolated from the nearest populations by 40 miles (Griffin and Critchfield 1972).

The preponderance of late-seral or old-growth forest stands in the Bear Creek watershed occur on cool, moist, north slopes and drainage bottoms which generally grow larger trees with a high percentage of Douglas-fir. Fires are less frequent in these areas, and ones that do occur are usually low to moderate in intensity. The trees also grow faster and taller due to finer-grained and deeper soils.

Chaparral brushland vegetation occurs on sites within the Bear Creek watershed where soils are rocky and shallow, and where the aspect is hot and dry. These areas are vegetated with manzanita, ceanothus, and canyon live-oak chaparral lands, and grassland coastal prairie "balds". Grasses and shrubs from the coastal mixed shrub community occur mixed with the chaparral community or as lower seral stages on sites that could potentially grow mixed-evergreen forest. These seral stages are usually caused by fire and are located on hot dry ridge tops or on recent landslides.

Though intensity and magnitude varied greatly, evidence indicates that fire occurred on a frequent basis in the Bear Creek watershed and influenced the vegetative composition and structure. Relatively frequent low intensity ground fires curbed the build up of flammable dead material and probably decreased the incidence of catastrophic fires. Frequent low intensity fires were likely to have killed some trees and created natural gaps in the stands that allowed for development of old-growth characteristics. Fire also probably released other trees to achieve large size with fire resistant bark and become old-growth.

Fauna

Wildlife habitats are determined by the interspersion of plant communities, the structure of plant communities, and the mix of species within a community. Although all the components of habitat are important to certain wildlife species, many forest species habitat preferences are related to structure of vegetation rather than plant species making up a community (Thomas et al. 1979). For example, the northern spotted owl usually nests in LSOG and satisfies this preference equally well in mixed evergreen, redwood, mixed conifer and Douglas-fir communities.

Certain special features such as riparian zones, edges between vegetative types, snags, dead and down woody material, and landslides provide special or unique habitat and may occur in or adjacent to plant communities occurring in the watershed. Many species are dependent on one or more of these special features for part of their life cycle.

The patchiness and age distribution of vegetation strongly influences what wildlife species

can occur in an area. The northern spotted owl, the piliated woodpecker and the pacific fisher are species that require the features provided by late seral or old-growth forests such as a closed canopy, multiple-layer, open understory, coolness, high humidity, and structural complexity. Some species require large continuous patches of a certain vegetation type while others may be tied to a specific type or seral stage, but require it in very small amounts (such as certain salamanders that have whole populations in a several acre area). Deer and bear are species that can be at home in many seral stages of the several vegetative types in the Bear Creek watershed. Riparian zones and wet areas are important to many species for water and some less mobile species such as frogs and salamanders carry out their entire life cycles in these areas.

Disturbances such as fire, landslides, and wind-throw encourage tender young sprouting vegetation and the emergence of grasses and forbs which are important to deer, elk, quail, and young grouse. Snags are important to woodpeckers, flycatchers, brown creepers, owls, and bats for food sources and home sites. Dead and down woody materials provide important niches for reptiles, amphibians, and small mammals by providing cool moist homes, hiding places and sources of food such as insects and mushrooms.

Wildlife species inventories and surveys prior to the influence of Europeans are nonexistent. Species occurrence can only be extrapolated from species occurrences documented for vegetative types over a large geographic area. Lists of hypothetical historic species occurrence have not be compiled in this document, but, sources that can be used to compile such a list are contained in Marcot et al. 1979 and Anderson et al. 1985.

The habitat available to stream-dwelling animals in Bear Creek is similar to that of much of the Pacific Northwest and northern California. Cool water, shaded by a canopy of large trees, made Bear Creek ideal habitat for the spawning and rearing of sea-going fishes such as salmon, steelhead, and lamprey. Large trees that died and fell into the streams provided shelter for these young fishes as well as a variety of salamanders and frogs. The aquatic fauna in the Bear Creek drainage were suited to cool, clean flowing water and ample structure from large wood and boulders.

Indigenous People

Little is known for certain about the original inhabitants of the Mattole watershed. Ten years after contact with Euro-Americans in the mid-1800s, these people had been virtually eliminated by disease and genocide. They are commonly referred to as the "Sinkyone", a name given them by early ethnologists, and belonged to the Athabascan language speaking group of people (M. Greenway, pers. comm.). What little is known of the lifeways of the Sinkyone people is based on sketchy and generally racist

accounts of early explorers and settlers, interviews with elderly Sinkyone survivors, commonalities with other indigenous groups to the north and south, and archaeological evidence.

The Sinkyone are considered by ethnologists to be a "transitional people"; they were the southernmost people to share Northwest salmon culture; they also shared commonalities with the central California cultures to the south.

The influence of northwest salmon culture is seen in the (at least seasonal) reliance on salmon, the use of building materials, the architecture of their dwellings, and the use of canoes for hunting marine mammals and fishing in the ocean. The influence of Central California Pomoan culture is seen in the major role of acorns in their diet.

This complex of northwestern and Central Californian cultural elements is expressed in the Sinkyone utilizing Yurok building materials and technology (redwood planking) to construct Pomo-like round houses (Yurok redwood houses are rectangular). The Sinkyone relied on salmon as much as they relied on acorns; their adaptation of northwest-style "first-salmon" rituals were very similar to the "first-acorn" rituals observed by the Sinkyone, and other acorn-dependent cultures to the south.

Archaeologists have identified several sites along the upper reaches of the South Fork of Bear Creek, from the headwaters area north to the vicinity of the present-day Shelter Cove Road, a linear distance of about two and one-half miles (M.Greenway, pers. comm.). While most of the South and North Forks of Bear Creek run through very steep and narrow drainages, the terrain on the upper South Fork is relatively gentle, with some flood plain development, openings in the forest canopy, and large wet meadows in the Hidden Valley area. These sites show evidence of long periods of continuous use, and are estimated to be at least 4,000 years old, which pre-dates the Sinkyone people. A large and very old (4,000 to 6,000 years old) site also exists at the north end of Paradise Ridge (the eastern divide of the South Fork of Bear Creek watershed) in a stand of tan oak and madrone at the edge of a formerly large prairie (based on 1948 aerial photographs) (M.Greenway, pers. comm.).

Although the South Fork Bear Creek sites show long periods of continuous use, they were probably not used as intensively as the major settlements at present-day Shelter Cove, or at McKee Flat in the Whitethorn valley on the upper Mattole River. Archeological excavations of the Shelter Cove settlement, as well as numerous sites north and south of Shelter Cove, show the Sinkyone spent much time on the coast. Excavations of these coastal sites yield remains of whales, seals and sea lions, many kinds of fish and shellfish, elk, deer, and waterfowl, and the implements used to harvest and process these resources.

Similarly, excavations on the upper Mattole on or near McKee Flat show these sites were occupied for more than 4,000 years by people utilizing the seasonal salmon resource; for the Sinkyone, fishing was at least as important as hunting for supplying winter food. Significant among the finds at the upper Mattole sites are wood-working tools (such as stone adzes and mauls, elkhorn wedges, and flanged pestles) and salmon processing tools.

Based on the evidence of long periods of continuous use of the coast, upper Mattole, and upper South Fork of Bear Creek one could assume the Sinkyone, and their predecessors, utilized these sites on a seasonal basis; living on the coast to utilize shellfish in the winter and spring before the danger of paralytic shellfish poisoning, harvesting spawning surffish or kelp in the summer, travelling to the interior to harvest acorns in the late summer and fall, and camping on the upper Mattole to harvest the winter salmon run. Fall, however, was the most important food procurement period for the Sinkyone; the time when surffish and salmon runs overlapped, a seasonal abundance of sea lions and fur seals, while acorns were ripening, harvested, and processed. It was the time to accumulate food reserves for the coming winter.

Seen in this context, the upper South Fork Bear Creek sites would seem ideally suited as an intermediate camp while travelling between the coastal sites and the Mattole, both spatially and temporally. Given the long-term occupancy and use of the upper South Fork Bear Creek sites, as well as the Shelter Cove and upper Mattole sites, the impacts of Sinkyone land uses on the landscape of the area should be assumed to be similar to those of other indigenous groups in pre Euro-American California.

Fire was by far the most powerful tool available to native Californians. Fire has the most potential for profound effects on the landscape; however, native Californians utilized fire in very specific situations for very specific purposes. Fire was used, for example, to treat the understory of tan oak stands, the preferred acorn among northcoast peoples, in the late summer and fall after the first wormy acorns had fallen to the ground. Fire applied at this time not only cleared the understory of brush making it easier to gather the acorns that fell later, but killed acorn worms which would have infested the next years crop (Raphael 1974).

Grass and forb seeds, as well as acorns, were a staple of many native Californian diets. Fire was applied to pinole fields (the seeds of several different species of perennial grass were used as grain) after harvest to ensure abundant growth the following season. Fire was used, along with tillage, to maintain bulbs, corms, and tubers utilized as food resources (Brodiaea, Allium, Perideridia, Camassia, and Calochortus species, among others). Fire also was used to maintain coastal prairies as open grassland and as productive elk and deer hunting areas; recent research has demonstrated that the majority of the coastal prairie habitat was "anthropogenic" in nature and quickly reverted to woody vegetation after Euro-American settlement of the area (Bicknell 1992).

Native Californians were highly skilled basket makers. Most storage, cooking, and food processing implements, as well as nets, snares, and weirs used for fishing and hunting, were woven baskets of plant materials. The variety of materials used to construct baskets for every imaginable use is quite large: willow, hazel, redbud, huckleberry, ocean spray, and many other shrub stems, beargrass, wild iris, sedge roots, fern fronds, and stems, seed stalks, and rhizomes from many different forbs, grasses, sedges, and rushes. The procurement of these items required active manipulation of each plant source to produce quality construction materials, usually epicormic or adventitious shoots (ie., young growth) for the intended use. The techniques used to produce the desired materials included: burning, pruning and coppicing shrubs to encourage sprouting of straight shoots, burning and pruning grasses to produce long straight stalks and to remove old plant material, tillage and weeding of basket sedge patches to encourage the formation of long straight rootstalks.

The management techniques used and the procurement of plant resources to meet the needs of native Californians could have significant impacts on the landscapes. Much has been written of the open, mixed conifer Sierran forests and the open understory of the vast Californian oak woodlands at the time of Euro-American contact, as examples. The impact of indigenous land uses on the Bear Creek watershed was probably not as extensive as elsewhere in California, but rather localized in areas of consistent, long-term use and habitation, such as the upper South Fork Bear Creek.

The landscape and plant communities of the upper South Fork Bear Creek probably were influenced, to some extent, by the domestic activities of the original inhabitants, which are presumed to have been seasonal in nature. The major effect of indigenous management was probably the maintenance of an open understory under the Douglas fir/tan oak forests as a result of acorn management activities and as a result of the management and collection of construction materials (hazel, willow, and huckleberry stems, for example). The extensive meadows in the Hidden Valley area also may have been maintained indigenously, as elk habitat, for example, by the use of fire. It also is probable the extent of meadow/coastal prairie habitat was much greater. Sedge meadows also may have been more extensive along the upper South Fork in areas of suitable gradient and substrate as a result of the tillage of sedge basket rootstocks

Animals used by Native Americans included black-tailed deer and Roosevelt elk as food sources as well other animals. Bones, sinews, intestines, and other animal parts were used to make tools and other valued goods. Waterfowl and other birds were used for food and clothing. Animals had great spiritual significance to early peoples. Many spiritual rituals and traditions were based on animal behavior and functions within the ecosystem and animal parts were used as well.

Although indigenous use and management probably influenced the character and composition of the landscapes in areas such as the upper South Fork, the majority of the Bear Creek watershed was most likely not influenced significantly by indigenous human activity. Most of the Bear Creek watershed is too steep for habitation and concentration of human impacts. It may have been used by some as a travel corridor and/or for hunting, but there are more accessible hunting areas in the general vicinity. The neighboring Cahto peoples, who maintained trade and social relationships with the Sinkyone, held Horse Mountain and the ridges north of Shelter Cove (the western divide of the Bear Creek Watershed) in superstitious regard. One could assume the Sinkyone held similar beliefs.

European Settlement

The Humboldt Bay area was settled by Europeans in the 1850s as a supply port for gold rush mining occurring in the Trinity River area. Shiploads of settlers arrived from San Francisco intent on establishing townsites. More gold was found even closer to Humboldt Bay and the encroachment of settlers onto the lands of the native inhabitants was inexorable. Though there were many attempts at treaties, and various trading arrangements of trinkets for food or livestock for land, the Indian culture over time became a nuisance to the Euro-Americans. Thus the government established Fort Humboldt near Eureka. The clashes of the native and European cultures became more and more frequent usually resulting in escalating atrocities from both sides taking on the scale of small wars. Military and vigilante expeditions began to systematically eliminate the Indian "problem" by raiding villages and killing inhabitants. In 1864 a "battalion" of local citizens augmenting the regular army troops from Fort Humboldt raided all the villages they could find in the Whitethorn Valley. As with other tribes throughout northwestern California who were similarly decimated, captured Indians were placed in one of four Indian Reservations at Round Valley, Hoopa, Smith River, or Klamath where they were under the complete control of the government. Their culture was absorbed into the Euro-American's agricultural and industrial enterprises and the social structure of their ancestors was eliminated. They were subject to racism, slavery, and total loss of cultural identity.

Whereas the settlers of Humboldt Bay and along the newly established railroad from San Francisco led a civilized existence with readily available goods and a cash economy, the settlers of the backcountry led a self-sufficient lifestyle. Homesteaders in the upper watersheds of the Mattole maintained their own small herds of cows and horses along with goats and chickens mostly for their own use. They fished for salmon and cured it for use throughout the year. Settlers ate venison, grouse, quail, and whatever else could be provided from the free natural larder. Roosevelt elk were extirpated during this time. They also shot, trapped and otherwise killed mammalian predators that preyed their livestock. To protect domesticated chickens from natural predators, settlers killed

goshawks, Cooper's, and sharp-shinned hawks. Trips to town were often annual events to stock up on staples and tools and to sell or trade some of the surplus from their herds. Up until this time the impact of these settlers on the landscape was minor and localized.

In contrast to the backcountry homesteaders in the upper Mattole watershed, farther downriver the Mattole River basin was being rapidly settled. The economic structure of the area became established and was rooted in three major industries of agriculture, livestock, and timber. The Mattole Valley was planted with apple and nut orchards throughout its length and commercial crops of fruit, vegetables, grain, corn, potatoes, and beans along with an infant timber industry brought the Mattole into economic contact with the outside world. Significant areas of timber land in river valleys and lower slopes were cut and burned to accommodate livestock grazing and farming, some of which remain cleared today. The mainstem of Bear Creek was treated in this manner and remains cleared and available to livestock today. One such homestead was started in the 1890s by the seven Etter Brothers near the mouth of Bear Creek. This location eventually became the town of Ettersburg. Because of its remoteness, and because of poor soil, this area was not occupied by earlier settlers. Within 20 years, the hard working brothers had turned their homestead into an 800 acre ranch with sheep, a saw mill, tan bark peeling, apple orchards, and strawberries. The varieties of apples and strawberries developed at this ranch by Albert Etter have given some notoriety to this area. As the ranch proved successful, more settlers occupied this area. In the early part of this century, Ettersburg supported a post office, a school, and a store (Raphael 1974).

Most of the upper Mattole and tributaries such as South Fork Bear Creek were not significantly impacted. As a result of the diversification of the rural economy and the emergence of a rural "cash" economy, the homesteaders in the remote regions of the river basin could now participate seasonally in paid labor outside of their own properties primarily splitting redwood bolts into shakes, fence posts, grape stakes, and railroad ties. Transportation routes were beginning to establish which linked the entire basin. It was during this time, in the early 1900's, that the tan bark industry emerged in the Mattole.

Tanoak bark yields a substance called tannin which is used for the tanning of leather. Briceland and Whitethorn were centers of operation for numerous tan bark camps and grew into population centers of several hundred people with hotels, stores, stables, and saloons. The tanoak trees were cut, their bark stripped and hauled to the nearest road by mules or horses and wagons, then hauled into the local processing facility. Seaports were established at Shelter Cove, Usal, and at the mouth of the Mattole where ships were loaded with bark, tannin, redwood shakes, or fence posts for shipment to southern California or the San Francisco Bay area. The industry was short-lived, lasting only into the 1920's, but was the first large-scale manipulation of the landscape brought about by Europeans. The industry resulted in the elimination of virtually all the mature tan oak forests of the area. The harvested area may have included the Bear Creek watershed with

haul roads emanating from the Shelter Cove road. Anecdotal accounts from the backcountry indicate the extent of the tan oak harvest. Settlers were forced to discontinue the raising of hogs because there were no longer enough acorns in the forest to carry the hogs through the winters. The tan oak wood itself was usually left in the forest.

After the tanoak boom, there were no real large-scale changes in the landscape until the mid-1930s. The largely self-sufficient populace trapped, raised their crops and animals, worked in agriculture and splitting mills during the summers, and hunted and fished to supplement their foods. During this time, Bear Creek remained a remote and wild place. According to long-time resident Bob McKee a brothel was in operation in the lower North Fork. McKee and another resident, Gene Brown, reported that a Mrs. Meeks was the madam for "Shelter Cove" brothel which operated in a currently-occupied cabin on the upper South Fork.

In the 1930s a sawmill was established at Whitethorn for the purpose of processing Douglas-fir. The methods were manual and the transportation system crude, and the logging methods lent themselves to high-grading of the largest and most easily accessible trees.

Post World War II Land Use

After World War II, logging began in earnest in the Bear Creek watershed. Airphotos from 1948 show no timber harvest in the watershed prior to 1948. Long time resident Syd Green reports that this period was a "starvation situation" in which it was difficult to make ends meet. The logging boom occurred concurrently with the return of many Word War II veterans who were without work and "trying to get by". The post - World War II housing boom created a large market for Douglas fir sawlogs. In addition, a tax on standing timber was a disincentive for landowners to leave standing timber on their property. The availability of modern tractors (Caterpillars or "Cats") to landowners around this time, allowed landowners to log previously inaccessible timber. Modernization of chainsaws made timber falling easier. Widespread logging of the watershed occurred from 1950 to 1970 with little regard to placement of roads, skid trails, or protection of watercourses. Large amounts of slash (unused branches, limbs, logs, and other debris) left on the ground after logging has increased the fuel available for fire. At one time, eight small saw mills operated in the town of Honeydew. By the end of the 1960s the timber boom had faded. In 1973, the California Forest Practices Act was enacted which began to change the methods and practices used for logging.

Long-time watershed residents can attest to the magnitude of the careless logging

practices of the time. "Trees were and endangered species then" said Richard French. The logging operations showed "no respect for the country and streams" according to Lee French.

Bulldozer logging left countless skid trails. It was not uncommon for logging operations to use stream channels as transportation corridors. Some logging roads were located in the inner gorge areas of the watershed. These roads and skid trails disrupted the natural drainage patterns in the watershed. Compacted soils on roads and skid trails prevents infiltration of rainfall. Rather, the water is concentrated on road surfaces and erodes rills and gullies downhill. This alteration of the hydrologic cycle causes higher peak flows and increased sediment yield to the stream channels.

Prior to 1958, fires in the watershed were seldom suppressed or documented due to the remoteness of the area. Watershed resident Lee French recalls a fire in 1948 fire called the "Lannigan Fire" as the first fire in the area to be fought with the help of heavy machinery. Fire suppression in the region was made easier with the availability of bulldozers, chainsaws, and airplanes capable of dropping fire-retardant materials. In addition, the policy of the California Department of Forestry and the BLM is suppression of fire as soon as possible. As the capability of fire-fighting increased, the rapid suppression of fires became easier and the frequency of large fires decreased. This, in turn, has caused the forest fuels to increase to higher levels, and when fire conditions are extreme (low humidity, high temperatures, and high winds) large, hot, and destructive fires have occurred in Bear Creek. As a result, fires in Bear Creek have changed from being frequent, low-intensity, lightning-caused fires to large, infrequent, potentially catastrophic fires. The most recent catastrophic fire, the Finley Creek Fire, occurred in 1973 burning 3,000 acres in the upper South Fork of Bear Creek, including riparian vegetation along the South Fork. The most recent fire, the Saddle Mountain Fire, occurred in 1988 burning 200 acres of the South Fork, with little damage to the riparian area. Both of these fires were human-caused.

The floods of 1955 and 1964 caused drastic changes to Bear Creek, the Mattole River, and other drainages in the region. The effects of these floods on the morphology of Bear Creek was exacerbated by the impacts of logging and road building in the watershed during this time. The 1964 flood was lesser in magnitude than the 1955 flood. Observations of watershed residents of both these floods differ. According to long time watershed resident Michael Etter, the 1955 flood deposited large amounts of silt and gravel in the mainstem, and subsequent high waters in 1966 or 1967 seemed to disrupt Bear Creek to a greater extent. However, residents Lee and Richard French, and Syd Green remember the 1955 flood as "being good for the Mattole River" in that it cleared log jams. These residents report the 1964 flood was "real bad for the river". The upper South Fork of Bear Creek was little impacted by the 1964 flood.

Over 40% of the total acreage of the Bear Creek watershed (5,723 acres) was never homesteaded and came under the management of the BLM. The other acreage in the watershed is believed to have been acquired under original Homestead Act patents and handed down to generations or sold. After passage of the King Range National Conservation Area Act in 1970, the BLM began active acquisition of available lands within the boundaries of the National Conservation Area, including Bear Creek. Since 1973, the BLM has acquired 3200 acres in the watershed, 3100 acres by exchange and 100 acres by fee purchase. The majority of the land acquired was exchanged with large timber companies (Simpson, Louisiana-Pacific, Sierra-Pacific, and Harwood) who logged and roaded the land prior to exchange. Currently, 65% of the watershed is public land, the majority of this land is in the South Fork sub-watershed which is 90% public land (Figure 5).

The number of residences in the watershed increased during the 1960's and 1970's, especially in the upper South Fork where the number or residences has doubled since the 1960s. Residences along the South Fork are concentrated near the stream. In the North Fork, four private parcels currently occur with one known residence. A great majority of resident, live on the flatter land near Ettersburg located at the confluence of the Mattole River, and another group of residences occurs in the alluvial valley in the upper South Fork. The post office, school, and store that once existed in Ettersburg are currently not operating.

All residents use water for personal use, irrigation, and to water livestock. The use of water by watershed residents increased as the number of watershed residents increased. Most residents have tapped into a spring and a few residents report drinking water and irrigating with water directly from Bear Creek. Most residents report using the stream for swimming and fishing.

The number of people using the watershed for recreation increased beginning in the early 1960s. In 1964, four BLM campgrounds were constructed which encouraged the use of the area by campers. Increased interest in outdoor recreation during the 1970s and 1980s, along with improved road access and trail development in the watershed, led to an increase in recreationists. Hikers, campers, hunters, horse riders, offroad vehicle riders, and anglers come to the watershed to engage in these activities.

Currently, a few collectors of forest products such as beargrass, huckleberries, and mushrooms gather these products in the watershed. It is not known if places of spiritual significance occur in the watershed. It is also not known if locations within the watershed are currently used by individuals or groups for spiritual purposes.

The physical remoteness of the watershed from any population center makes it an attractive place for those wishing to perform illegal activities. During the 1930s, under

prohibition, a moonshine still was known to exist in the North Fork (Raphael 1974). Currently, marijuana cultivation occurs in the watershed on both private and public lands. The Campaign Against Marijuana Planting (CAMP) has made several raids on marijuana gardens in the watershed during the 1980s and 1990s. Since cultivation in this climate requires irrigation, growers will often divert water from springs. Both organic and inorganic fertilizers used by growers can enter into the nutrient pathways of the terrestrial and aquatic ecosystems. Marijuana gardens are sometimes protected from rodents and deer by the use of poisons, traps, and fences.

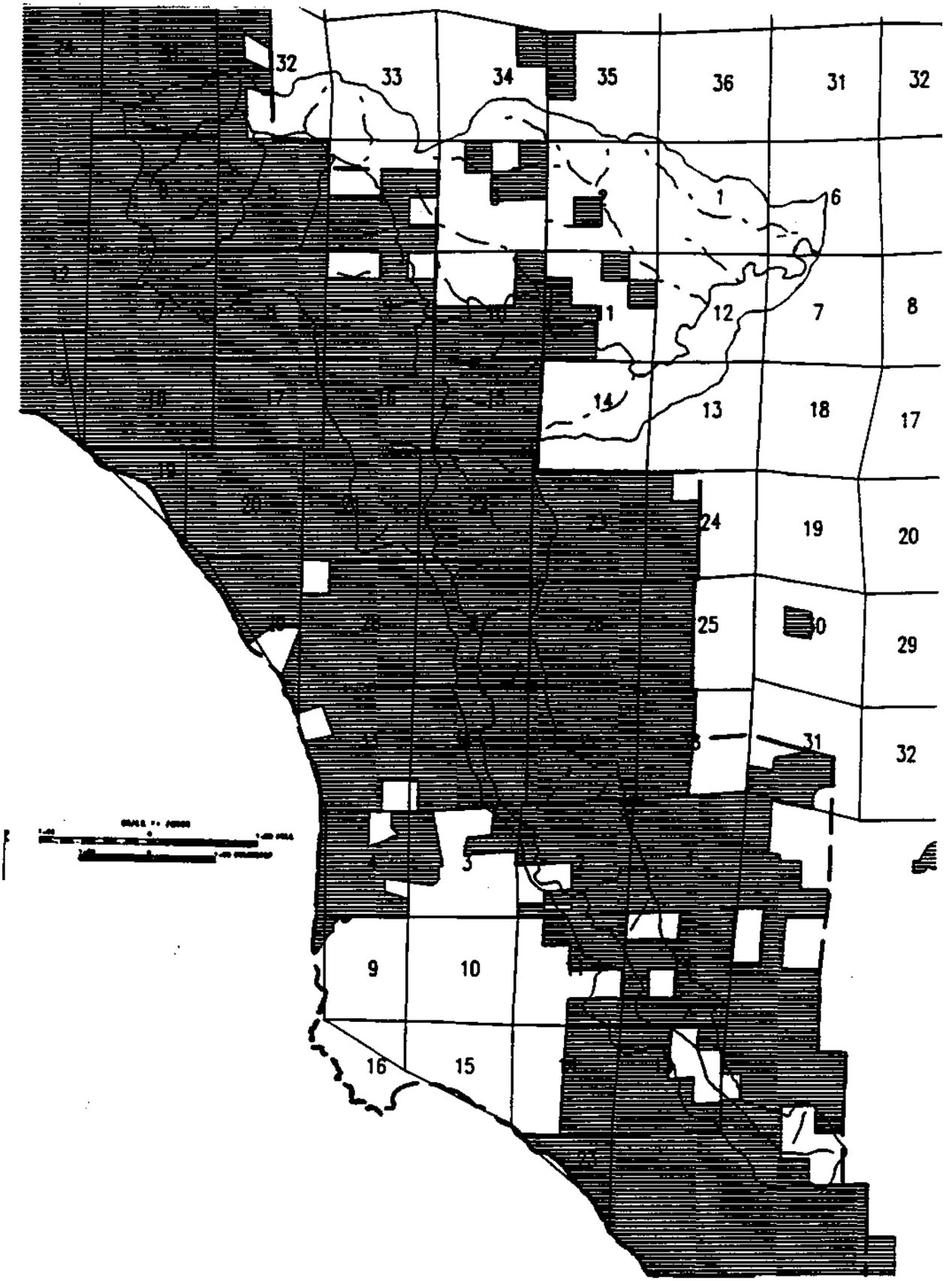


Figure 5 - BLM owned lands in the vicinity of the Bear Creek Watershed
(Source: Humboldt County tax assessor records, 1994)

III. Issues

Roads and Land Use Practices

Logging

The Bear Creek watershed contains approximately 13,828 acres. With regard to land use, 5,723 acres (41% of the watershed) was never homesteaded and was therefore always in public ownership. Older planning documents in the Arcata Resource Area allude to the removal of tan oak prior to World War II; however, only three BLM timber sales were completed in the watershed. A 77-acre clearcut of 1.2 million board feet (MMBF) was executed one-half mile south of the current Horse Mountain campground in 1966, and a 110-acre clearcut of 1.77 MMBF was completed in 1957 on three forty-acre parcels on Jewett Ridge on the north side of the Bear Creek mainstem. A third sale completed in 1967 of 2.9 MMBF was partially in the Jewett Creek drainage. It included 47 acres of clearcut and 135 acres of selection cut, 90 acres of which was in Jewett Creek. By 1970, management emphasis for the public lands had shifted to recreation and conservation under the King Range Act. The management plan for the King Range "zoned" the NCA, eliminating timber harvest from some zones, and leaving others in the allowable cut computation. Bear Creek watershed remained in the allowable cut computation for Sustained Yield Unit 8 (SYU 8). Further timber sale planning occurred in the watershed, but no sales were completed. Today the original "vacant" lands remain as the major old-growth component of the watershed. Mapping of the original public lands correlate directly with the mapping of current late-successional forest with the exception of approximately 324 acres affected by the sales.

Virtually all the private timberlands in the watershed were logged after World War II (Figure 6). Early logging activity concentrated on the lower watershed mostly along the mainstem of Bear Creek and on low-gradient areas of the upper watershed accessible from the Shelter Cove Road, a pattern similar to the sequence of tan oak harvest in the early 1900's. Subsequent logging moved into steeper portions of the watershed from 1962 through 1983. *Elements of Recovery* (MRC 1989) notes that the majority of this logging occurred between 1962 and 1974. No significant logging occurred after 1983 as most of the accessible private timber had been removed. It is the logging and attendant road development, and profusion of skid trails associated with logging on steep slopes, particularly inner gorges, that remain as persistent sources of sediment into the stream channel. This assessment is corroborated by two independent studies, the *Elements of Recovery* (1989) and watershed inventory data gathered by BLM in 1991 and 1992. Both reports point to stream reaches starting roughly midway between Tolkan and Horse Mountain campgrounds on the South Fork downstream to the confluence with the mainstem. These lands were subsequently acquired by BLM over a ten-year period between 1973 and 1984. The reports also identify inner gorge erosion problems associated with roads on the North Fork from the mainstem upstream to the boundary of the original "vacant" lands where the most extensive late-successional forest in the watershed begins. Long-time resident at the mouth of Bear Creek, Lee French, notes that of the two major floods (1955 and 1964), the 1964 flood was the most damaging. This observation seems consistent with the sequence of logging which by 1964 included the most unstable portions of the watershed. Michael Etter, when interviewed, noted the siltation and

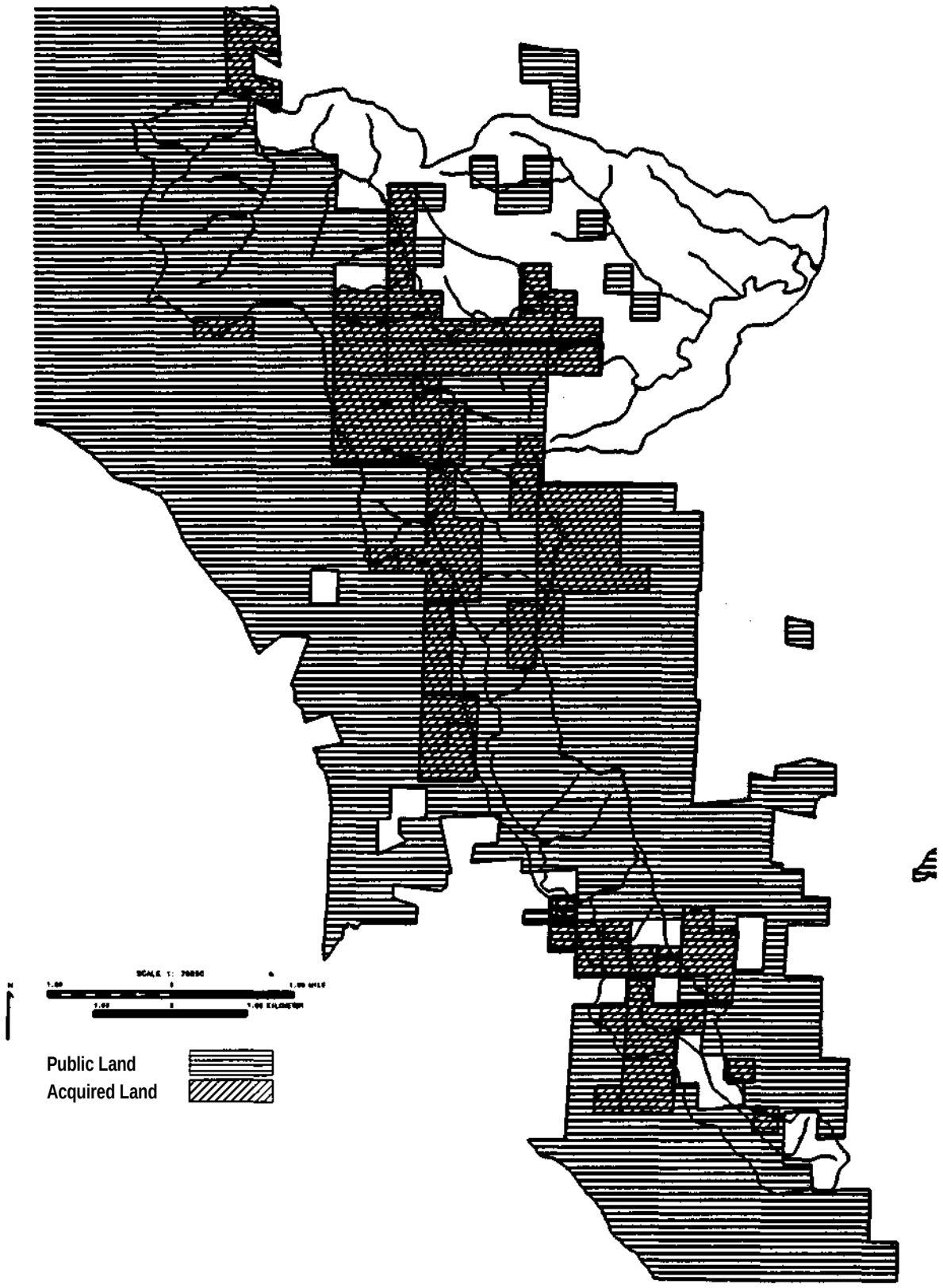


Figure 6 - Lands acquired from private ownership.
(Source: King Range lands files)

deposition from both events and noted further that subsequent floods "chopped out the bank and all the rubble came down". This is consistent with a scenario of the stream beds filling with sediment in the '55 and '64 events, then, flowing across the filled (aggraded) steam channel, nicking active unstable inner gorge areas in new locations and disturbing the angle of repose in a chain reaction of erosion and deposition.

The haul roads, skid trails, stream crossing fills, and slope disturbances associated with logging on steep slopes are an apparent source of major sediment loads to Bear Creek. Many of these were built along and across stream channels. It is noted in both the 1991-1992 BLM inventory and in MRC 1989 that most of the sediment load from these disturbances (*Elements of Recovery* 1989, estimates 80%) has already been delivered to Bear Creek and that much of the remaining road segments have more or less stabilized. Numerous interviews with local residents reference the watershed as "healing" over the past twenty years. Elements of Recovery notes that "over half the disturbances (of all types) investigated (throughout the Mattole) were judged to be past the time of their major contribution of sediment and well advanced in the process of recovery". Field observations support these conclusions but identify numerous sites where significant sediment sources remain. These sources are both chronic and potentially catastrophic sediment producers and are potential sites for restoration activities.

Transportation Network

The King Range National Conservation Area is managed with an emphasis on a variety of recreation uses. These uses, as well as the needs of local residents, are supported by a transportation network of maintained roads. Within Bear Creek watershed there are five arterial gravel roads and one paved road (Shelter Cove Road) which transects the South Fork Bear Creek (Figure 7). A transportation plan was completed in 1986, outlining the use and maintenance of various road network in the King Range NCA.

Kings Peak Road

The Kings Peak Road is a county-maintained gravel road originating at the Shelter Cove Road on the western divide of the watershed. It provides a through route which connects to the Wilder Ridge Road as a second route linking Honeydew and Shelter Cove. It accesses numerous private inholdings, provides recreational access to campgrounds and trailheads, and facilitates fire control. The road extends along the entire length of the watershed. It continues north from the Shelter Cove Road on the western watershed ridgeline for approximately five miles to the junction of the Saddle Mountain Road. Continuing northerly, the Kings Peak Road becomes a mid-slope road, eventually crossing the North Fork Bear Creek and exiting the extreme northern end of the watershed. Kings Peak Road is maintained a minimum of one time per year. The road contains an extensive inboard ditch system, is insloped, and exhibits a nearly continuous outboard berm. This design disrupts the microdrainage network through the entire length of the watershed to some extent, but particularly where the road becomes midslope. The ditches collect and concentrate surface runoff from large upslope areas and from the road, discharging it downslope through the major drainages into Bear Creek. Many of the culverts are "shotgunned" (the downstream culvert end is protruding from the fillslope rather than lying directly in the drainage bottom) and initiate more erosion downslope. As the road runs along the ridgeline the road diverts water that would have drained to the ocean-side of the ridge into the Bear Creek drainage. The modified drainage configuration provides an efficient mechanism for the direct delivery of fine road sediments into Bear Creek. The BLM sediment source inventory for South

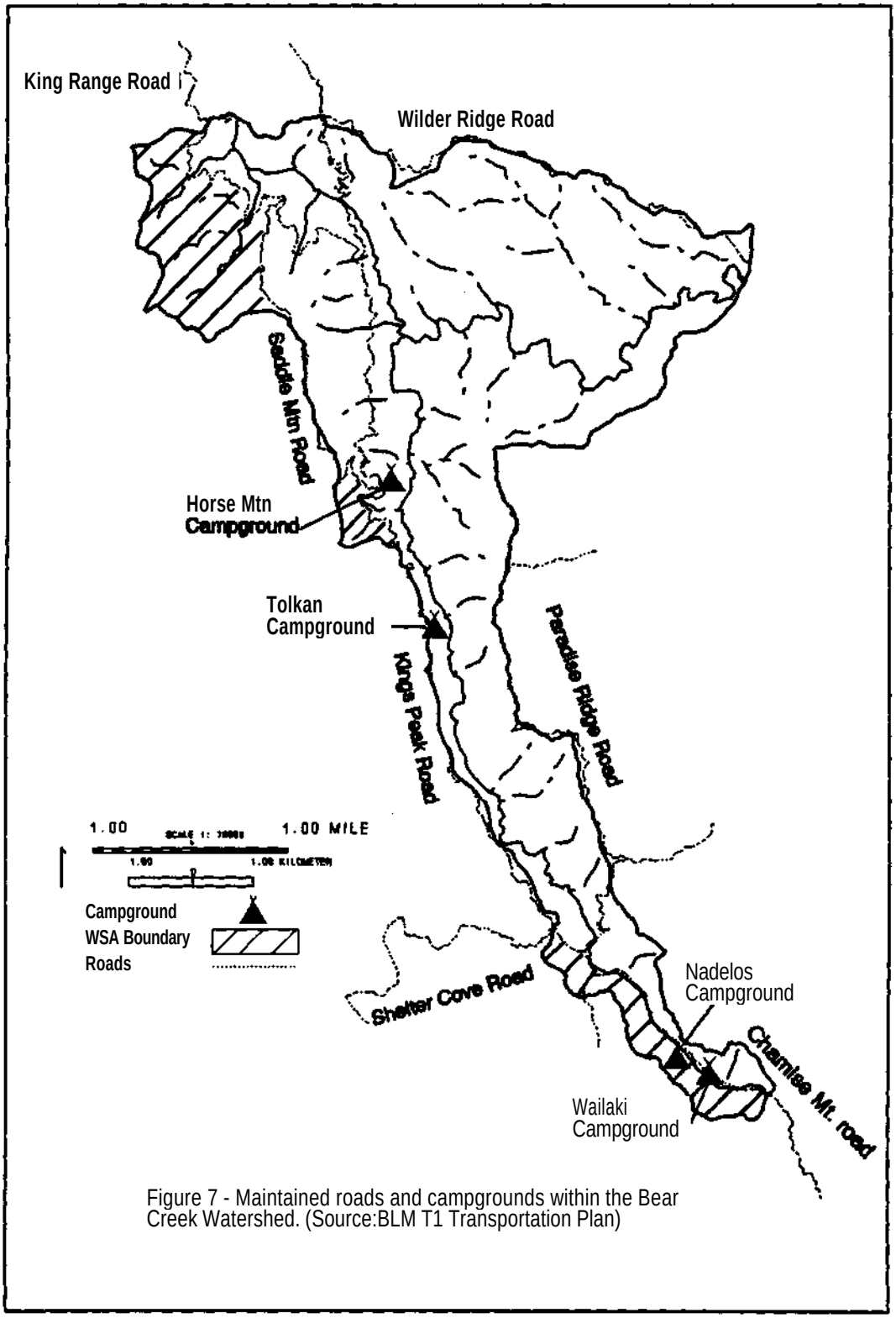


Figure 7 - Maintained roads and campgrounds within the Bear Creek Watershed. (Source:BLM T1 Transportation Plan)

Fork Bear Creek (Horn 1992) contains a conservative fine sediment yield approximation based on erosion of .10 inch of road surface per year. Using the length of the midslope road segment and the average road width, the report estimates a yield of 733 cubic yards per year. The report identifies three major sediment problems with the road:

1. Large quantities of fine sediment are washed off the road by winter rains into inboard ditches and transported directly into the stream channel.
2. Culverts have deteriorated by aging, rusting through, and leaking, causing erosion of the fill beneath the culvert and threatening to wash out the road prism (and stream crossing fill material).
3. Fill materials across unstable soils are failing and in some cases are threatening to enter the stream channel.

Chemise Mountain Road

The Chemise Mountain Road originates at the Shelter Cove Road and continues southeast to exit the upstream end of the watershed. It is the primary access route for numerous upper watershed residents and two BLM developed campgrounds. Upon leaving the watershed the road enters the small community of Whale Gulch and eventually intersects Briceland Road. The entire road is located in or immediately adjacent to the riparian zone of South Fork Bear Creek. The road is maintained by Humboldt County on a schedule similar to Kings Peak Road. Maintenance is reported to include occasional "graveling" of the road with aggregate. The road does not have large amount of fill material associated with stream crossings. The primary impact to the creek is fine sediment delivery. Its proximity to the creek allows the direct introduction of large amounts of fine sediment transported by winter runoff. *Elements of Recovery* (MRC 1989) identifies numerous private driveways as sources of fine sediment as well and recommends paving of the Chemise Mountain Road to help control its contribution of fine sediments. The road was paved as recently as 1972 but now only has one 0.25 mile section of pavement. Numerous private driveways were observed to have undersized culverts and to be in need of cleaning. In some instances the driveways are collecting and discharging runoff directly onto Chemise Mountain Road.

Paradise Ridge Road

This road originates at the Shelter Cove Road and traces the eastern boundary of the South Fork watershed northerly to Paradise Ridge. The road provides access to several private inholdings via improved skid trails which serve as private driveways, and to the Queen's Peak mine site. Current usage beyond the last private inholding is primarily recreational for hunting access, and exploring by vehicle or horseback. The ridgetop road is generally well-outsloped and water-barred and appears to minimally impact surface flows through its length. Near the terminus of the road however, it crosses steep open annual grassland on soils of the Cahto series. These "prairie" soils are loose and fine-grained, with very little resistance to erosion. Horn suggests that these soils are underlain by active or dormant earthflows. Several extensive, active gullies are associated with the road in this area. One large gully system originating at the roadside extends downslope two to three hundred yards and is exacerbated by the presence of an abandoned haul road. It appears that this gully, in particular, is so large and unstable that just the precipitation falling directly into it will generate erosive surface flow and perpetuate the process. Though reduction of surface flows through recontouring, relocation, and closing of the road is a necessary step, it appears that expensive, direct rehabilitation of the erosion features would be necessary. Horn suggests the following treatment scenarios:

1. Revegetation of exposed banks:

Plant native trees and / or shrubs.
Broadcast seeds from native shrubs and / or perennial grasses.
Hydromulch with native perennial shrub and / or grass seeds.

2. Revegetation of entire prairie area:
   Try to replace exotic annual grasses with perennials.
   Plant trees on shadier and damper areas.
3. Re-contour roads and slopes above the gullies to disperse surface flow.
4. Install gully plugs, check dams or other structures in the gully bottoms to trap sediment and stop erosion.
5. Using heavy equipment, fill in gullies. Then establish stable channels wherever surface flow is expected.

Saddle Mountain Road

The road originates from the Kings Peak Road near Horse Mountain Campground and climbs to the top of Horse Mountain Ridge, the western watershed boundary. It receives annual maintenance by BLM. Horn (1992) reported that the road was constructed well with respect to erosion. It generally avoided stream crossings by staying along ridgetops, had no inboard ditch, and was outsloped for much of its length. Years of maintenance have created some ruts and outboard berms near the top of the road, and minor inboard ditch segments exist on the lower end. Generally, the road is a minor sediment source.

King Range Road

The King Range Road is a midslope road originating from the Kings Peak Road in the North Fork Bear Creek drainage. The road was originally envisioned, at the time of its design, as primarily recreation access and as an alternate route from Shelter Cove to Honeydew. The construction was eventually abandoned in the adjacent Honeydew Creek watershed due to steep slopes and incompetent soils encountered during construction. The only current use is for recreational access to a major trailhead 3.5 miles from its terminus. The distal end is scheduled for decommissioning in 1995. The road is annually maintained by BLM and exhibits extensive outboard berms and inboard ditches. There are three major stream crossings with huge fills. It exhibits the same general characteristics as the Kings Peak Road, with inboard ditches, insloping, and outboard berms. The road contains a greater number of inboard ditch "relief culverts" and does not concentrate surface flows to as great an extent. The culverts are receiving winter maintenance and are relatively effective. There has been an attempt in recent years to notch the outboard berms to further relieve the surface flows. This road is potentially a large sediment source if the large crossings fail or if diversions occur.

Shelter Cove Road

The Shelter Cove Road is the paved road connecting Redway with Shelter Cove. It has been a route of travel since before European settlement. Indians apparently used a similar route between the Whitethorn valley and Shelter Cove and it was a major haul road to the tan bark landing at Shelter Cove. The road is paved and transects the one-mile-wide watershed near its south end. It does not appear to contribute sediment to the creek or to be the source of any significant erosion features.

Other Roads

Many abandoned logging roads exist in the logged areas of the watershed and are especially dense in the lower South Fork and lower North Fork. Several of these roads can be accessed from

Kings Peak Road and Paradise Ridge Road. Since these roads are not maintained, they are a potential source of catastrophic failure into the stream network and provide chronically increased levels of fine sediment to the stream channels. Some of these roads, although not officially part of the transportation network provide vehicle and off-highway vehicle access to the public (although this is illegal).

The Queen Peak Mine Road runs from King's Peak Road across South Fork Bear Creek and then up the east side of the creek to the mine site, from there it continues up a steep grade and connects with Paradise Ridge Road. The segment running from Kings Peak Road to the South Fork of Bear Creek was "reclaimed" in 1982 and then re-opened to allow further access to the mine in 1984 (BLM 1985).

A small road segment beginning on Kings Peak Road near Horse Mountain Saddle was "reclaimed" in 1981.

"Homesteading" (Recent Residential Development)

The Bear Creek watershed contains private inholdings which include homesites. Approximately 500 acres of private lands are grouped either side of the Shelter Cove Road in South Fork Bear Creek (the remaining 4,600 acres are public land). Approximately 400 acres are along Chemise Mountain Road in or near the riparian zone of the upper one-third of South Fork Bear Creek. About half of the current residents live on homesteads which have been established since the early 1900's. The other half of the homesteads seem to date from the late 1960's and early 1970's. Homestead development continues to occur along the South Fork with one house currently under construction, and a pond constructed on the flood plain in the summer of 1994. Residents do small-scale gardening and raise domestic animals for their personal use such as goats, cows, horses, chickens, etc. Riparian vegetation is impacted directly by the location of homesites, roads and driveways, corrals, garden plots, and small ponds directly in the riparian zone. Residents use the creek for drinking water in some cases, garden irrigation, and livestock watering, although most homesteads have developed tributary springs to the South Fork for domestic water use.

Observation of some driveways notes a lack of maintenance, diversion of water onto Chemise Mountain Road, and undersized or clogged culverts along the Chemise Mountain road ditch. Residential driveways and riparian land use practices combine with the riparian placement of the Chemise Mountain Road to create a significant chronic source of fine sediment. *Elements of Recovery* (MRC 1989) identified the Chemise Mountain Road, private driveways, and residential land use as major erosion problems, identifying them as priorities for fine sediment control. *Elements of Recovery* recommended the paving of the entire length of the county road, elimination of diversions caused by the road, re-sizing of roadside culverts associated with driveways, education programs for residential driveway maintenance, outsloping, water bars, etc.

North Fork Bear Creek contains approximately 840 acres of private land and 2,400 acres of public land. Because of steep inner gorge morphology, homesites associated with these parcels are located outside the immediate riparian zone, except for the parcel located where the Kings Peak Road crosses the north fork on the recently re-constructed county bridge. Generally, there is less agricultural orientation on these upland parcels. A significant watershed impact of these developments relates to access roads / driveways to the parcels. Many of the driveways are routed along old skid trails on steep terrain. They are maintained, natural surface roads subject

to surface runoff and water diversion. Though no detailed inventory has been completed, some of these residential driveways may be chronic fine sediment contributors to the North Fork of Bear Creek.

The mainstem of Bear Creek is predominantly private land (75%). Approximately 3,720 acres of private land include holdings of larger landowners near the confluence with the Mattole River. These lands are irrigated farming and orchard operations, and / or working livestock operations which were established with the original settlement of the Mattole River valley. These lands were cleared through timber harvest and burning to maintain open grazing lands. Most residential "homesteading" development occurs on the northern watershed divide along the Wilder Ridge Road.

Trends

Given the information known about the stream habitat in Bear Creek, the condition of stream habitat seems to be improving. The large loads of course sediment introduced during the 1955 and 1964 floods have, for the most part, been transported from the drainage. Riparian vegetation is now established and growing. The growth of riparian trees will decrease the amount of direct solar radiation on the water surface of Bear Creek and will result in decreased water temperatures. Large wood is present in stream channels within the South Fork and North Fork, but the future supply of large wood has been diminished because of logging. It will probably take three to four centuries of tree growth in the basin for the supply of large wood to recover to the level that consistently existed prior to logging.

The potential effects of the next large flood to habitat for fish and other aquatic organisms will probably have similar effects to earlier floods, but perhaps with less coarse sediments. A summary of road surveys from 1992 estimates that 80% of the sediment from old logging roads and skid trails has already been yielded to the channels (Horn 1992), so the sediment load from another large flood may be less than previous floods but would likely be significant. Less large wood is available to be recruited into the stream channels, which may slow future recovery habitat quality.

Wildlife Habitat

As stated earlier, many of the reasons for the development of the Northwest Forest Plan were a result of a long standing concern over the viability of wildlife species associated with late-seral or old-growth (LSOG) coniferous forests as their habitat - especially the northern spotted owl and the marbled murrelet. Under the President's Forest Plan, the entire King Range National Conservation Area (KRNCA) is designated a Late Successional Reserve (LSR) in order to protect and restore species associated with LSOG habitat. The role of Bear Creek in this plan is to, over time, grow LSOG habitat and be part of a network of ecosystems for old-growth dependent animals. As stated earlier, most of the land surrounding the KRNCA is private land managed for industrial timber supply or ranching, and thus the KRNCA is a rather isolated patch of a relatively rare suite of habitat types.

The vegetation in the Bear Creek watershed has been altered greatly over the past fifty years due to a change in two important disturbance factors: fire and logging. The role of fire in the vegetative succession in the watershed was described earlier. Suppression of fire for the past several decades has caused an unnatural build-up of fuels within the watershed and stability of some vegetative communities that is highly unlikely under natural fire regimes. The intensive logging that occurred in the watershed during the 1950s and 1960s caused great changes to the natural succession of forests probably unlike any other disturbance ever experienced in this basin. This same change of disturbances occurred almost simultaneously throughout the entire region.

As a result of these relatively recent changes, the habitat available to terrestrial wildlife species has been greatly altered. Because of the long-term stability of LSOG forests, certain wildlife species have evolved to take advantage of this habitat. In evolutionary history, little need has arisen for these species to be highly adaptable to rapid changes in their habitat. Widespread, regional changes in old-growth forest habitat has caused a suite of species, even far ranging species such as birds, to become at risk of extinction. Although much information necessary for a full analysis of all wildlife species in the Bear Creek watershed is lacking, an analysis of available information, with special reference to northern spotted owls and marbled murrelets was completed.

As stated earlier, anthropogenic burning by both indigenous people and European settlers occurred within the watershed. With no precise records of fire occurrence and causes prior to the late 1950s and only anecdotal information on the impacts of the tan bark industry, it is difficult to form a picture of the natural vegetative patterns in the Bear Creek watershed. However, a comprehensive and detailed inventory of soil and vegetative resources was conducted in 1952 by the U.S. Department of Agriculture, USFS, Pacific Southwest Forest and Range Experiment Station. This earliest vegetative mapping effort, using 1948 aerial photography, indicates that 56% of the Bear Creek watershed was in late seral or old-growth stages at that time with about 22% of the land capable of growing forests vegetated in lower seral forest or non-forest types. Only 80 acres had been converted to cultivated land (orchards and pastures).

Considerable interest and debate has centered around the original and current occurrence and distribution of LSOG forests and their natural range of variability. Concern is also centered around their ability to provide for the processes and functions inherent to the systems and still allow for a wide range of land uses. The 1948 inventory indicates that over 6,700 acres of LSOG

occurred in the watershed at that time. This acreage was contained in seven stands that ranged in size from 35 to 3168 acres. The north lobe of the watershed (Figure 8) made up of the North Fork, the main Bear Creek and a small part of the South Fork of Bear Creek comprised two large interconnected stands of LSOG that covered 40 percent of the watershed and comprised 87 percent of the LSOG in the watershed. The long narrow south lobe of the Bear Creek watershed contained 358 acres of LSOG in five stands. The stands, generally confined to the drainage bottom and north slopes, were very irregularly shaped. The mixed-evergreen forest still dominates the Bear Creek watershed with chaparral, coastal prairie "balds", and cultivated land making up a minor component. However, amount and distribution of plant assemblages, and seral stages currently occur in response to past land-use practices and natural disturbances.

Current vegetation type mapping has come from forest Timber Production Capability Classification (TPCC) and operations inventories of the early 1980's and have been interpreted and combined to produce a "Wildlife Habitat Relationships" organization and display of current forest vegetation in the Bear Creek watershed. These data are summarized into seral stages by the following:

Seral Stage	Acres	Percent
Mature conifer / hardwood >24"	2,135	17
Young confier / hardwood 11 - 24"	2,077	15
Early seral <11"	2,571	19
Brush or non-forest	1,722	12
Private	5,050	37
TOTAL	13,820	

Current inventories indicate that approximately 2135 acres of LSOG are present and are highly fragmented into 21 stands in the watershed. As illustrated by Figure 9, the north lobe of the watershed contains only three sites with significant size stands of 142, 735 and 368 acres, respectively, and they are very fragmented. Approximately 1324 acres of LSOG occur in the north lobe altogether. In the south lobe, approximately 300 acres evolved from a mid-seral stand to late-seral between 1948 and the 1980s. The largest stands at this time are 737, 368, and 300 acres in size. These changes represent a net 68% reduction on LSOG forest and a 300% increase in the number of stands in the watershed. The 2135 acres of LSOG in the watershed represent roughly 40% of the LSOG in the KRNCA Late-Seral Reserve and most of the LSOG in the Mattole River basin. Old-growth trees have generally been harvested in the entire Mattole basin, except for public lands and a few small residual stands on private land widely scattered throughout the watershed. The last timber harvest on BLM land was in 1972.

Dense mid-seral stage tan oak-madrone communities occur throughout the watershed. Approximately 2,850 acres of the tan oak-madrone stands now occur in the watershed. A total

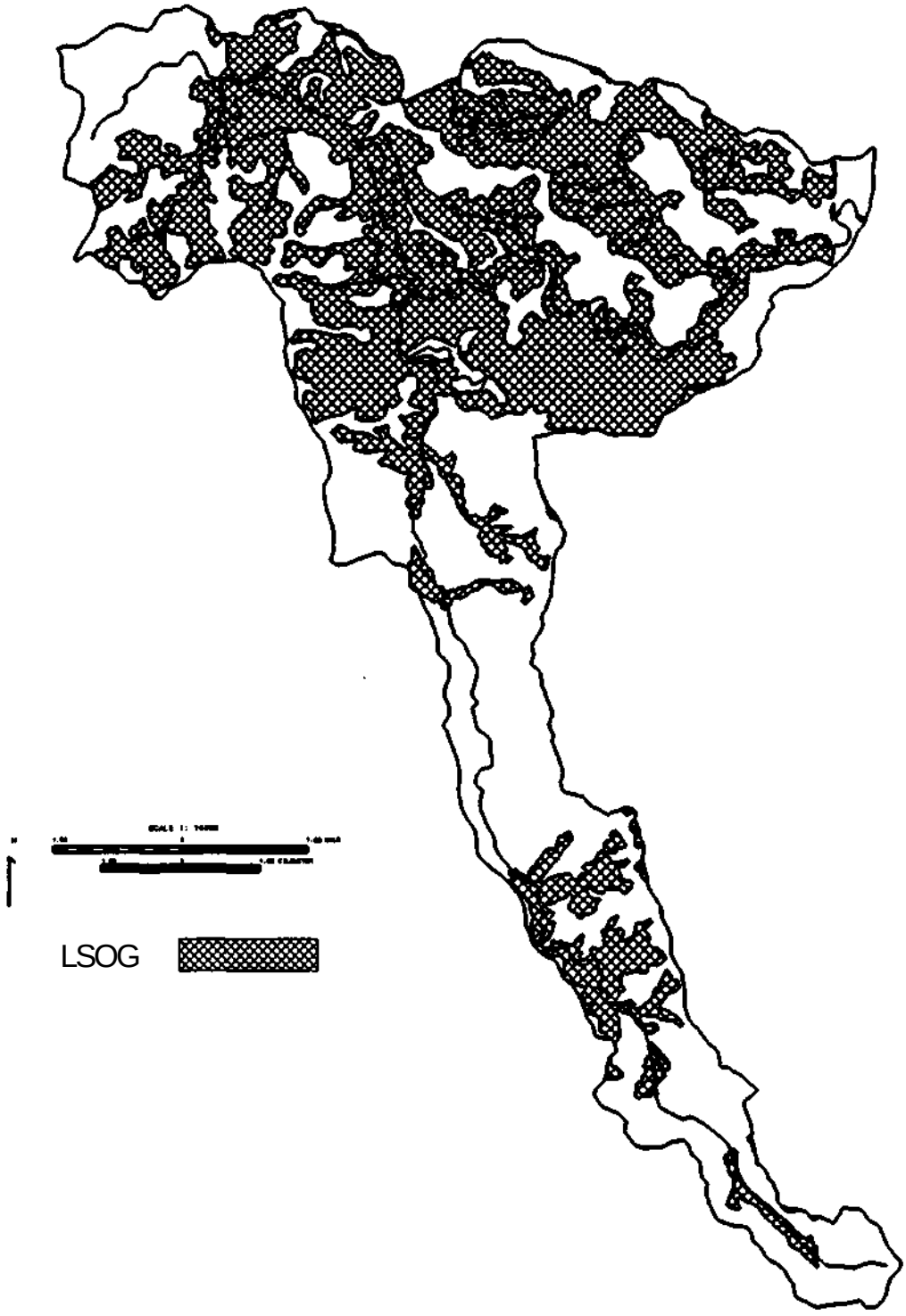


Figure 8 - Late-Successional / Old-Growth forests 1948
(Source: USFS - CDF 1948 timber stand evaluation)

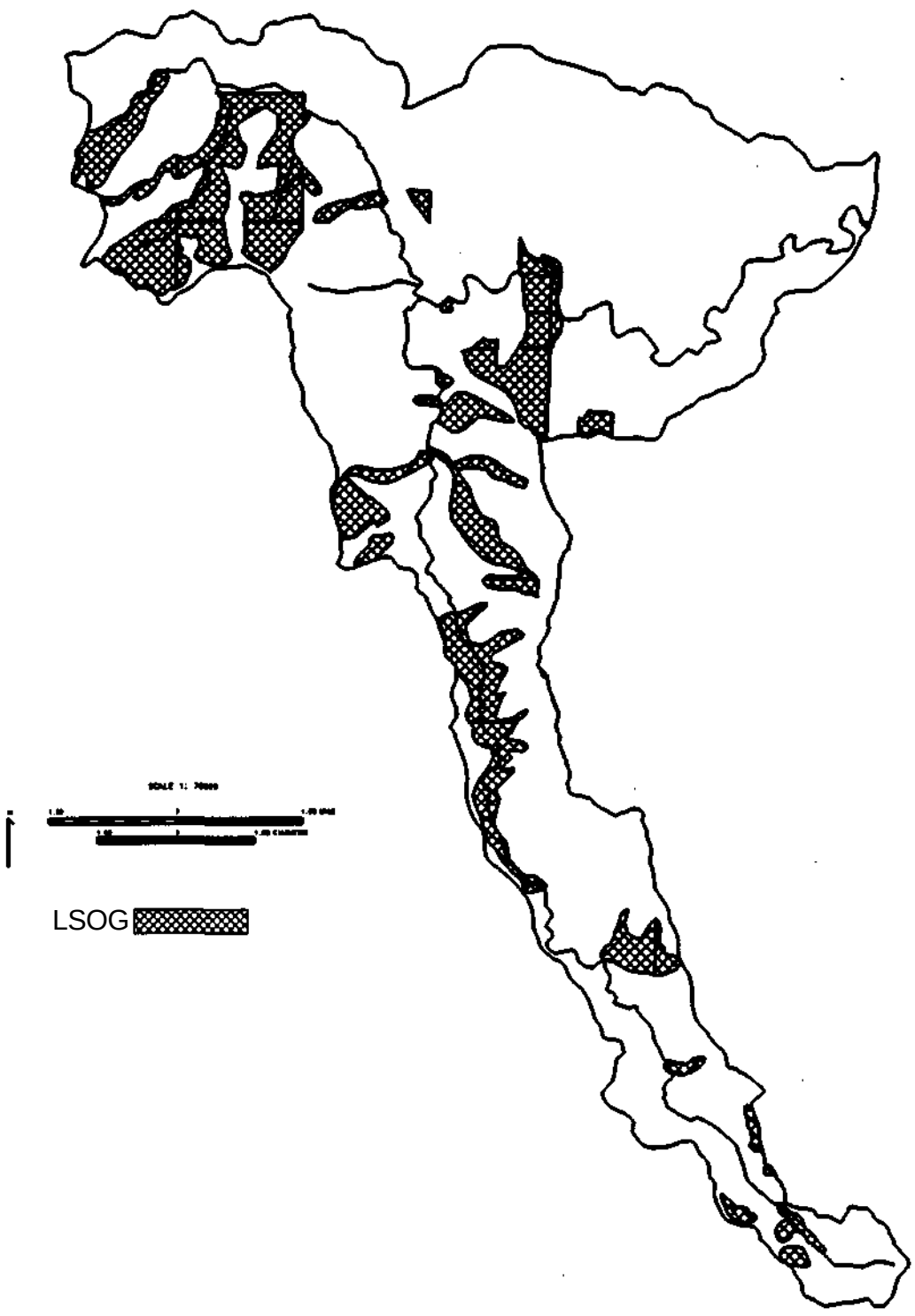


Figure 9 - Late-Successional / Old-Growth forests 1992
(Source: BLM WHR records)

of 380 acres of sapling hardwoods stands (1-6" diameter) and 2470 acres of pole size hardwood stands (6-11" diameter) occur in the Bear Creek watershed. Most of these stands are on ridge tops, south or west slopes and have burned naturally on a periodic basis prior to active fire suppression. The tan oak and madrone sprout after fires and grow rapidly, getting the jump on the Douglas-fir that must generate from seed so there are few if any Douglas-firs in the stands.

Other tan oak-madrone stands are on more productive sites where human-caused fire or timber harvest has impaired the natural successional processes of the stands and removed or suppressed the conifer component. A total of 906 acres of 60-100% canopy closure, 11-24" diameter hardwood stands that have not been logged occur in the Bear Creek watershed. A total of 813 acres of 40-60% canopy closure 11-24" diameter hardwood stands occur where the timber on the private and previously private BLM land was extracted in a manner that left many hardwoods and a few cull conifers standing (Figure 10). These sites that were previously private land were not planted with Douglas-fir after logging.

Approximately 15% of the watershed is composed of chaparral and grassland soils. Acreage of chaparral types have remained stable at about 1150 acres, however average height of manzanita has increased from 2 feet to almost 6 feet. Douglas-firs has slowly started to invade chaparral stands on some sites because of the absence of fire.

Coastal prairie "balds", on public land, vegetated with grasses and bracken fern have decreased approximately 40% since 1948. Absence of fire has allowed Douglas-fir and hardwoods to establish in these sites.

Three nesting pairs of the threatened northern spotted owls are known to occur in the Bear Creek watershed. They represent one-half of the known pairs in the KRNCA. Approximately 3850 acres of suitable owl nesting / roosting habitat occur in the watershed.

Approximately 1125 acres of marginally suitable nesting habitat for the marbled murrelet, also a threatened species, occurs in the watershed. Surveys on 300 acres in the watershed have not revealed the occurrence of the bird with one year of the two-year protocol completed.

The northern bald eagle and the peregrine falcon are federally listed endangered species that have been observed in the watershed, but nesting activity has not been documented. The western pond turtle and the Pacific fisher are two candidates for federal listing and have been observed in the watershed by casual observers (resident interviews), but for which there is no inventory data. Other species of concern that are known or suspected occur in the Bear Creek watershed are the southern torrent salamander, tailed frog, red tree vole, goshawk, and pileated woodpecker.

At the current time many areas logged in the 1960's and 1970's in the Bear Creek watershed and in the Mattole basin, in general, have grown back to tall shrub, pole or young saw timber stages of vegetation. Many recently logged sites on private lands are being managed on a fast rotation basis and have been treated with herbicides. The results have been a slow but steady decrease in deer populations, which are still being harvested, from the peak numbers of the 1960's.

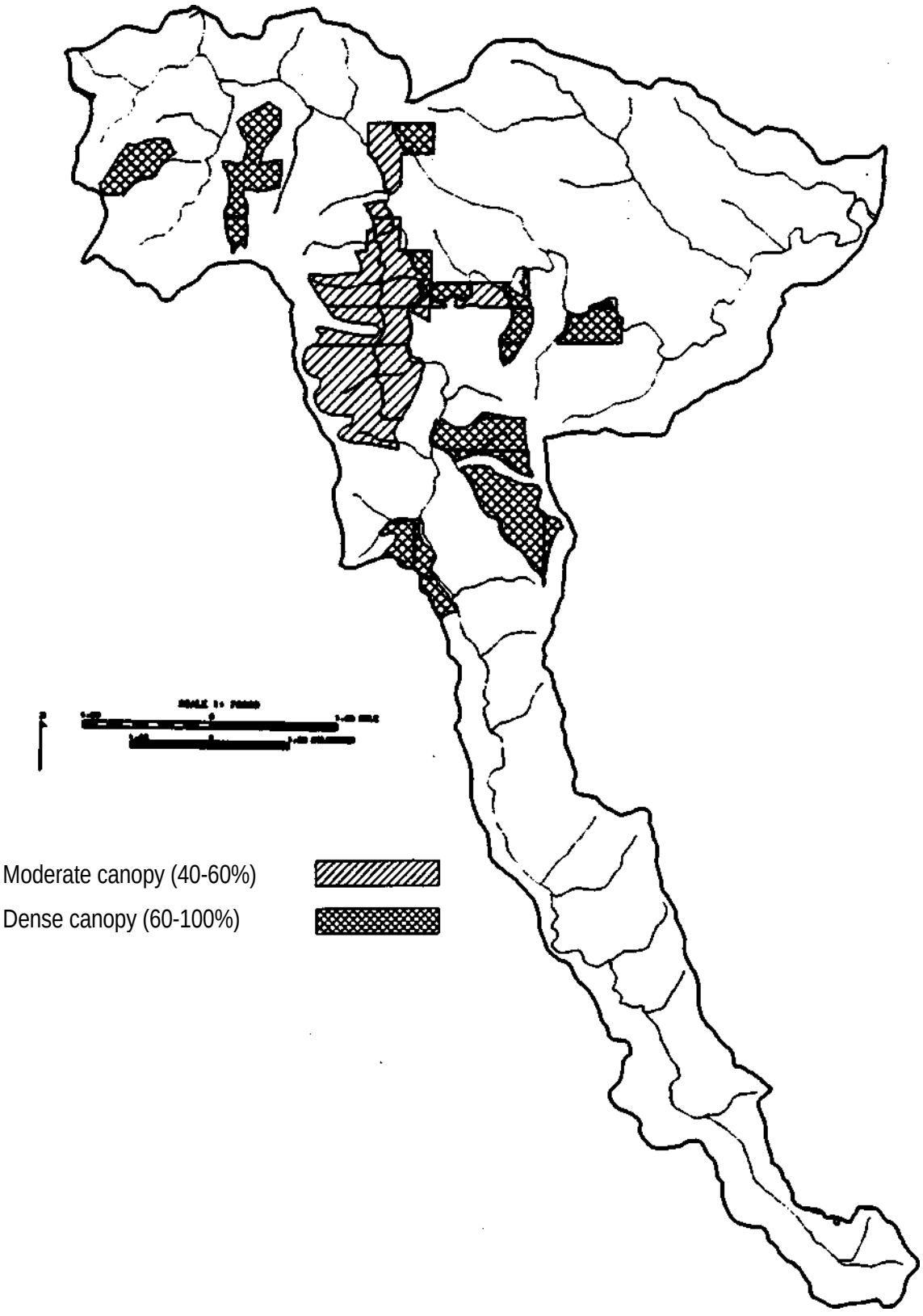


Figure 10 - Mature hardwood timber stands within the Bear Creek Watershed 1992. (Source: BLM WHR files)

Systematic inventories for wildlife species occurrence or distribution have not been conducted in the Bear Creek watershed. Except for the northern spotted owl and the marbled murrelet, wildlife information is anecdotal, or extrapolated from suitable habitat existing in the Bear Creek watershed. As mentioned previously, vegetative inventories for the area have been completed, however, some specific stand characteristics, such as snag and down wood conditions, were not recorded. These and other missing data sets make it impossible to predict wildlife species occurrence and distribution from existing vegetative inventories.

Fragmentation of LSOG stands, as described above, exists in the watershed at this time. Connectivity between stands is poor, and connectivity outside of the watershed is poor except to the north within the KRNCA. However, in the larger context, the LSOG in the Bear Creek watershed along with the adjacent Honeydew Creek watershed, is the second largest aggregation of old-growth lowland mixed evergreen forest in northwestern California.

Other species of wildlife that are currently hunted in the watershed are gray squirrel, black bear, California quail, blue grouse, band-tailed pigeon, and feral pig. Roosevelt elk have been reestablished in the area and use small parts of the Bear Creek watershed but have not been hunted. Furbearing mammals which are trapped include mink, raccoon, gray fox, bobcat and coyote. Hunting and trapping provide recreation, food and incidental income for many watershed residents and visitors. The Bear Creek watershed and the remainder of the KRNCA is a 56,000 acre island of land open to public hunting in a sea of private and state park land that is closed to public hunting. However, based on the number of licenses and tags sold in Humboldt County, demand for hunting is static or somewhat down, and trapping is decreasing with little flurries of activity when fur prices are high (H.Pierce, pers. comm.). The overriding hunter interests in the area center around maintaining and increasing deer and other game hunting opportunity. In addition many hunters voice their desire for decreased vehicle access to improve quality of hunting experience. The policy of the California Department of Fish and Game is to endorse management of natural occurring communities on a sustainable basis so that it will ensure the viability of all wildlife species and not enhance the habitat of one species to the point of endangering the viability of another.

Trends

The past 30 years of fire suppression has had the effect of causing a build-up of large amounts of unburned dead vegetative material. At present there is a potential for a large intense wildfire. The trend is for this fuel buildup to continue unless prescriptive burning in areas of fuel build-up occurs.

No commercial timber harvest on BLM land will occur in the foreseeable future. The reason for this is because the public lands in the watershed are designated as northern spotted owl critical habitat, proposed marbled murrelet critical habitat, and are part of a Late-Seral Reserve in the President's Forest Plan. Standards and guidelines of these designations prohibit timber harvest that would not serve to improve habitat for the two species or further the perpetuation of old-growth forest ecosystems. The LSOG stands will probably evolve slowly into full multi-layered old-growth stands with a compliment of snags and down woody material. The largest trees will probably develop more open crowns with portions that are dead. Crown bases of old trees will be high above the forest floor and tree bark will be relatively thick, creating a resistance to low and moderated intensity fires. There will also probably be an excess build-up of heavy fuels in

the understory; however, the cool humid micro-climate provided by the old stands will probably keep fuel moistures relatively high and fire hazard low. Logging on adjacent private lands is likely to continue as previously logged stands reach a commercially valuable size.

In the mid-seral tanoak and madrone the trend for these stands will probably be for them to start to grow much more slowly because of the competition between the densely packed trees. Conifers are not expected to come into these stands. Without treatment, fuel loading will continue in these stands, and the chance of an intense lightning-caused wildfire becomes greater as the years go by.

In the logged Douglas-fir stands that are now dominated by hardwoods, the trend is that these areas are now developing into multi-layered stands with a mixture of young tanoak, madrone, and Douglas-fir coming up in a legacy of scattered old Douglas-firs and hardwood. The BLM timber sale area is coming back to a mixture of hardwoods with a heavily stocked Douglas-fir component that was planted after harvest. These harvested stands are in close proximity to LSOG stands currently intact. With some thinning to release conifers and prescribed burning to reduce fuel loading, the 813 acres can become a large block of forest with many late-seral characteristics in the next 50 years. Opening the hardwood canopy on areas of the 906 acres of tan oak-madrone stands by emulating small natural disturbances (such as wind throw and small lightning strikes) and planting Douglas-firs would add a conifer component to stands that would eventually increase connectivity and decrease fragmentation in six of the LSOG stands present. It could also add about 900 acres of late seral mixed-evergreen habitat to the watershed in the next 150 years.

In the chaparral and grasslands, fuel loading on the brushlands will continue and a fire started on this hot dry site would probably be of high intensity and difficult to control before it burned some of the remaining LSOG in the immediate vicinity. Prescribed burning under the right prescription would decrease this hazard.

Northern spotted owl nesting/roosting habitat and potential habitat for the marbled murrelet would tend to increase in the watershed in the future. Without silvicultural and fuel reduction treatments, habitats will develop suitable characteristics over a much longer period of time and be at risk of catastrophic fire. Spotted owl populations will probably increase in the watershed and in the KRNCA. Predictions of population viability and whether management of this watershed will meet the objectives of the draft spotted owl recovery plan or the President's Forest Plan will have to be made at a larger scale than the Bear Creek watershed (e.g. basin scale). Until marbled murrelets are detected in the King Range it is academic whether habitat will be used by them.

Small relatively immobile forest dwelling species that require LSOG forest characteristics for all or part of their life cycles would be expected to have their vulnerability to stochastic events decreased and their populations increased as LSOG stand characteristics develop in the areas as stated above. The time period of habitat development and chances of catastrophic events would be the same for the spotted owl as stated above.

Medium to large mobile species that utilize large home ranges and depend on LSOG forests for much of their habitat, such as fishers, will probably not benefit appreciably from the vegetative trends in the Bear Creek watershed. The Bear Creek watershed may, however, contribute a small

part of the habitat required for populations of this type of species.

Populations of species requiring lower seral stages of vegetation, such as deer, rabbits, and quail will probably experience some decrease in population due to the decreased quality of about 4,000 acres of mid-seral hardwoods. This could be mitigated to some extent by treating the 1100 plus acres of chaparral with prescribed burning.

Anadromous Fish

Bear Creek is the third largest tributary to the Mattole River, with measured summer flows near five cubic feet per second (cfs) in the mainstem (as noted in CDF&G surveys from 1972-73). Bear Creek supports populations of steelhead (*Onchorynchus mykiss*), chinook salmon (*O. tshawytscha*), and coho salmon (*O. kisutch*), Pacific lamprey (*Lampreta tridenta*), and three-spine stickleback. Very little data exists on the habitat conditions and fish populations of Bear Creek both historically and recently. More information is available for the South Fork than the North Fork.

Both the Mattole River and Bear Creek are said to have had large runs of salmon and steelhead. Local residents unanimously state that the number of salmon and steelhead returning to Bear Creek has drastically declined in the past several decades. Long time watershed residents state that the stream morphology has changed dramatically over the past thirty years. Unlike other major salmon-producing rivers in northern California, the Mattole River has never been subjected to hydraulic mining (as the Trinity, Klamath, and Smith), large canneries operating at the mouth (like the Eel, Klamath, and Smith), dams (like the Klamath, Trinity, Mad, Eel, and Russian), or large-scale hatcheries (like the Klamath, Trinity, Mad, Eel, and Russian). In the Mattole, the causes for large scale changes in stream morphology and fish populations are solely a result of logging, roads, grazing, fire, and the floods which mobilized the upslope material disturbed by these activities.

Bear Creek provides approximately 19.5 miles of spawning and rearing habitat for salmon and steelhead (Figure 11). This is a significant portion of the total tributary habitat for anadromous salmonids in the Mattole Basin.

Habitat

Little is known of the historic aquatic habitat conditions in Bear Creek. The morphology of stream channels, which determines the quantity and quality of aquatic habitat, is quite dynamic and is dependent on the processes operating in the watershed. In Bear Creek, abundant, and sometimes intense, seasonal rainfall on steep, unstable slopes leads to frequent high streamflows, erosion, and mass wasting. The habitat for aquatic organisms in streams operating under these processes is greatly influenced by in-channel structure such as large wood, boulders, and bedrock outcrops. Deep forest soils, capable of producing large Douglas-fir, are located on lower slopes near stream channels. The presence of these soils, along with a general lack of stand-replacing fires along channels, tend to create consistent conditions for production of large Douglas-fir trees near most perennial or moist channels in the watershed. Prior to post-World War II logging the presence of these large conifers would have provided a continuous supply of large wood into the channels.

These large pieces of wood are routed through the channels by the forces of high streamflow. The largest pieces of wood will remain in one location for several decades and can have a significant

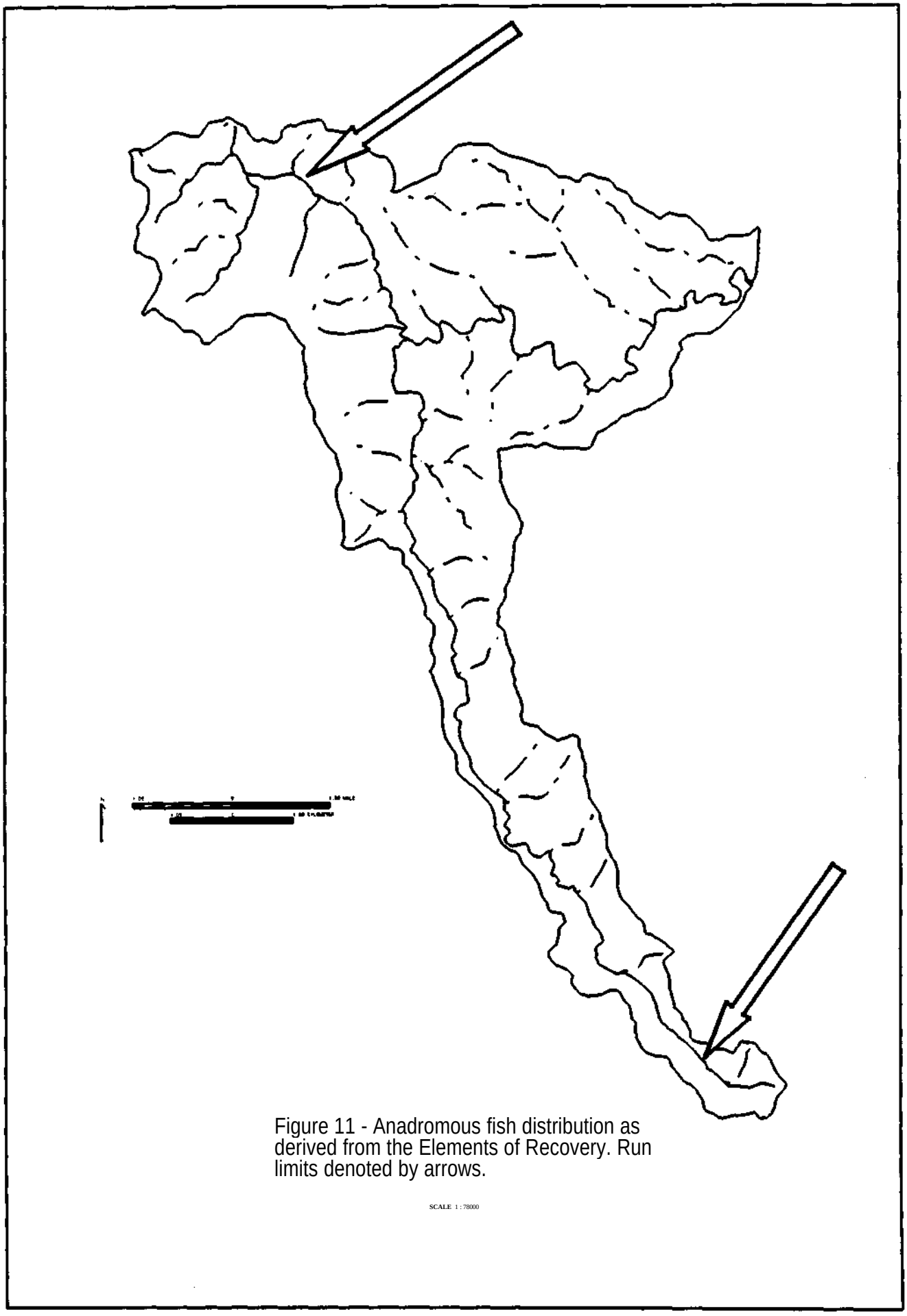


Figure 11 - Anadromous fish distribution as derived from the Elements of Recovery. Run limits denoted by arrows.

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influence on the local morphology of the stream channel. It is well known that large wood is a key component to providing complex habitat for fishes and other aquatic species.

Frequent flooding in the watershed periodically scoured bars and floodplains which would have led to stands of red alders along floodplains and bars. Given the erosiveness and steepness of the watershed, mass wasting events occurred during winter storms contributing a mix of course and fine sediments into the stream channels. Overall, the historic habitat for anadromous fishes and other aquatic species was probably consistently of good quality. It is likely that Bear Creek experienced periods of poor habitat quality when combinations of fire, floods, and large-scale mass wasting events introduced mass quantities of sediment into the channels. Under historic hydrologic conditions (an absence of compacted soil and road-related water diversions) and large wood supply, it is likely that such periods of poor habitat quality were local and relatively brief.

The lower mainstem of Bear Creek, including Jewett and French Creeks, most likely experienced the first impacts of human settlement in the watershed from the livestock operations in the area beginning in the 1890s when Ettersburg was settled. The largest impacts to aquatic habitat occurred after intense logging and road building in the 1950s and 1960s along with the 1955 and 1964 floods. No stream surveys were conducted in Bear Creek prior to logging and floods, however, long-time watershed residents have provided their observations on the flood. Michael Etter stated that the 1955 flood transported a large quantity of silt to the lower mainstem. Opinions differed regarding the 1964 flood. Lee French reported the 1964 flood as "more damaging" than the 1955 flood while another long time watershed resident stated that the 1964 flood was "quick" in Bear Creek and had little impact. Although some disagreement about the flood exists, almost all residents observed that Bear Creek was noticeably different following intense logging and floods.

Stream surveys were completed in the summers of 1966, 1972, and 1982 by the California Department of Fish and Game. The BLM completed a stream survey in the winter and summer of 1972. These surveys all reported abundant good quality spawning gravel. Deep pools of three to four foot depths were reported as relatively common, with the largest pools found in the gorge area of the mainstem. The section of the lower South Fork which was logged to the streambanks has had pools filled with sediment and a lack of pools according to the 1982 survey.

The 1982 survey reports a lack of riparian canopy in the South Fork in the logged section. *Elements of Recovery* (MRC 1989) states that much of the riparian zone in the South Fork was burned in the 1973 Big Finley Fire.

Large wood is less abundant in the North Fork than in other surveyed areas. The 1966 survey of the North Fork reports 37 "log jams" ranging in size from 225 to 20,000 cubic feet and totalling 62,975 cubic feet. The 1972 North Fork survey states "The North Fork suffers from the effects of logging - in the aspect of log jams, debris, and siltation". The 1966 survey of the South Fork reports 38 "log jams" upstream of Shelter Cove Road ranging in size from 100 to 1000 cubic yards and totalling 87,500 cubic yards. This section is mostly an alluvial valley and these this large wood helps to provide quality fish habitat. It is likely that much of the woody material present in the channels in these surveys was slash due to recent logging activity.

The California Conservation Corps (CCC) are reported to have modified log jams beginning in

1981 to facilitate fish passage (MRC 1989, BLM 1985, G.Flosi, pers. comm.). It is reported that approximately 5 miles of spawning habitat in the South Fork that had been blocked to anadromous salmonids were opened up with the modifications of these log jams. The mainstem surveys report few log jams and some occurrences of "logging debris". From the available information, it seems as though Bear Creek contains less large wood in the main stream channels than likely existed prior to 1950. Less large wood is currently available for recruitment into the channels now because of extensive logging both upslope and streamside. The CCC also planted approximately 15,000 red alder and stabilized over 1000 feet of bank between 1983 and 1986 (G.Flosi, pers. comm., BLM 1985).

Fine sediment which enters the stream through runoff from the numerous roads impairs successful reproduction of salmonids. Salmonids deposit their eggs in gravel nests (called redds) that they construct at locations where an adequate amount of water will filter through the nest to bring oxygen to the incubating eggs while removing waste material. Chinook salmon spawn during the late-fall while coho salmon and steelhead spawn during the winter. It is during these months, while the salmonid eggs are incubating, that winter storms cause erosion of fine sediments on areas of bare soil and road surfaces which are carried into the stream. These fine sediments tend to collect in the interstices of the salmonid nests and diminish the water flowing through the nest. If water flow through the nest is not adequate, the incubating eggs will experience increased mortality. Chemise Mountain Road, which runs next to the South Fork for 2.5 miles, introduces large amounts of fine sediments directly to a known spawning area.

Water temperature is one of the most important abiotic factors for fish and other aquatic organisms. For anadromous salmonids, temperatures exceeding 79 F are considered lethal. A water temperature of 79 F was measured on Aug. 11, 1972 in the mainstem and reported in the 1972 BLM survey. Temperatures exceeding 68 F are considered stressful to fish. Several water temperatures exceeding 70 F have been reported for the mainstem. The 1982 survey of the South Fork reports a measurement of 75 F in the logged section. High water temperatures are most likely reducing the survival of anadromous fishes and other aquatic organisms that depend on cool water for survival. Elevated water temperatures from Bear Creek enter the Mattole River and contribute to the elevated water temperatures in the Mattole River.

Fish

Electrofishing surveys were conducted in 1978, 1988-93 in South Fork; and 1978, and 1988-1990 in the North Fork by the California Department of Fish and Game. Densities of steelhead found in Bear Creek are comparable to densities found in similar drainages (Table 2).

Some surveys of spawning have been conducted by the Bear Creek Watershed Association and the Mattole Watershed Salmon Support Group. In 1979, 100 steelhead were estimated to have spawned in South Fork Bear Creek. No other estimates of spawning were found in California Department of Fish and Game files.

Bear Creek was stocked with steelhead and rainbow trout from 1930 to 1935 (Table 3). Both Bear Creek and "Middle Bear Creek" were reported to be stocked. The only stocking of rainbow trout occurred in 1933 when 7,500 were stocked in the "upper" section of Bear Creek. The *Elements of Recovery* (MRC 1989) reports that the California Department of Fish and Game planted a large number of juvenile steelhead into the South Fork around 1979. In 1982 a chinook salmon

hatchbox program was initiated by the Bear Creek Watershed Association and the Mattole Watershed Salmon Support Group, in cooperation with the California Department of Fish and Game, on the South Fork (Table 4). In 1987, a hatchbox facility for coho was initiated The intent of both these hatchbox facilities was not to greatly increase the population of salmon but to help avoid the extinction of native Bear Creek salmon.

Table 2. Density (fish / m2) of steelhead captured by electrofishing in the North Fork and South Fork of Bear Creek, tributary to Mattole River, Humboldt County, California, 1988-1993.

Year	South Fork	North Fork
1988	0.53	0.22
1989	1.81	0.33
1990	0.33	0.15
1991	0.08	not surveyed
1992	0.79	not surveyed

Table 3. Number of juvenile steelhead stocked into Bear Creek and "Middle Bear" Creek, tributary to Mattole River, Humboldt County, California, 1930-36.

Year	Bear Creek	"Middle" Bear Creek
1930	25,000	not stocked
1933	15,000	not stocked
1934	10,000	20,000
1935	25,000	25,000
1936	10,600	not stocked

Table 4. Number, size, release date, and release location of juvenile chinook and coho salmon raised in rearing facilities by the Mattole Watershed Salmon Support Group and released into the Bear Creek drainage, 1982-94. "Solitude" rearing facility is located on the South Fork, "Oliver Gap" is located on South Fork, "Arcanum" is located near the headwaters of the Mattole River, Mill Creek is located near the mouth of the Mattole close to the town of Petrolia (Source: Gary Peterson, Mattole Watershed Salmon Support Group).

Season	Rearing Facility	Release Date	Species	Number	Size	Release Location
1982-3	Solitude	4/13/83	Chinook	6,300	568/lb	on site
1983-4	Solitude	4/29/84	Chinook	6,150	393/lb	on site
1984-5	Arcanum	4/17/85	Chinook	2,200	680/lb	near Shelter Cove Rd
1986-7	Solitude	5/6/87	Chinook	11,300	350/lb	South Fork
1987-8	Oliver Gap	5/6/88	Coho	8,500	270/lb	North Fork
1987-8	Solitude	5/17/88	Chinook	14,000	255/lb	near Ettersburg
1988-9	Solitude	5/7/89	Chinook	10,000	190/lb	South Fork
1988-9	Oliver Gap	5/18/89	Coho	4,400	210/lb	North Fork
1990-1	Solitude	6/19/91	Coho	2,500	140/lb	on site
1990-1	Solitude	6/19/91	Coho	3,500	140/lb	North Fork
1990-1	Solitude	3/15/92	Coho	1,000	16/lb	on site
1991-2	Solitude	10/31/92	Chinook	3,600	26/lb	on site
1991-2	Solitude	12/7/92	Chinook	7,600	23/lb	on site
1991-2	Mill Creek	12/7/92	Chinook	5,700	19/lb	Ettersburg
1992-3	Solitude	11/29/93	Chinook	4,600	24/lb	on site
1992-3	Solitude	12/10/93	Chinook	2,750	23/lb	on site
1992-3	Solitude	12/12/93	Chinook	4,050	23/lb	on site
1993-4	Arcanum	7/12/94	Coho	600	125/lb	South Fork
1993-4	Solitude	?	Chinook	6,000	17/lb	?

No estimates of total fish populations have been conducted. The only source of information on population trends for anadromous salmonids comes from interviews with long time watershed residents. Both Michael Etter and Lee French report seeing 50 to 60 fish per pool. Lee French stated: "The riffles were full of spawners." Lee French also stated that between 1930 and 1935 when he forded the stream he could walk across fish. All long time residents state that fish are much less abundant than thirty years ago. Tim Day, a resident of the South Fork, who conducts fish counts for the Mattole Watershed Salmon Support Group reports that

he observed 54 fish upstream of Shelter Cove Road in 1985 but hasn't seen a fish since 1991.

Other Aquatic Organisms

In 1994, the US Forest Service Pacific Southwest Research Station in conjuction with BLM and the Mattole Restoration Council conducted surveys for amphibians and reptiles in tributaries to North Fork Bear Creek and other small tributaries in the Mattole Basin. The results of this survey as well as amphibians and reptiles that potentially live in the basin are reported in Appendix B.

Trends

The information available shows that habitat for fish and other aquatic species is recovering from the relatively recent floods and fire, much like many of the streams throughout northwestern California. Riparian vegetation is becoming well established which should help to reduce water temperatures in coming years. Since so many large trees were removed from the watershed, especially along stream courses, the amount of large wood in stream channels will likely not return to pre-1950s levels for three to four centuries unless intensive management can speed these processes along.

Anadromous fish populations throughout the entire Pacific Northwest are at such low levels that recovery to pre-1950 levels may take several decades or more. Current fish propagation should help keep the native stocks from extinction until such time that natural population levels increase.

Water Quality

Water from Bear Creek is utilized for several beneficial uses: domestic uses such as drinking water, cooking, bathing and washing, irrigating domestic gardens, and watering livestock. Several homesteads have constructed small dams to create ponds on tributaries, specifically on tributaries to the upper South Fork; one individual constructed a pond in the flood plain adjacent to upper South Fork in the summer of 1994, apparently for stock watering purposes.

In addition to domestic uses, at least two property owners on the mainstem of Bear Creek near Ettersburg pump directly out of the creek for agricultural purposes. Michael Etter estimates that he pumps 500,000 gallons per irrigation season from the mainstem for irrigation of his chestnut orchards as well for the rest of his agricultural operation; Lee French also pumps an unknown volume of water for irrigation of his irrigated pasture (Appendix A). Stream survey notes from the 1960's note in-stream gravel dams constructed near the mouth of Bear Creek from which irrigation water was being pumped for agricultural uses. We are not aware if this practice still occurs.

Most homesteads obtain their domestic water supplies from developed tributary springs within the watershed, although some residents pump directly from Bear Creek. An additional use of water from the Bear Creek watershed is for support of the Salmon hatchbox program; at least one resident of the upper South Fork utilizes spring water from private property to support the hatchbox, and to fill and maintain a constant turnover of fresh water in the rearing pond (a large, above-ground doughboy-type swimming pool) year around. One other Salmon hatchbox was active in the South Fork watershed in previous years but it has not been active for the past two or three years.

Water quality parameters considered in this analysis, and for which data in varying quantities and qualities are available are: water temperature, turbidity, quantity, fecal and total coliform bacteria, and parameters such as hardness, alkalinity, dissolved oxygen, etc. Data sources for these parameters are from various surveys conducted by BLM and California Department of Fish and Game personnel since 1966, coliform samples collected by BLM personnel during the spring and summer 1993, and data collected from the upper north fork Bear Creek as part of the Intermountain Wilderness Area Ecosystem Study (IWAES) conducted by the National Biological Survey (NBS).

The IWAES study is a long-term global climate change study conducted on or adjacent to BLM Wilderness or Wilderness Study Areas (WSAs). The study consists of the on-going collection of meteorological data from remote weather stations, plant community sampling, and hydrological and limnological data collection from an index reach of stream within the watershed most closely associated with the remote weather station site. The IWAES sites are scattered across the western US on BLM lands, and several sites double as paired-ecosystem study sites with similar sites in the (former) Soviet Union. An IWAES remote weather station is located on Horse Mountain in the King Range NCA on the King Range WSA boundary (on the western divide of the South Fork Bear Creek watershed). This site was established in the fall of 1992 and has been collecting data since (semi-continuously dependent on the integrity of the weather station which suffers from periodic storm damage and vandalism) . Baseline limnological data also was collected in the fall of 1992, and re-sampled in the summer of 1994. Baseline vegetation data was collected during the summer of 1994. Data analysis from this

project is currently unavailable but will be incorporated into this analysis as it becomes available.

Water quantity was an issue raised and discussed during the interviews of watershed residents and users. The beneficial uses of water from the Bear Creek watershed all draw water from either source springs, Bear Creek itself, or impounded tributaries. The cumulative effects of these diversions may have a significant effect on the quantity of water flowing in Bear Creek and its tributaries, particularly during the low-flow, summer months and in the upper reaches of the watershed. Flows in the upper South Fork near the headwaters at Wailaki campground have been measured as low a 0.01 cubic feet per second (Appendix C). Additional diversions of water from the upper reaches of the watershed could impact flows downstream, which in turn could affect other parameters such as temperature (see Anadromous Fisheries section).

BLM personnel monitored total and fecal coliform levels in the upper South Fork Bear Creek watershed in the vicinity of Wailaki and Nadelos campgrounds during the winter, spring, and summer of 1993. Levels are well below contact levels established by the North Coast Water Quality Control Board for human contact. Sources of fecal coliform are domestic septic systems, livestock and wildlife, and in campground areas, campers defecating near the stream.

A possible water quality issue considered in this analysis is possible toxic runoff associated with the Queen Peak Mine. The Queen's Peak mine is located in the middle third of the South Fork Bear Creek watershed, on the lower slopes of Paradise ridge (the eastern divide of the watershed). The Queen Peak mine shipped its first load of manganese ore in 1958. Shipping of ore ceased in 1959, although assessment work continued through 1971. The claim lay idle until 1984, when it was reopened and assessment work performed until the claim was abandoned in 1994. The manganese ore mined was 41 to 52% manganese, 6% iron, and less than 15% silica. Mineral was hausmannite (Mn_3O_4), with lesser amounts of black manganese oxide, pink manganese carbonate, manganese silicate (neotocite), and hydrous manganese silicate (bementite). Approximately 1,115 tons of hand sorted, high grade ore were shipped from the Queen's Peak mine (BLM 1973). The ore was recovered with bulldozers and front-end loaders, and hand sorted. No ore was processed on-site. The tailings and waste from the mine have been examined by the BLM Ukiah District geologist and determined to be very stable, with very little oxidation or weathering occurring (C. Whitcome, personal communication, 1994). Observation of the Queen Peak Mine site on December 29, 1994 found the excavation full of wate and draining into the South Fork of Bear Creek. The impact of this drainage and the chemical constituents is unknown at this time. The most observable impact of the mine on the Bear Creek watershed appears to be sediments from the access roads and excavations associated with mining operations. These sources are addressed in Horn (1992).

Recreation

The use of Bear Creek by recreationists has increased dramatically over the past thirty years. Recreationists use maintained and abandoned roads with cars, trucks, or off-highway vehicles to access their desired location. Campers, hunters, hikers, horse riders, off-highway vehicle riders, anglers, and bird-watchers all come to the Bear Creek watershed, mostly during the spring, summer, and fall, to engage in these activities. To varying degrees, these activities can

have an impact on the natural processes operating in the watershed. For example, horses packing along a wet trail can increase the amount of fine sediment that enters the stream, or hunters driving along abandoned roads can increase the likelihood of a landslide along the old road bed. Trash or pollutants left behind by campers can be harmful to fish and wildlife. It is important to address the role of various recreational activities as they interface with natural processes in the Bear Creek watershed in order to develop management options for the future.

In total, developed recreation facilities within the Bear Creek watershed include four developed campgrounds (Wailaki, Nadelos, Tolkan, Horse Mountain) (Figure 7), 2.5 miles of hiking trail, nearly 4 miles of equestrian trail, and approximately 8 miles of dirt/gravel road that provide vehicle access to these recreation facilities and developments. Another 12 miles of road within the watershed provide motorized vehicle access for dispersed recreation uses such as hunting, sightseeing and driving for pleasure. Approximately 90% of all the recreation use occurs during spring, summer and fall. Concentrated use occurs during the 3-day holiday weekends when the campgrounds are full.

Annual visitor use within the Bear Creek watershed is estimated at:

Recreation Activity	Visitor Days
Camping/Picnicking	6000
Hiking	750
Horseback Riding	400
Hunting	200
Sightseeing/Pleasure Driving	2000
Other	500
TOTAL -	9850

The primary tools used to manage recreation in the watershed are interpretive and educational materials such as on-site kiosks and signs; in addition brochures and maps are made available at BLM offices upon request. BLM Rangers and County Sheriff provide necessary law enforcement within the King Range. These law enforcement officers regularly patrol the campgrounds during busy weekends.

The *KRNCA Final Visitor Services Plan* (BLM 1992) divides all land within the KRNCA boundaries into Visitor Management Zones, ranging from Zone 1 (wilderness) to Zone 5 (highly developed). Within the Bear Creek watershed, two areas making up approximately 20% of the land are within Zone 1. One is located on the easterly facing slopes of the Chemise Mountain Wilderness Study Area (CA-050-111) and upslope from Chemise Mountain Road; the other is found upslope of Kings Peak Road north of Horse Mountain Campground and within the King Range Wilderness Study Area (CA-050-112) (Figure 7). The land within these two Wilderness Study Areas are subject special management constraints. The must be managed so as not to impair their suitability for designation as wilderness. The only activities permissible are temporary use which create no new surface disturbances, do not

require reclamation, nor involve permanent placement of structures. Exceptions are limited to actions such as emergencies, reclamation activities, or existing activities which enhance wilderness values.

Zone 1 is managed to be essentially free from the evidence of on-site human induced restrictions and controls. Motorized vehicle use is not allowed. A high probability of experiencing isolation from the sights and sounds of others, independence, closeness to nature, self reliance through the application of backcountry skills, and an environment that offers a high degree of risk and challenge is maintained. Backcountry use levels and resource management is dependent on maintaining natural ecosystems which allows for natural ecological changes. On-site visitor management activities are designed in harmony with the existing ecological site conditions and developed under the concept of "minimum tool". Primary recreation activities managed for within this zone include hiking, backpacking, horseback riding, nature study and wildlife viewing. Annual visitor use is estimated at 850 Visitor Days, accounted for almost entirely by hikers along the two mile Chemise Mountain Trail.

Approximately 2000 acres of the Bear Creek watershed lies within Visitor Management Zone 3. The area includes land east of Chemise Mountain Road and from ridge to ridge north of Shelter Cove Road to Saddle Mountain Road, where the boundary follows Kings Peak Road and King Range Road. This zone is managed for predominantly natural or natural appearing environments. Evidence of humans, restrictions and controls are present, but subtle. Motorized vehicle use is limited to designated roads and trails as specified in the King Range Transportation Plan; however, abandoned roads left in the acquired lands that have been previously logged, are used by hunters, hikers, campers, and off-highway vehicle riders. Facilities for the administration of visitor use is allowed. On-site interpretive facilities, dirt and gravel roads, trails, signing, equestrian and camping facilities, and staging areas are designed to harmonize with the existing natural environment and be the minimum required to achieve the objectives. Within this zone the concentration of users is low, but there is often evidence of others. On-site visitor management activities stress protection of natural values, in harmony with the existing site conditions, thus designs will be rustic in nature. Primary recreation activities within this zone include camping (40%), horseback riding (10%), backcountry vehicle touring (40%) and hunting (10%). Annual visitor use is estimated at 2,800 Visitor Days.

Within this management zone there are two developed campgrounds located along the ridgeline. Tolkan Campground has recently been reconstructed to provide for new and universally accessible facilities, including two vault restrooms. Each of the nine campsites contains a picnic table and fire ring. A 1/2 mile narrow hiking trail leads from the campground to Bear Creek. It is seldom used due to lack of signing and maintenance. Horse Mountain Campground also contains nine campsites with similar facilities although they are very old (25 years) and need replacement.

The remaining 10% of the land within the Bear Creek watershed is within Zone 4 and is located adjacent to Chemise Mountain Road, Shelter Cove Road and Kings Peak Road north to West Rancho Lane. This zone is managed to be a natural appearing environment, but the evidence of humans, restrictions, and controls are often present. Motorized vehicle use is limited to designated roads and trails. Facilities for the administration of visitor use are

allowed. On-site interpretive facilities, graveled and paved roads, trails, signing, equestrian and camping facilities, and staging areas are designed with a rustic theme. Within this zone the concentration of users is moderate, and there is often evidence of others. Primary recreation activities managed for include vehicle touring, sightseeing, camping, and horseback riding. Frequency of managerial contact is high within developed facilities and moderate on roads and trails.

Both the Wailaki and Nadelos Campgrounds are located within this zone and are immediately adjacent to South Fork Bear Creek. These campgrounds were recently redesigned and reconstructed to reduce the amount of sediment transport into the stream, to prevent leakage of the restroom vaults, and to provide a wider array of visitors with new, universally accessible facilities. Wailaki contains 13 campsites and Nadelos 9 sites each with a picnic table and cooking grill. Annual visitor use for the two areas totals approximately 6,500 Visitor Days, most of which is accounted for by overnight camping and associated vehicle touring and sightseeing.

Approximately 75% of the total visitor use occurs in the vicinity of the Wailaki and Nadelos campgrounds (Visitor Management Zone 4) because of their close proximity and attractiveness of South Fork Bear Creek and adjoining network of hiking trails. The majority of this use occurs during the summer and fall seasons. These two campgrounds have been identified as being within the Interim Riparian Reserve area. Minor repairs and some corrective maintenance of facilities need to be made in order to maintain streambank stability (sediment) and water quality (coliform). Also, maintenance of both the Chemise Mountain Trail and Bear Creek Nature Trail, particularly waterbars and switch-backs, is needed on a more regular basis to minimize or prevent fine sediment from entering the stream. Use of these two trails in this area is predominantly pedestrian and not equestrian which causes less of an overall impact.

Trends

Projected use in the vicinity of the Wailaki and Nadelos Campgrounds is estimated to increase 5% per year for the next 10 years and then level off from then on as campground capacity is more fully realized. This increased use, however, should not have any appreciable impact beyond current levels of disturbance, assuming that proactive measures are taken to maintain facilities and trails properly and the visiting public is better educated after reading on-site interpretive displays and posted regulations. Continued law enforcement patrols and presence of a volunteer campground host will help inform visitors of acceptable behavior and prevent activities that could otherwise adversely affect the stream.

Water quality testing upstream from Wailaki Campground and downstream from Nadelos Campground has been occurring for the past two years. This will continue for the foreseeable future in order to monitor the stream's condition and to alert us of any need for corrective measures.

The other two developed campgrounds (Tolkan and Horse Mountain) and the newly developed pedestrian / equestrian trailhead are located high on the ridge, and activities occurring within these relatively seldom used recreation sites pose little probability of impacting the aquatic environment of South Fork Bear Creek. Use levels at Tolkan

Campground are estimated to increase 5% annually for the next five years and then level off. Use at Horse Mountain Campground is anticipated to stay at its current level.

A proposed equestrian / hiking loop trail would begin at the recently constructed staging area and follow an old logging road (rehabilitated into a trail nearly 12 years ago) to the South Fork Bear Creek. From here the proposed trail crosses the stream and traverses the steep hillside along a few of the numerous existing, unmaintained skid roads. After reaching the top of the ridge, the proposed trail heads south along Paradise Ridge Road and then down the Queen Peak Mine Road, across Bear Creek again and up to Kings Peak Road. The last segment follows this road back to the staging area. Approximately 75% of this trail is already being travelled upon by equestrians (150 Visitor Days) and hunters on foot (75 Visitor Days) because it follows existing and rehabilitated roads which are easily accessible. The short but steep segment from Bear Creek up to Paradise Ridge would need to be brushed and some minor construction required in order to connect the skid trails to each other. The actual work required to complete this loop trail is not anticipated to cause any new impacts to the stream but the subsequent use by equestrians may add fine sediment into the South Fork Bear Creek. Use along this completed loop trail would increase significantly (50% annually) for the first five years and then level off from then on to roughly 1000 Visitor Days each year.

Dispersed recreation use, including unstructured camping, hunting by foot, vehicle and horseback, hiking, and sightseeing by vehicle within the watershed occurs mainly in Visitor Management Zones 1 and 3 along Kings Peak Road and several unmaintained spur roads that lead down to Bear Creek. According to the King Range Transportation Plan, these spur roads and other access routes that lead toward Bear Creek are designated "closed" to motorized vehicle use but they are not blocked, gated, or signed and thus receive use by recreationists. Unauthorized use of these roads is expected to continue unless road blocks, gates, or signs are installed at the junction of these roads and Kings Peak Road informing visitors that the roads are closed.

Fishing within the watershed is not allowed, however, a very small amount does occur, primarily because anglers are uniformed of the regulations. With additional signing and interpretive displays posted at various locations along Kings Peak Road and in the campgrounds, this negative impact on the stream can be prevented.

Grazing

The early settlers of the Ettersburg area introduced sheep and cattle grazing to the Bear Creek watershed. The Etter family, who started a ranch near the mouth of Bear Creek around 1890, along with other settlers, cleared and burned land to accommodate grazing of sheep and horses, as well as open land for agriculture.

Unlike some of the other regions of the Mattole Valley, the Bear Creek watershed contains mostly forest soils and is quite steep throughout. Once cleared, bracken fern, which is the first stage in succession back towards forest land, would invade the newly created grasslands. Horses that consumed a large quantity of the bracken fern would die. Regular clearing and

burning was required to maintain these areas as open as grasslands. For this reason, little historical grazing has occurred in the Bear Creek watershed.

Sheep have historically been the most heavily grazed animal in the Mattole Basin. Early homesteaders raised few cows because, lacking ice or refrigeration, they were unable to store all of the meat from a cow once it was slaughtered. Sheep have been grazed in the Bear Creek watershed continuously since 1890 and are presently grazed. Although a small amount of grazing occurred in the lower South Fork near Shelter Cove Road, the overwhelming majority of the grazing has been, and remains, concentrated in the lower mainstem. Although no firm numbers are available for historic grazing, an interview with Lee French infers that much less livestock is currently grazed in Bear Creek than in the past. Lee French also stated that most of the land that was originally cleared for grazing has returned to forests and that all the present grazing occurs in upland areas away from the creeks.

Nearly all grazing in the watershed occurs on private land near Ettersburg and in the French and Jewett Creek drainages. One BLM allotment currently operates in the watershed, the "Jewett Ridge Allotment". This allotment lease of 80 acres was initiated in 1946 and acquired by Lee French. This area was logged in the 1950s and seeded in rye grass and orchard grass. In the 1950s approximately half of the allotment was grazable but currently it is mostly forested except for approximately ten acres, located on a corner of the allotment, which is in open prairie. Until the mid-1980s approximately 300 sheep and 10 cows were allowed on this allotment. Currently approximately 25 cows are allowed. The allotment comprises approximately 2% of the range for these animals.

Grazing in the watershed occurs in terrain that is less steep than the majority of the landscape. For this reason, the majority of the grazing occurs where the least amount of highly erosive soil is present (Figure 12). The magnitude of grazing impacts in the watershed are not clearly known but are most likely minor due to the limited amount of historic and current grazing. Soil exposed by grazing will likely contribute to the fine sediment load in lower Bear Creek and the Mattole River. Soil compacted by grazing will likely reduce infiltration of rain and thus increase peak discharge in the drainage system. Plant regeneration and succession is most likely altered due to the constant disturbances of grazing.

Overall, grazing seems to be a minor issue in the Bear Creek watershed. Since almost all grazing occurs on private lands, very few opportunities are available to BLM to manage grazing activities within the watershed.

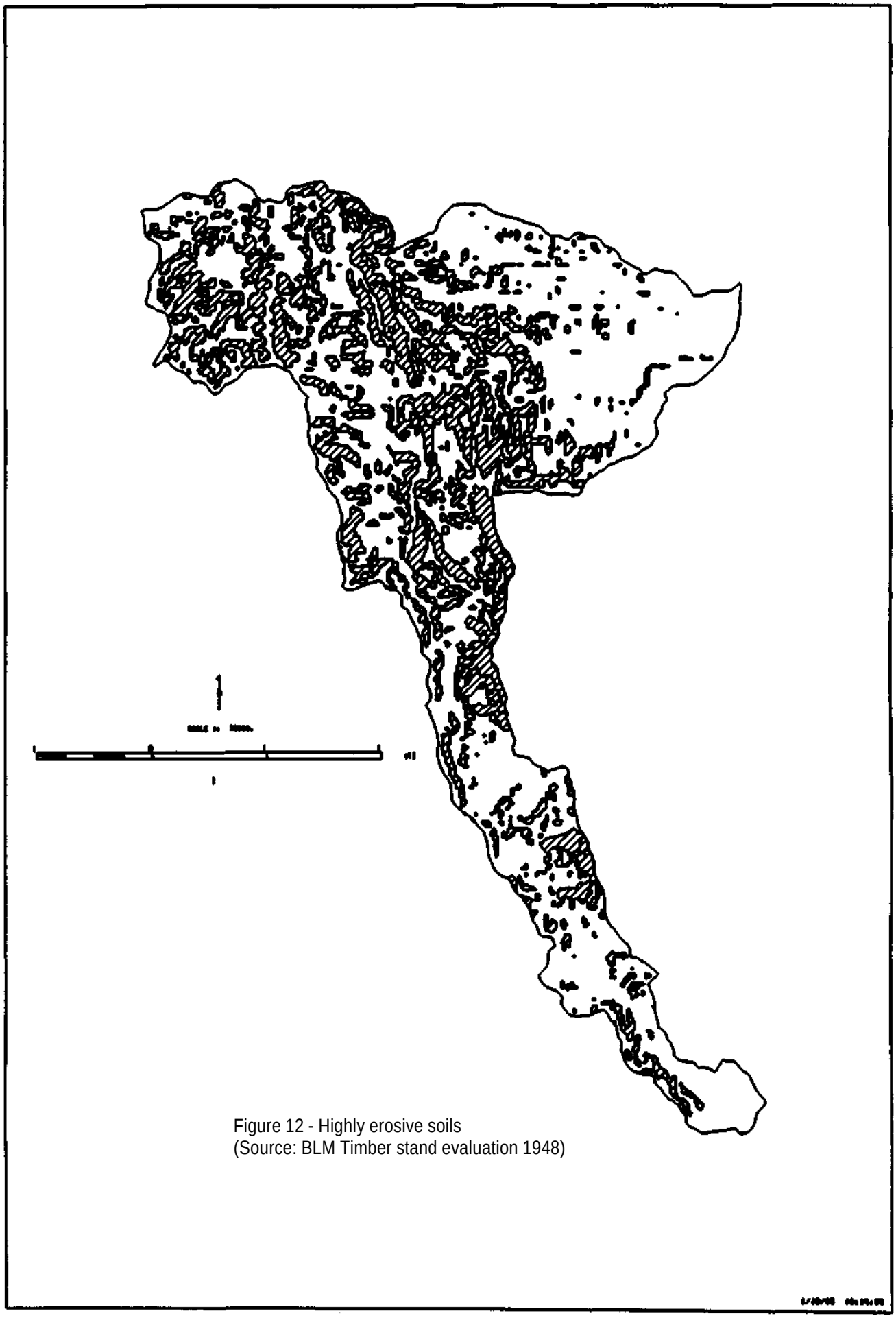

Figure 12 - Highly erosive soils
(Source: BLM Timber stand evaluation 1948)

IV. Recommendations for Project Planning

The identification of the ecological processes and an improved understanding of the relationship of these processes to one another and to the current conditions within a watershed provides a backdrop of information with implications toward future land management decisions. The analysis can provide a general ecological framework within which management actions can be put in context within the watershed and related to other local and regional scales. It can provide a basis for considering cumulative effects.

Management direction for the Bear Creek watershed is driven by the King Range National Conservation Area Management Program (1974). Emphasis is toward management of recreation providing for a broad range of experiences which are generally primitive in nature and are supported with facilities considered the minimum required to manage the visitors in concert with the capacities of the ecosystem. Management direction does not include an expectation of commercial commodity production or the accommodation of uses which degrade the natural setting. Management direction includes the maintenance of a transportation network which provides access points for primitive recreation experiences. This includes a network of trails linking the attractive Lost Coast beach trail with inland areas as well as staging areas and campgrounds with varying levels of amenities. There is also a demand for and a desire to accommodate utilization of special forest products for cultural and personal use such as bear grass, mushrooms, salal, and willow.

Given the small size of the watershed, the focused nature of anticipated management actions, and the need for restoration of acquired, previously logged lands, there is an opportunity to be relatively site-specific with regard to restoration opportunities and provide specific guidance to management regarding anticipated recreation plans. The following sections attempt to outline high priorities for restoration and considerations for recreation planning.

Restoration Priorities

Uplands Restoration

Uplands restoration in this analysis refers to extensive areas on the landscape where past land use practices have created conditions which continue to disrupt the natural ecological processes and beneficial uses. There are two major areas within the watershed where upland restoration opportunities should be considered.

1. Inner gorge logging between 1962 and 1974.

As described in chapter III, early logging in the watershed occurred at smaller scale and generally on gentler slopes and did not significantly impact the watershed. During the later years, technology and the demand for Douglas-fir logs allowed logging operations to exploit steep terrain. The access roads, skid trails, and stream crossings which were employed during these operations resulted in huge sediment inputs into Bear Creek. Though a high percentage of the sediments from these sources has already entered the stream, significant amounts remain. The stability of these remaining potential sediment sources has not been

systematically assessed. These lands include the formerly private lands which BLM acquired either side of the confluence of the North and South Fork. Generally this includes an approximate three-mile long reach along the downstream end of the South Fork to the confluence of the forks, an approximate one and one-half-mile reach along the downstream end of the North Fork to the confluence of the forks, and an approximate two and one-half mile reach of the upper mainstem to the confluence of the forks. The condition is of highest priority along the inner gorge but also includes the steeper uplands to the watershed boundary. Approximately 2,300 acres are affected.

Potential restoration approaches:

a. Complete sediment source inventory for the entire watershed.
b. Using BLM inventory data from 1991-1992, screen and prioritize identified sites for restoration potential.
c. Utilize geomorphological and engineering expertise with restoration experience to:
    Assess restoration need at specific sites
    Assess project feasibility and tradeoffs associated with disturbance of specific sites
    Design projects
    Prioritize potential work areas and optimize project sequence

2. Paradise Ridge mass-wasting.

A large area of "Cahto" series soils occurs on Paradise Ridge starting approximately one-half mile north of Queen Peak and extends approximately three miles to the northern end of Paradise Ridge. These soils occur on the ridgetop and extend downslope to the west. These soils are high shrink-swell and are subject to extreme frost heaving when wet. They also are easily displaced and rutted when driven over when wet and are extremely erosion-prone when disturbed. Over the northernmost mile the ridgetop Paradise Ridge Road and old logging roads down the west slope have channeled the erosive force of the runoff and caused extensive, ongoing gullying. It appears that wet season road use continues to exacerbate this active erosion. Additionally, the eroded area is large enough that it catches enough rainfall falling directly into the gullies to concentrate into rivulets sufficient to perpetuate the condition. This implies a need to directly treat the eroded area to curtail further erosion.

Potential restoration approaches:

a. Inventory gullied sites.
b. Complete project design for direct treatment of gullies.
    Approaches for curtailing further erosion
    Approaches for recontouring ridgetop area to dissipate runoff
    Revegetation of eroded sites
c. Consider seasonal wet weather use restrictions on motorized access beyond Queen Peak.

3. Other mass-wasting.

Bear Creek contains reaches where logged inner gorges have mass-wasting potential, or are actively slumping and introducing sediments.

Potential restoration approaches:

a. Stabilize inner gorge slide areas with Douglas-fir plantings.

Fine Sediment Control

Fine sediment control refers to the persistent inputs of fine sediments into the stream network primarily from maintained road surfaces due to design flaws, location, and maintenance practices. Fine sediments are usually introduced into the system during critical months of the salmonid life cycles and have direct effects on reproductive success.

1. Chemise Mountain Road

As described in Chapter III, this road is located directly in the riparian zone of the upper South Fork and may be the greatest contributor of fine sediments in the watershed. The location and system of ditches associated with the road completely disrupts the natural drainage network and concentrates sediment-laden runoff, a situation which is heightened by private driveway flow diversions and inadequate culverts. Fine sediments from the unsurfaced roads are delivered efficiently and directly from the road surface into the stream throughout the wet season. Most of the culverts along this road appear to be undersized, and there are not enough of them to effectively drain the ditch system along this road; therefore, they are prone to clogging with storm debris during major runoff events.

Potential restoration approaches:

a. Explore feasibility of paving Chemise Mountain Road. This road was paved as recently as 1972.
   Coordinate with Humboldt County regarding design and costs
   Develop partnerships for seeking funding
   Identify problem culverts and driveways.

2. Kings Peak Road

The Kings Peak Road extends the length of the watershed north of the Shelter Cove Road. It includes an extensive inboard ditch which collects surface runoff over long distances. Relief structures such as inboard drains are inadequate and too widely spaced, allowing extremely long uninterrupted inboard ditch reaches. The road has numerous stream crossings with large fills, some of which have deteriorating culverts. Maintenance practices perpetuate the inslope of the road.

Potential restoration approaches:

a. Coordinate and cooperate with Humboldt County regarding maintenance practices
b. Identify specific improvement projects such as:
Installation of more inboard ditch relief structures
Outsloping road where feasible
Notching of outboard berms
Replacement of deteriorating culverts

3. Queen Peak Mine

The Queen Peak Mine was a source of manganese ore from which ore was shipped for only two years, though assessment work continued another thirteen years. Though believed to be stable relative to the release of toxics into the watershed, the mine, associated tailing piles, and areas of disturbance associated with access roads and assessment work cover a large area and have been observed as chronic sources of fine sediment. The main access road to the mine descends extremely steep terrain. It has extensive waterbarring and is nearly impassable but apparently receives a level of "off-road" use. There are stream crossings along the road with inadequate or poorly installed culverts, one of which is noted as being "shotgunned", a term denoting a culvert which is not installed in the drainage bottom having its downstream end protruding from the road fill.

Potential restoration approaches:

a. Reconstruction or removal of problem stream crossings.
b. Closure and erosion-proofing of road surfaces.
c. Stabilization or relocation of mine tailings.
d. Analysis of toxic potential of mine runoff.

4. Uncontrolled vehicle use.

Roads comprising the transportation network are identified and discussed under "Roads and Land Use Practices". Recreation use is planned around access points along this transportation plan. Additional uncontrolled / dispersed motorized recreation use persists. Such use is illegal and "citable". Physical access is not restricted to abandoned roads and skid trails and the general public may be poorly informed as to their legal closure. King Peak Road and Paradise Ridge Road provide access to many of these. The intermittent use of these roads and trails contributes to sedimentation.

Potential restoration opportunities:

a. Physical closure of abandoned roads and skid trails using gates, berms, rocks, etc.
b. Signing and education of users regarding closures.

Species Viability

This category of restoration opportunities focuses on the adequacy of existing conditions to support the habitat requirements of special status species within the watershed. It attempts to identify opportunities to accelerate the recovery of those conditions in the relatively short term to improve species viability. Conditions are often found to be inadequate due to the effects of past land use practices. Few wildlife inventories have been conducted within the watershed and little is known about the occurrence of most wildlife species such as those identified as "Survey and Manage" species in the Northwest Forest Plan. There may be habitat requirements for many of these species which are not now being met. Subsequent analysis efforts will rely upon future inventories for certain species and better understanding of their habitat requirements and identify additional restoration activities based on those findings. Based on the information available, the amount and connectivity of late-successional and old-growth conifer stands, in particular, is a readily apparent priority for restoration. This priority emphasizes certain species such as the marbled murrelet and northern spotted owl, species for which much data is available regarding current distribution and habitat requirements. It is assumed that other species such as those associated with the riparian corridor, those dependent upon recruitment of specific old-growth attributes (downed logs, snags, nutrient cycling, etc.), or those dependent upon the micro-habitats of old-growth systems (cool, moist, stable) will accrue the benefits of improved late-successional forest attributes. Comparisons of pre-logging and post-logging era LSOG acreage reveal that LSOG habitat was reduced by approximately two-thirds (from 6,700 ac. to 2,135 ac.) as a result of human manipulation of the landscape. Forty-eight percent of the watershed supported LSOG habitat under natural conditions (1948) and only 15% following the logging and burning of the watershed. Soils on up to 78% of the watershed are capable of supporting LSOG dependent upon other disturbance factors. Examination of the current distribution of three owl territories and the LSOG availability comparison indicates that from five to seven owl territories may have occurred in the watershed under expected natural conditions. All indicators about which information is available indicate that by the 1980s this habitat probably occupied less of the watershed than at any time in its history. Two restoration approaches are identified for accelerating recruitment of this habitat.

1. Augmenting existing LSOG stand

The same area described under "Uplands Restoration, 1. Inner gorge logging between 1962 and 1974" was at one time a relatively continuous stand of LSOG, the removal of which disrupted the connection between, and the amount of available habitat within the remaining undisturbed stands in the North Fork drainage, and those lands which were historically public lands in the South Fork. Significant logged acreage was "high-graded" during the logging era and is characterized by isolated remnant Douglas-fir "cull" trees and a relatively even-aged mature hardwood canopy. Natural regeneration on the original private lands and the replanted BLM timber sale area are in overstocked condition impeding the re-connection as dispersal habitat in the short-term, the replacement of LSOG in the remaining stands. Appropriate silvicultural treatments could improve dispersal conditions between the stands and eventually establish habitat conditions suitable for owl nesting.

Potential restoration approaches:

a. Thin the BLM timber sale area in section 21 to accelerate growth of the conifer component. Emphasize retention of large and mature hardwoods.
b. Identify overstocked areas of natural regeneration for potential stand improvement projects.

2. Adding a conifer component to and creating a multi-layer canopy in older closed-canopy hardwood stands.

The conifer component may be minimal or non-existent in some areas. These sites present an opportunity to achieve multi-layer canopy conditions typical of mixed-evergreen LSOG stands through silvicultural techniques which emulate natural disturbance by creating small openings for re-stocking with Douglas-fir or thinning hardwoods around existing isolated pockets of Douglas-fir ingrowth.

Potential restoration approaches:

a. Identify potential project areas for small patch thinnings and re-stocking with Douglas-fir.

Ecosystem Sustainability

Ecosystem sustainability in this analysis refers to the restoration of ecological processes within the watershed. In addition to the impacts land use practices have had on the current conditions within the watershed, these practices have also disrupted basic ecological processes which create or maintain habitat conditions over time. Though there may be many processes which have been altered and continue to affect habitats for various species, three deficiencies have been identified in this analysis. These include those physical conditions affecting the sediment budget, the elimination of fire as a natural agent for maintaining many diverse aspects of the ecosystem, and the supply of coarse woody debris for maintaining diverse aquatic and terrestrial habitat.

The physical conditions affecting the sediment budget have been previously addressed in detail.

Various components of the ecosystem have been maintained by lightning-caused fires for thousands of years. Application of fire as a manipulative tool by indigenous peoples also played a role in maintaining "anthropogenic" landscapes of greater extent than currently exists, such as coastal prairies and hardwood stands. The natural conditions under which fires occurred usually consisted of ridgetop lightning strikes under conditions which included high humidity. The fires tended to gain momentum under the driest parts of the day, then smolder and creep through the forest floor as humidities recovered. Natural fire created diversity by providing a balance of seral stages in the brush communities. It created and maintained natural prairie balds where strikes were frequent, and controlled fuel loadings on the forest floor which reduced the threat of catastrophic loss of old-growth stands. (Note: The team felt information was inconclusive regarding the origins of the prairie "balds". There is some evidence that the indigenous population may have created and maintained these features. Their function and ecological role is unclear at this time.) Fuel buildups resulting from years of fire suppression provide a setting conducive to "catastrophic" fire events.

Accumulated downed material and dense young growth provide both the heat and the pathway for loss of old-growth forest. Brush communities are in an advanced seral stage with high incidence of decadence and tend to transport hotter fires into forested areas. These fuel and structural conditions are compounded by a change in fire origin to human-caused. These fires are most frequent during the driest of conditions and are not related to the convective conditions associated with summer thunderstorms. Recent man-caused fires have often had their origin during hot, dry offshore flows. Human-caused fires often have their origins at the toe of densely vegetated slopes, rather than on ridgetops, allowing long upslope runs of fire. These fires are typically much more destructive than natural fires. Two restoration opportunities are identified for re-introducing fire into the ecosystem in a manner which simulates naturally occurring burns.

1. Fireproofing and maintenance of LSOG stands.

Previously logged areas often contain heavy concentrations of downed material, brush, and young trees which are often adjacent to valuable LSOG stands. LSOG stands may have large accumulations of dead material on the forest floor. These conditions may result in excessively high fire intensities from either human-caused or lightning-caused fires.

Potential restoration approaches:

a. Design and implement a program of prescribed burning which will serve to systematically control fuel loadings within LSOG stands.

b. Determine feasibility of reducing brush and excessive fuel loading adjacent to LSOG.

2. Reintroduction of fire into "fire-maintained" brush communities.

Manzanita brush communities are fire types but currently exhibit advanced heavy growth due to the exclusion of fire. These conditions may greatly increase the intensities of either human-caused or lightning-caused fires. The imbalance to large unavailable shrubs suppresses some early-seral-dependent animal populations such as deer.

Potential restoration approaches:

a. Design and implement a program of prescribed burning which considers a rotation schedule of burns to maintain a balanced distribution of size classes in the manzanita brush communities.

<u>Riparian Reserves</u>

Riparian Reserves as defined in the Record of Decision in the President's Northwest Forest Plan are one of four components of the Aquatic Conservation Strategy. They are the land allocation which provides the basis for protecting the health of the aquatic system and its dependent species. The other three components include a system of key watersheds, the

process of watershed analysis, and watershed restoration. Guidance for watershed analysis is specific in the ROD concerning riparian reserves.

> "Watershed analysis will identify critical hillslope, riparian, and channel processes that must be evaluated in order to delineate Riparian Reserves that assure protection of riparian and aquatic functions. Riparian Reserves are delineated during implementation of site-specific projects based on analysis of the critical hillslope, riparian, and channel processes and features."

There has been a general expectation among the land managing agencies that watershed analysis would provide a specific mapping of riparian reserves which modifies the interim reserve widths outlined in the ROD. This may be a reasonable expectation in some watersheds where extensive site-level project work has been undertaken and detailed inventories are available. The approach to riparian reserves in the Bear Creek watershed analysis is more consistent with the direction quoted above and does not, at this time, result in an amended riparian reserve map. This analysis attempts to identify information pertinent to the consideration of riparian reserve widths, information which can then be applied on a site-specific basis to direct restoration efforts and provide guidance for project development.

Several information layers have been developed during the Bear Creek analysis which are pertinent to project planning and riparian reserve widths. An effort was made to fully delineate the stream network. USGS 1:24,000 quadrangle maps were analyzed using a "crenulation" method which attempts to capture the stream network beyond the USGS-mapped "bluelines" throughout the full extent of the intermittent and ephemeral channels (Figure 13). Variation exists in methodology for tracing the extent of each drainage between the FEMAT comparison and the Redwood National Park comparison. FEMAT methodology of tracing the drainage one-half the distance beyond the last visible crenulation would increase total stream mileage by up to 20% compared to the methodology of stopping at the last visible crenulation. The Bear Creek stream network was mapped using the latter method, which would make the 14.09 miles per square mile figure appear smaller compared to the FEMAT method. The Redwood National Park comparison for Tom McDonald Creek used the FEMAT method and also projected drainages over landforms where the crenulation disappeared but was presumed to continue. In all cases the stream mileage should be considered a minimum for the watersheds. Additional variability in the accuracy of this method has been documented and appears to depend upon topography type to some extent. It does provide, in the absence of detailed field mapping, a general depiction of the stream network sufficient for this level of analysis which has been applied to numerous watersheds throughout the Pacific Northwest. Bear Creek watershed stream density (miles of stream per square mile) is 14.09. This indicates a very dense and extensive network in general, similar to, but consistently more dense, than watersheds with

similar geology, climate, and topography in the immediate region . Interim riparian reserve widths applied to the network encompass virtually the entire watershedwith the exception of small ridgetop zones.

Representative Stream Densities
(from FEMAT)

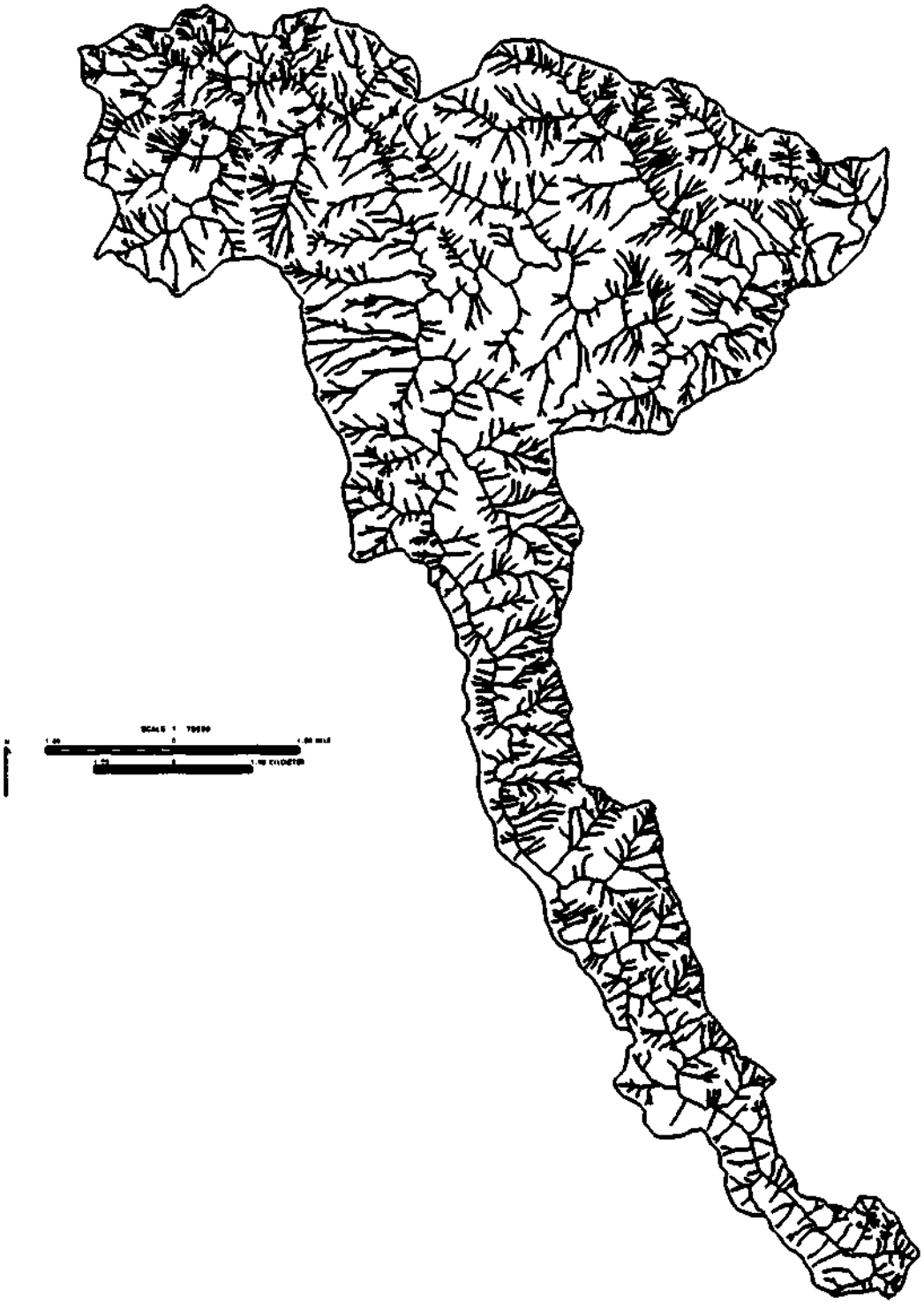

Figure 13 - Crenulated stream network as interpreted from USGS 7.5 minute quadrangle, Lambert conformal conic projection, 1970.

Watershed Name	Density (mi/sq mi)	Geology
Oregon Coast Range		
Kilchis River	8.53	Resistant, other
Daniel's Creek	12.80	
Meacham Corner	5.31	
Walton	5.48	Resistant
Baldy Mountain	6.94	
Glenbrook	5.97	
Trask Mountain	6.49	Weak Rock
Franciscan Formation		
Quail Prairie Mountain	6.28	Intermediate sediments
McCullough Creek	6.27	
Leech Lake Mountain	8.96	
Hull Mountain	9.04	
Bear Creek	14.09	

Representative Stream Densities
(from Redwood National Park)

Watershed Name	Density (mi/sq mi)	Geology

Franciscan Formation (Redwood Creek, California)

Tom McDonald Creek	12.9	Schist (Intermediate)
Panther	5.3	
Noisy	6.7	
Lacks Creek	8.8	Sedimentary (weak)
Coyote Creek	8.7	Sedimentary (weak)

The Bear Creek analysis has developed a "Highly Erosive Soils" layer with particular implications for the control of fine sediment inputs into the riparian reserves. The model combines slope with the erosive "Hugo" soils where they occur on slopes of 50% or greater, and "Cahto" soils on all slopes. (Figure 12) The erosive soils include 3,786 acres or 27% of the watershed. Considerations of these soil types are critical elements for management of riparian reserves.

An additional analysis is being conducted to estimate potentially unstable areas associated with the riparian reserves. This model combines aerial photo interpretation of geologic features with mass wasting potential with a GIS-generated slope map. The product will provide information directly applicable to the FEMAT definition of riparian reserves subject to field verification.

> "Riparian Reserves: Lands along streams and unstable and potentially unstable areas where special standards and guidelines direct land use."

Management activities within riparian reserves are restricted to those which do not "retard or prevent attainment of the Aquatic Conservation Strategy objectives", or are directed at those activities which "attain Aquatic Conservation Strategy objectives". Opportunities are identified in Bear Creek under each of these general areas of emphasis.

1. Riparian silviculture.

Habitat deficiencies and upland restoration opportunities are identified for both fisheries and terrestrial habitat. Inner gorges have been harvested over long reaches of stream resulting in slides and significantly reducing the natural recruitment of large wood into the stream. Numerous stands of overstocked Douglas-fir show very slow development of LSOG characteristics. Appropriate silviculture within riparian reserves will facilitate attainment of the Aquatic Conservation Strategy objectives with the recognition that there is the potential for short-term disturbance to achieve long-term habitat improvements.

Potential restoration approaches:

a. Plant conifers on previously harvested inner gorges to stabilize slides and to accelerate eventual recruitment of large wood.

b. Thin overstocked Douglas-fir stands to accelerate attainment of LSOG conditions.

2. Upland restoration.

Roads and skid trails in harvested areas continue to produce sediment loads which are transported directly into the stream. Road and skid trail removal would be necessary within riparian reserves to eliminate conditions which currently prevent attainment of the Aquatic Conservation Strategy objectives.

Potential restoration approaches: (See "Restoration Approaches", "Uplands Restoration")

3. Instream projects.

Though the processes which contribute to instream habitat features are altered within the watershed, no inventory to date has conclusively indicated the need to correct these deficiencies directly, that deficiencies exist, or that they are necessarily limiting to fisheries at this time.
No instream restoration opportunities are identified and are not anticipated unless a major deficiency is uncovered by new studies or data.

Management Standards and Guides

Standards and Guides incorporate the information derived from watershed analysis and attempt to present it in a form useful to managers of the watershed. Management emphasis in the King Range National Conservation Area is outlined above and is focused on environmentally compatible recreation and the facilities needed to sustain it.

1. Road maintenance

The watershed roads with BLM maintenance responsibility include King Range Road, Saddle Mountain Road, and Paradise Ridge Road. Humboldt County road maintenance responsibility includes Shelter Cove Road, Chemise Mountain Road, and Horse Mountain Road. Complete descriptions of these roads and their status with respect to sediment contribution and general condition are contained in the"Roads and Land Use Practices" section of this document. Reconstruction and maintenance should consider the following guidance:

a. Cooperate with state and county agencies to achieve consistency in road design, operation, and maintenance necessary to attain Aquatic Conservation Strategy objectives.

b. Road reconstruction and maintenance criteria:

(1) Minimize disruption of natural hydrologic flow paths, including diversion of streamflow and interception of surface and subsurface flow.

(a) Remove or notch outboard berms
(b) Outslope roads
(c) Design adequate inboard relief structures
(d) Size culverts for 100-year runoff considering debris and bedload
(e) Install culverts along drainage slope
(f) Use rolling dips
(g) Institute winter road, culvert, and drain inspection and maintenance program

(2) Minimize sediment delivery from roads.

(a) Outslope roads
(b) Route road runoff away from unstable fills, slopes, channels
(c) Avoid mid-winter and mid-summer grading of road surfaces
(d) Institute winter road, culvert, and drain inspection and maintenance program

2. Recreation use / user education

King Range management emphasizes dispersed recreation supported with facilities considered the minimum required to manage visitors in concert with the capacities of the ecosystem. In Bear Creek this includes the vehicle transportation network, existing and proposed trails linking coastal and inland areas, and five developed recreation sites. Two recreation sites (campgrounds) are within the riparian reserve and three (two campgrounds and one equestrian staging area) are on ridgeline locations. Riparian reserve campgrounds have been re-constructed in the last year to minimize riparian impacts and provide universal access.

a. Evaluate and mitigate impact on recreation sites in riparian reserves to insure that these do not prevent, and to the extent practicable contribute to, attainment of the Aquatic Conservation Strategy objectives.

(1) Evaluate sediment inputs resulting from recreation use.
(2) Monitor water quality impacts resulting from recreation use.

b. Adjust dispersed and developed recreation practices that retard or prevent attainment of Aquatic Conservation Strategy objectives.

(1) Attempt to disperse recreation uses where possible.
(2) Using natural or constructed barriers, direct streamside use to armored or low-impact areas.
(3) Develop interpretive materials (signs, displays, brochures) which explain fish / sediment relationships and effects of streamside disturbance.

(4) Insure that signs restricting use include interpretive information as to reason for restrictions.
(5) Convey "watershed" concept in signing and interpretation.

3. Trail maintenance

Current trail system in Bear Creek watershed includes the Chemise Mountain trail originating at Nadelos campground and connecting to the Lost Coast Trail, and a short section of the Lost Coast Trail heading from Chemise Mountain to Hidden Valley. An unmaintained trail leads from Tolkan Campground to South Fork Bear Creek. The Queen Peak Mine road serves as a trail for both equestrians and hikers. An additional trail is proposed which will cross the watershed and includes a Bear Creek crossing location. General trail maintenance and construction criteria are similar to those for roads.

a. Minimize fine sediment delivery due to trails.
(1) Outslope entire length of trails where possible.
(2) Utilize waterbarring to resolve drainage problems in specific locations.
(3) Minimize "short" switchbacks which invite "cutoffs" by hikers.

(4) Install interpretive materials advising hikers of sediment issues.
b. Reduce impact to trail and recreation areas by providing loop trails wherever possible to disperse use.

4. Project design criteria

Future additions to the trail system or to recreation sites should incorporate design considerations to minimize watershed impacts, particularly delivery of fine sediments to the stream network. Considerations also include habitat and species disturbance considerations. Project screening should address the following regarding location and design.

a. Is construction needed to locate the facility or trail?
b. Does the trail follow existing skid roads or trails?
c. Would use / users (level, type, intensity) conflict with objectives for LSOG habitat, species?
d. Does routing avoid highly erosive "Hugo" soils on slopes greater than 50%?
e. Does routing avoid highly erosive "Cahto" soils on any slope?
f. Would the use or construction of the trail or facility contribute fine sediment into stream network?
g. Does the trail cross streams?
(1) Is the stream naturally armored at the crossing?
(2) Does the crossing or routing decrease bank stability?
(3) Is personal safety an issue at the stream crossing?
(4) Do any of the crossings require culverts?
h. Are there trail segments within the riparian reserve?
i. Does trail use increase fire hazard?
j. Do planned trail switchbacks minimize potential for "cutoffs"?

V. Information and Monitoring Needs

Through the process of completing this watershed analysis, several significant gaps of information necessary for proper implementation of the President's Forest Plan were identified. Most of these information gaps are data collected in basic field surveys and inventories. Such field surveys have never been conducted, were conducted ten or more years ago, or were conducted only over a limited area. Although limited surveys for spotted owls and marbled murrelets have been conducted in recent years, very limited information exists on the other fauna and flora of the watershed. As for the aquatic environment, the last stream survey was conducted in 1982. A few square miles of roads in the South Fork were surveyed for sediment sources in 1991 and 1992, but the majority of roads in the watershed remain unsurveyed. Effective ecosystem management requires this basic knowledge prior to implementing any sensible management.

Acquiring addition basic information will be essential when establishing the three types of monitoring called for in the Northwest Forest Plan. The three types of monitoring include: implementation monitoring, effectiveness monitoring and validation monitoring.

Implementation monitoring determines how closely the following strategies of the President's Forest Plan have been followed:

> Land allocations with specific boundaries
> Standards and guidelines for managing the land allocations, including Key Watersheds
> Watershed analysis
> Social and economic effects
> An adaptive management process, or learning framework

Effectiveness monitoring is to be designed to evaluate how effective the application of the above listed management strategies have been at achieving the desired goals and objectives of the President's Forest Plan or to evaluate the effectiveness of specific projects.

Validation monitoring is to be designed to determine if the management,protection and restoration of ecosystem processes and functions implemented result in stable and well-distributed populations of selected indicator species.

The Final Supplemental Environmental Impact Statement (FSEIS, 2-10) states:

"Monitoring is an essential component of natural resource management because it provides information on the relative success of management strategies."

In a recent District Court decision in a case which unsuccessfully challenged the President's Forest Plan, U.S. Justice William Dwyer stated:

> "A failure to monitor adequately, due to financial constraints, would call for reconsideration of the plan."

Such statements provide clear direction as to the importance of monitoring in the success of implementing the President's Forest Plan.

The ROD for the President's Forest Plan states that monitoring efforts emphasize a high degree of coordination and cooperation with other agencies, groups and organizations. It also states that BLM should work closely with the research community for assistance with systematic and statistical designs for appropriate sampling regimes.

Through the process of completing this analysis, several key needs for monitoring were identified. Listed below are information and monitoring needs that are necessary to implement the President's Forest Plan in the Bear Creek watershed.

Information Needs

Anadromous fish habitat information for all three forks of Bear Creek and their major tributaries.

Potentially unstable areas that need to be included in the Riparian Reserves

Estimated populations of juvenile anadromous salmonids for summer months.

Assess condition of riparian corridor on all segments of the perennial streams.

Inventory the "Survey and Manage" species as specified in the ROD (Table C-3) in the watershed and determine appropriate buffers when necessary.

Location, age, and condition of all existing and abandoned roads within the watershed. In addition, location, condition, and capacity of all stream crossings are necessary to meet the requirements of RF-4 in the ROD (Page C-33).

Inventory bare slides and collect other data to determine feasibility of planting with native species.

Inventory, as necessary, to determine species presence and distribution for mammals, birds, reptiles, and amphibians in the "rare" category as stated in the ROD.

Inventory hardwood stands, identified in this document, for feasiblitiy of manipulation to enhance LSOG characteristics.

Inventory stocking density on re-established conifer stands on cutover acquired lands to assess silvicultural opportunities for enhancing LSOG characteristics.

Inventory densities and locations of snags and down logs throughout the watershed.

Inventory and map forest fuels by category and amount.

Monitoring Needs

Both implementation monitoring and effectiveness monitoring are activities which should be conducted by BLM staff. Validation monitoring should be conducted at a research level over large geographic and temporal scales and then applied to on-the-ground situations in the watershed when needed.

Implementation Monitoring

Periodic reviews of all BLM activities within the watershed should be conducted and compared to the standards and guidelines in the ROD to check for compatibility. Questions that should be asked include:
Are recent or ongoing activities compatible with direction given for Late Seral Reserves?

Are recent or ongoing activities consistent with the Aquatic Conservation Strategy Objectives?

When incompatibilities are detected such activities should be modified, or ceased, as to comply with the ROD.

A periodic review of watershed analysis documents should occur to determine if these documents are still valid or if updates and revisions are necessary.

Effectiveness Monitoring

Effectiveness monitoring should address the effectiveness of the overall objectives of the President's Forest Plan and address the effectiveness of specific projects implemented to achieve the goals of the plan. Below are lists of currently-recognized monitoring needs. Monitoring needs are expected to increase as implementation of the President's Forest Plan is further developed.

Plan Effectiveness
Spotted owl reproductive status of all pairs, functions of Late Seral Reserve over time, and species demographics should be monitored to determine if this Late Seral Reserve is contributing to the recovery of spotted owls as predicted by the President's Forest Plan.

Fecal coliform levels, water temperature, and turbidity in each fork of the stream should be monitored to ensure compliance with the standards set by the North Coast Regional Water Quality Control Board.

Long term salmon spawning counts of index reaches within the North and South Forks should be monitored to determine if these populations are recovering, declining, or stable.

Recruitment of snags and coarse woody debris should be monitored to determine if the rate of development of these features is sufficient to produce habitat features desired by terrestrial and aquatic species.

Abundance and diversity of species in LSOG areas should be monitored to determine if these populations are viable within the watershed or within the Late Seral Reserve

Monitor long-term seral development shifts in forest plant communities to track habitat for various wildlife species, determine if predicted shifts do indeed occur, and track opportunities for management of these areas to benefit wildlife.

Forest fuel levels should be monitored to determine what the risk of various types of fires might be in various areas throughout the watershed and what opportunities exist for creating fuel levels compatible to produce desired fire scenarios.

Project Monitoring (based on some of the potential projects discussed in this document) Monitor effectiveness of road rehabilitation projects after completion. Did each project reduce the potential amount of sediment that would have been delivered to the channel?

Effectiveness of road blocks of abandoned roads along Kings Peak Road. Did these road blocks keep vehicles from accessing these roads? Did this action help to reduce potential sediment yield or chronic fine sediment yield?

Monitor growth and development of areas treated with silvicultural practices (if implemented) to determine if such practices are producing desired results. Are old-growth characteristics increasing? How many years, based on these data, will it take for each area to achieve the characteristics to be included as LSOG?

Monitor turbidity or fine sediment along Chemise Mountain Road prior to and after implementation of fine sediment reduction activities (such as paving, as recommended in Part 4). Has the amount of fine sediment in South Fork Bear Creek decreased significantly?

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Appendix B. List of aquatic amphibians and reptiles in the Bear Creek watershed

List of amphibians and aquatic reptiles captured or that potentially inhabit the Bear Creek watershed, tributary to Mattole River, Humboldt County, California.

Common Name	Scientific Name	Captured / Potential
Black salamander	*Aneides flavipunctatus*	Captured
Pacific giant salamander	*Dicamptodon tenebrosus*	Captured
Tailed frog	*Ascaphus truei*	Captured
Western terrestrial aquatic garter snake	*Thamnophis elegans*	Captured
Northwestern salamander	*Ambystoma gracile*	Potential
Southern torrent salamander	*Rhyacotriton variegatus*	Potential
Rough-skinned newt	*Taricha granulosa*	Captured
Red-bellied newt	*Taricha rivularis*	Potential
Western toad	*Bufo boreas*	Potential
Pacific tree frog	*Psuedachris regilla*	Potential
Northern red-legged frog	*Rana aurora aurora*	Potential
Western aquatic garter snake	*Thamnophis couchi*	Potential
Common garter snake	*Thamnophis sirtalis*	Potential
Western pond turtle	*Clemmys marmorata marmorata*	Potential

Appendix C. Recorded streamflows in Bear Creek (source, CDF&G files)

Historic Flows in Bear Creek

Date	Location	Flow CFS	Temperature Degrees F	Comments
7/20/55	Unknown	24.69	None	Unknown section of Bear Creek
9/6/72	Wailaki Campground	0.2 est	56	0.5 miles downstream from headwaters of South Fork
9/6/72	Campground bridge	1.0	60	Assumed to be Nadelos Campground
9/7/72	Hippie Cabin	3.0	58	Unknown locations along the South Fork as part of a BLM water quality study
9/7/72	Logging show	3.0	68	
9/10/72	50 yds above mouth	5	58	
8/14/73	Logging show	1.67	69	
8/14/73	At Forks	2.67	73	
8/15/73	Wailaki	0.1	58	
8/15/73	Campground bridge	0.42	62	
8/15/73	Hippie cabin	1.05	65	
7/17/75	@ Sheltercove Rd	0.875	NA	South fork
8/19/75	@ Sheltercove Rd	0.38	60	South fork
1/7/76	Near mouth	67.17	46	Mainstem
5/27/76	Near mouth	19.52	56	Mainstem
5/27/76	@ Sheltercove Rd	1.15	54	South Fork
6/29/76	@ Sheltercove Rd	0.86	60	South fork
Sheltercove Rd	0.61	61	South fork	
8/9/76	near mouth	5.14	72	Mainstem
8/9/76	@ Sheltercove Rd	@ Sheltercove Rd	0.61	61South fork
8/9/76	near mouth	5.14	72	Mainstem
8/9/76	@ Sheltercove Rd	0.30	61	South fork
8/26/76	near mouth	4.62	70	Mainstem
8/27/76	@ Sheltercove Rd	0.45	55	South fork
10/4/76	@ Sheltercove Rd	0.25	57	South fork
10/5/76	near mouth	4.49	70	Mainstem
11/17/76	@ Sheltercove Rd	0.94	50	South fork
11/17/76	near mouth	10.54	55	Mainstem
7/20/77	@ Sheltercove Rd	0.58	63	South fork
6/21/78	@ Sheltercove Rd	1.34	56	South fork

Appendix D. Recorded water temperatures in Bear Creek

Stream Survey Data Summary

Date	Location	Flow CFS	Water Temp ^{o}F	Pool Ratio	Salmonid Observations	Comments
8/23/66	Mainstem	6	69	2:1	100 salmonids per 100 ft of stream	Two man-made gravel dams encountered near mouth; stream shaded approx 60%; moderate pops of insects and amphibians; log jam at forks
8/23/66	North fork	3-4	none	2:1	Few due to barriers	37 log jams observed, 37,275 ft^2 of material est.; abundant insects
9/9/66	South fork	4-5	56-61	5:1	200-300 salmonids per 100 ft of stream up to Sheltercove Rd	No logging on lower slopes; stream shaded approx 75%; abundant insect pops; "excellent habitat conditions"; 38 log jams noted
2/17/72	North fork	20-30	44-48	30%	few salmonids	Recent, heavy logging noted with erosion, bank sloughing, logging debris observed in stream; one log jam 20 ft high
2/18-23/72	South fork	35 @ forks	44-48	40-50%	"underutiliz-ed by salmonids"	Notes heavy logging and assoc. damage first 3.25 stream miles from forks; upper reaches "best of all King Range streams"; notes Chemise Mtn road as paved
7/28/72	Main stem to forks	6-10	64-76	30-40%	observed possible summer run of steelhead	Heavy logging damage noted