Upper Hayfork Creek Watershed Analysis – July 1998

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Upper Hayfork Creek Watershed Analysis - Chapter 1

Characterization

Hayfork Creek drains a basin of 234,000 acres and is the largest tributary of the South Fork of the Trinity River, which flows into the main Trinity River and then to the Klamath River before reaching the Pacific Ocean. The 59,310 acre Upper Hayfork Analysis Area includes that portion of the watershed from the headwaters downstream to its confluence with Carr Creek. The watershed lies within the Klamath Mountains ecological section, spanning the Trinity Mountain-Hayfork (M261Ar) and Rattlesnake Creek (M261Au) subsections (USDA, 1997).

Natural disturbance processes that influenced the development of this Analysis Area include fire, mass wasting processes, floods, earthquakes, wind storms, climatic conditions and insect outbreaks. Most of these disturbance processes created relatively instantaneous alterations to biotic communities without persistent changes in the physical structure of the ecosystem. Others such as mass wasting processes could cause sustained alterations of habitat structure and biotic functions. In most cases these natural disturbances were followed by relatively longer periods of recovery.

There are seven ecological units, called land type associations, defined for the Upper Hayfork Creek watershed. These ecological units are defined on the basis of bedrock geology, geomorphology, climate, soils and potential natural vegetation communities. These are relatively broad-scaled ecological units which range from several thousand to tens of thousands of acres in size. These ecological units represent areas which have relatively similar stable terrestrial abiotic characteristics and function.

Land type associations are especially useful for comparing and analyzing terrestrial resources such as soil types, sensitive plants, commercial timber, and upland wildlife habitat. However, for resources and issues strongly tied to water, such as fisheries, road-related sediment, or riparian habitat corridors, subwatersheds are more logical and useful analysis units than are land type associations. Therefore, land type associations and subwatersheds are both used throughout this watershed analysis, where appropriate, depending on the resource being described and the particular points being made.

LTA 1 - East Fork Hayfork Land Type Association (19,012 acres)

This LTA contains metasedimentary rocks of the middle and upper Hayfork terranes, plus a minor component of the Great Valley Group. The soils are shallow and rocky. The vegetation is comprised of a matrix of mixed conifer stands on deeper soils on north aspects and a patchy distribution of shrub fields, live oak, Oregon white oak, grey pine, ponderosa pine and knobcone pine on shallower rocky soils on southerly aspects.

LTA 2 - Gemmill Gulch Land Type Association (13,613 acres)

This LTA is underlain by quartz diorite bedrock of the Ironside Mtn. batholith. Soils derived from the bedrock are highly erodible, especially in the western part of the unit. The vegetation is comprised of a matrix of mid to late-seral mixed conifer/Douglas fir forest with a patchy distribution of ponderosa pine, chaparral/gray pine stands, and knobcone pine stands.

LTA 3 - Chanchellula Land Type Association (1,767 acres)

This LTA comprises Chanchellula Mtn., which is composed of ultramafic rocks of the Hayfork Terrane. It lies entirely within the Chanchellula Wilderness. The soils are relatively shallow and unproductive. The vegetation is dominated by mid to late-seral mixed conifer and white fir, with patches of white oak, jeffrey pine and shrubs. This area is important to the viability of a suite of ultramafic-dependent rare plants geographically restricted to the Rattlesnake Creek Terrane and adjacent parts of the Hayfork Creek Terrane.

LTA 4 - Wildwood Land Type Association (10,676 acres)

The Wildwood LTA is underlain by the metasedimentary rocks of the lower Hayfork Terrane, as well as local areas of the Hayfork melange and the quartz diorite Goods pluton. Soils are relatively deep and very productive. Vegetation is dominantly late seral mixed conifer/Douglas fir stands, with patches of ponderosa pine, hardwood and small meadows.

LTA 5 - Dubakella Land Type Association (3,088 acres)

The Dubakella LTA contains ultramafic rocks and serpentine of the Rattlesnake Creek Terrane. Soils are characterized as having low productive capacity and plant communities are dominantly Jeffrey pine with patches of hardwoods, shrubs and incense-cedar. This area is important to the viability of a suite of ultramafic-dependent rare plants geographically restricted to the Rattlesnake Creek Terrane and adjacent parts of the Hayfork Creek Terrane.

LTA 6 - Jones Burn Land Type Association (7,811 acres)

This LTA is underlain by a variety of rock types associated with melange of the Rattlesnake Creek Terrane. Slump earthflows and small wetlands commonly occur in this unit. Soil productivity is variable, based generally on the underlying parent material, depth and available water capacity. The majority of the area comprises the Jones burn plantation, which is dominantly sapling to pole-sized Jeffrey pine, with patches of mixed conifer/Douglas-fir, ponderosa pine and shrubs. Ultramafic outcrops in the melange are inhabited by the same group of Rattlesnake Creek Terrane endemics as in the Dubakella and Chanchellula LTA.

LTA 7 - Mud Springs Land Type Association (2,552 acres)

This LTA is underlain by the same geology as the Jones Burn LTA, except that it lies at a higher elevation. Slump earthflows are common in this unit. The soils have a frigid temperature regime and are closely associated with white fir stands. Vegetation is dominated by mid to late-seral mixed conifer/white fir, with patches of Jeffrey pine. Much of the area was also involved in the Jones burn.

General Overview

Three elements relative to vegetation are unique to this analysis area: 1) the Jones burn, which occurred in 1959, created a 5000 acre feature in the Analysis Area; 2) a large portion of the drainage is within a Late Successional Reserve (LSR); 3) concentrations of several sensitive and endemic plants are present due to the ultramafic soils in the headwaters of the drainage.

Precipitation varies from 40 inches per year in the lower elevations to as much as 70 inches per year along the ridgelines between Dubakella and Red Mountain, with a distinct wet period from November thorough April and a dry period from May thorough October. Channel forming flows are usually associated with winter Pacific storms after an early period of subsurface recharge. Rain-on-snow events may occur. Stream channels vary for Rosgen A type channels in the headwaters, to B and in some locations C type channels on the main channel. Channel form and aquatic habitat are dependent upon the balance of water and sediment in the channel and its interaction with riparian vegetation. A number of springs are present throughout the analysis area, but particularly numerous in the Jones burn LTA, related to slump earthflows.

The Analysis Area includes the major sub-basins of the East Fork of Hayfork Creek, Wilson Creek, Hall City Creek, Goods Creek, and Dubakella Creek. From its headwaters, Hayfork Creek runs due north until reaching Carr Creek where it turns west. In the Forest Aquatic Conservation Strategy several sub-basins including , Dubakella Creek, Potato Creek, and the headwaters of Hayfork Creek have been identified as important to the distribution and viability of fish stocks at risk.

Steelhead trout are common to the entire watershed and Coho salmon have been listed as Threatened under the Endangered Species Act. Aquatic habitat quality and quantity within and downstream of the Analysis Area is linked to the condition of riparian areas and the balance of sediment and water (dynamic equilibrium). The habitat of downstream species that could be modified as the result of disturbance in the Analysis Area, such as water diversions, include that of coho and chinook salmon and steelhead trout.

There are a number of wildlife species proposed or listed under the Endangered Species Act present in the analysis area including the Northern spotted owl and the American Peregrine falcon. A number of designated sensitive animal species such as pine marten, Pacific fisher, and Northwestern pond turtles are also present. Habitat for these species (including Critical Habitat for NSO) varies in quantity and quality throughout the analysis area. The Chanchellula LSR is key to some species, and its connectivity to other LSR's in adjacent areas is very important at the landscape level.

Within the watershed all or part of 10 known NSO activity centers occur, of which 6, are located primarily in and and/or near the Chanchellula Wilderness and LSR. In addition, it appears that the watershed helps provide important dispersal corridors in the areas south and south/southeast (Mid Fork Cotttonwood and Beegum watersheds) and to the South/Southwest for East fork and

South Fork Trinity areas. Owl dispersal habitat into the latter areas from the Chanchellula LSR is somewhat fragmented in the area north of the Jones burn. Connectivity to the North/northwest (across Hayfork Valley) to the Corral Bottom LSR, is very fragmented.

As noted earlier, both pine marten and Pacific Fisher occur within the watershed. Unique to this area is the high number of fisher sightings in the Jones burn area (some of which would normally be considered as atypical habitat). This species is known to occur in other areas of the watershed as well, including a denning site in the Dubakella Creek drainage.

Portions of this watershed, including Hell-to-Find Lake provides for a fairly high population of Northwestern pond turtles including the presence of several age classes. Portions of Upper Hayfork Creek have one of the oldest monitored populations of this species in the state.

Known sites of Survey & Manage vascular plants and lichens occur in riparian habitats of the Upper Hayfork Creek watershed, mostly north of Highway 36. The survey & manage lichens are strongly associated with middle-aged hardwoods, particularly live oak and bigleaf maple. No survey & manage bryophytes or fungi are documented from this watershed, but no systematic field surveys have been done for these groups.

Long stringer meadows, portions of which are riparian, occur in the middle of the watershed and are considered to represent important existing and/or potential habitat for several species including, willow flycatchers. Some of this habitat type has been affected/modified by various types of land practices including , building of roads and mining.

This watershed is believed to provide for a migratory bird flightway that helps connect portions of the coast to the Central Valley.

Native Americans occupied the Hayfork Creek drainage for thousands of years, and dozens of prehistoric archeological sites preserve a record of their activities. Many of the nor-el-mul (Hayfork Wintu) still live in the area and have an active interest in the Hayfork drainage, particularly Chanchellula Peak and the massacre site at Natural Bridge.

Anglo-American settlement of Hayfork Valley began in 1852 and it soon became known as the "granary of the county." Much of the Analysis Area was public domain and was heavily grazed, predominantly by cattle and horses. The mid-1850's saw the beginning of placer mining on several tributaries of the upper Hayfork drainage, followed later by dragline mining and hardrock mining. The lumber industry developed concurrently with the local need for wood products in ranching and mining operations, and became economically important in national markets after World War II. The 1905 formation of the Trinity Forest Reserves (later the Trinity National Forest) led to changes in forest management practices, particularly in grazing and fire suppression.

Fire is a significant disturbance factor within the Analysis Area. Prior to the initiation of organized fire suppression in the early 1900's, the area was characterized by fires of a short return interval. These fires typically were low intensity, surface fires at intervals of 5 to 30 years. Vegetation types in this fire regime were dominated by fire adapted, fire resistant species. The exclusion of fire, along with other human caused disturbances, has initiated a transition to a fire regime characterized by more frequent, high intensity fire events and vegetation changes such as greater abundance of white fir.

There has also been a transition in fuel composition. Fuels have changed from primarily surface fuels at a low level of loading to moderate or high levels of surface loading, with a vertical fuel ladder connecting the surface fuels to the crowns of the dominant conifers. Parts of the watershed dominated by ultramafic soils do not show this fuel loading, or show it to a lesser degree.

A transportation pattern has developed that today ranges from 350 - 400 miles of road ranging from state highway to rudimentary jeep roads and 12 miles of trails largely associated with the Chanchellula Wilderness. The town of Wildwood lies in the center of the Analysis Area and was a logging industry supported town prior to the mill closing in the late 1970's. The abandoned mill site has not been reclaimed. Early settlement developed water diversions for domestic and agriculture which persist into today. These disturbances along with timber harvest and associated road development, were additive to the natural disturbance regime and had little or no natural analog. These disturbance processes have been widely distributed and of a more persistent nature and have caused sustained alterations of ecosystem structure and function, particularly in riparian areas.

The direction from the Forest Land and Resource Management Plan (FLRMP) for the Analysis Area emphasizes wildlife habitat management, both for late-successional stage dependent species (Rx VII - Late-Successional Reserves) and early to mid seral stage dependent species (Rx VI - Wildlife Habitat Management); anadromous fisheries habitat management (primarily Rx IX - Riparian Management); and sustained commercial timber production (Rx VIII - Commercial Wood Products Emphasis). Refer to Chapter 4 in the FLRMP for more specific management direction.

The FLRMP has designated all of the Analysis Area, outside of Late-Successional Reserves, to be within the Hayfork Adaptive Management Area, with an emphasis on the development, testing, and application of forest management practices which provide for a broad range of forest values, including commercial timber production and provision of late-successional and high quality riparian habitat.

Upper Hayfork Creek Watershed Analysis - Chapter 2

Issues and Key Questions

The purpose of this chapter is to focus on the key elements of the ecosystem relevant to future land management activities, and to identify data and analysis needed to provide broad direction for future projects. Issues and key questions were developed by the interdisciplinary team. Major issues of immediate concern are identified and characterized. Key questions have been developed.

Forest Health

Issue - Fire

Fire suppression and management activities have increased fuel loadings and fuel arrangements within the Analysis Area putting late seral stage wildlife habitat, salmonid habitat, water quality, commercial timber and lives and property within the watershed at an unacceptable risk of loss by catastrophic wildfire.

What are the effects of the interspersed lands on fire suppression and fuel management activities? What is the present fire regime for the watershed? What is the recent historical pattern in fires causes within the watershed? What are the Hazard/Risk ratings within the watershed?

Issue - *Forest Vegetative Dynamics*

The plant associations in the Upper Hayfork Creek watershed evolved under the influence of frequent, low intensity ground fires. Due to fire suppression for the past 90 years, thousands of acres in the watershed do not currently meet the assumptions of the FLRMP for the production of large trees and ecosystem resilience.

What are the current vegetative conditions within the watershed? What is the current vigor/growth of stands in the watershed? What is the current level of tree mortality in the watershed? What is the predicted future for these stands under current conditions? Are sufficient large trees being produced to meet projected replacement and or output expectations under the current FLRMP management? What management tactics should be used employed to meet these expectations?

Human Uses

Issue - *Transportation*

An extensive network of open roads, both Forest system and non-Forest system, have developed in the Analysis Area. Maintenance of this network may conflict with other resource objectives and fiscal reality.

What are the cumulative effects of the existing road system on riparian areas and wildlife? What would be the effect on public recreation and transportation if a major road closure/obliteration program were instituted?

Issue - *Commercial Timber*

The Forest Land Resource Management Plan identifies timber production as an important objective for the Adaptive Management Area/Matrix lands. A primary goal of these lands is to provide a long-term sustained yield of timber from regulated lands (Rx's VIII, VI and III) on the Forest. The FLRMP projected levels of timber harvest (PSQ) and desired condition my conflict with other management objectives for these lands.

What opportunities are available to meet timber production goals while meeting other management objectives, such as dispersal and connectivity for late-successional wildlife species? What regeneration harvesting opportunities (green tree retention and group selection) are available to move the suitable timber lands toward a DFC of a fully regulated timber land base? What intermediate cutting opportunities (commercial thinning) are available to maintain stocking levels that will reduce susceptibility to insect attack and maintaining stand growth? What opportunities are available that will meet AMA objectives to test forest management practices, including timber harvest practices?

Wildlife Biodiversity

Issue - *Wildlife Species/ Habitats*

Help maintain and/or provide for viability/enhancement of selected species and/or their habitats as related to historical and/or existing natural or man induced processes over time within the watershed.

Key Questions: What is the relative abundance and distribution of selected species and/ or their habitats including the use, location, trend, amount and condition of such habitats ? (refer to table 1). How do present day activities, either natural or human-induced, influence and/or affect these species and/or their habitats and the use of those habitats? What can be done to offset/improve selected conditions/effects? What is the role of the LSR relative to biodiversity?

Species

- Northern Spotted Owl - Threatened
- Peregrine Falcon - Endangered
- Northern goshawk, fisher, marten, North western pond turtle - Sensitive
- Neotropical migratory birds, white - headed woodpecker - Species of concern
- Deer, black bear, quail - Emphasis species
- Sensitive and endemic plants - restricted to ultramafic substrates of the Rattlesnake Creek & Hayfork Creek Terranes in southern part of the watershed.
- Survey and Manage species, especially components 1 & 2 - lady's slipper orchids, lichens, bryophytes, mollusks, fungi.

Water Quality/Salmonid Habitat

Issue - *Water Quality*

Past human activities such as mining, road construction, use of fire, stream diversion, and timber harvest have modified streamflow and natural erosion processes and altered the dynamic equilibrium of stream channels in the watershed.

The Environmental Protection Agency in cooperation with the South Fork Cooperative Resource Management Project (SFCRMP) is currently in the process of developing Total Maximum Daily Loads (TMDL) for the South Fork of the Trinity River watershed in fulfillment of Section 304 of the Clean Water Act. The Upper Hayfork Watershed Analysis area is part of the South Fork basin.

What are the long term-erosional processes in the watershed? What are the accelerated erosional processes and rates as influenced by natural and human induced disturbance? What areas of upper Hayfork Creek are highly erodible and require special attention or management? What historical water quality conditions are relevant to the establishment of TMDL's for the Upper Hayfork Watershed? What watershed processes are out of equilibrium and require restoration efforts, and in what order of priority.

Issue - *Anadromous Salmonid Habitat*

Past mining, water diversions, road construction and associated road failures, and timber harvest have significantly altered the quantity and quality of fish habitat in the basin placing anadromous fish stocks at risk.

What are the processes that create and maintain anadromous fish habitat over long periods of time? Have these processes been altered? If the natural processes have been altered how have they affected anadromous fish habitat? How have human induced disturbance altered these processes? What is the predicted future for anadromous fish habitat if the Standards and guidelines of the Aquatic Conservation Strategy are implemented?

Upper Hayfork Creek Watershed Analysis - Chapter 3

Current Conditions

Bedrock Geology

The Upper Hayfork watershed, lying within the Klamath Mountains physiographic province, is separated from the Coast Range Province, to the south and west, and from the Great Valley province to the east. Six different bedrock formations or terranes are present within the project area, each of which trends as belts in a north northwest manner. From south to north they are the Rattlesnake Creek Terrane, the Lower, Middle and Upper Hayfork Terrane, and the North Fork Terrane. In addition, small outliers of the Great Valley Sequence and the Weaverville Formation lie in the northern edge of the watershed, while a small area overlain by glacial till is located within the crest of Chanchellula Peak.

Geomorphology

The Klamath Mountains have been uplifted and eroded at least several times in their most recent history. There are many remnants of the old eroded surface throughout the Klamath Mountains. The Wilson Point area is a remnant of the old eroded surface. The middle portion of Upper Hayfork Creek has incised itself into the watershed. The gorge itself is over 500 feet deep with walls which are nearly vertical. Slopes developed on the Hayfork Terrane and large blocks within the Rattlesnake Creek terrane have undergone significant fluvial erosion, resulting in densely dissected mountain sideslopes. Mass wasting has also influenced many slopes within these bedrock lithologies. In contrast, areas underlain by the small block melange have been strongly developed almost exclusively through mass wasting processes. Therefore, depending on individual bedrock terranes, mass wasting and fluvial erosion are the dominant erosion processes which influence sediment regimes in the watershed.

Mass Wasting Features

Each of the major bedrock units has a characteristic mass wasting character, due to the difference in the lithologies and structure of each unit. The following mass wasting features are well represented within the Watershed.

Translational-Rotational Landslides

This type of slide is defined as one which moves as a coherent or semi-coherent mass along a concave (rotational) or planar (translational) failure plane. This type of slide is not restricted to the zone of weathering and can have deeply lying failure planes. Movements generally occur in the winter and spring when groundwater content is high. Translational-Rotational slides occur primarily within the both the large block and small block melange within the Rattlesnake Creek Terrane. Most of this type of slide occur in association with at least one of the following: serpentinized shear zones, lithologic contacts and wet steep zones such as inner gorges. Some of these slides are extremely large, especially within the large block melange. Many of these large deep-seated slides are ancient, having developed under different climatic and tectonic influences. It is unlikely that they can be reactivated under current conditions.

Debris Slides and Debris Avalanches

These types of landslide generally are confined to the shallow soil or colluvium zone. The failure surface generally corresponds to the bedrock/soil interface and usually is no deeper than fifteen feet. There is a complete gradation from debris slide to debris avalanche depending on water content, cohesion of material and slope steepness. Generally, debris slides have slump blocks at their head, with the slide mass becoming more broken toward the foot of the slope. Movement rates are moderate to high. Debris avalanches, however, commonly fail rapidly, with the slide mass fracturing and liquefying in part as its mass moves down slope. Failures often occur within low-order stream reaches or zero-order basins, or directly adjacent to higher order stream channels and channels. The preponderance of debris avalanches occur near the head of natural zero- order drainages (hollows) sometimes represented only by subtle inflection on the slope. Thus it is the more subtle features which can be the most hazardous. The scars characteristically are long and narrow in shape. Debris slides and avalanches generally occur in response to significant precipitation events. These mass wasting features are extremely common within the Hayfork Terrane.

Internested Translational-Rotational Slides

Internested Translational-Rotational slide areas are commonly found in areas overlain by cohesive earth materials. Typically they consist of individual slides having volumes ranging from 1,000 to 50,000 cubic yards which occur side by side, above, below and on top of one another over a broad area. Creep indicators such as "pistol-butted" and "jackstrawed" trees are commonplace. In the higher hazard types, springs and bogs occur.

Bedrock and structural properties such as downslope oriented bedding or foliation, shear and fault zones or melange areas are often responsible for the occurrence of widespread internested areas. Small block serpentine melange zones within the Rattlesnake Creek Terrane commonly exhibit this slide type.

Slump Earthflows

Slump earthflows are a complex mass wasting feature. They are comprised of various components which have varied processes at work. Slump earthflows generally have a well developed head scarp and lateral scarp which are generally steep and prone to debris slide or internested translational rotational slide processes. The slide mass itself is often highly complex in form and generally broken into many smaller blocks; separated from one another by secondary scarps. Commonly, there are sag ponds, wet areas and floating bedrock blocks on the slide mass. Finally, there is often a well defined toe zone at the lower portion of the slide which is often steep and hummocky. Generally, slump-earthflows are relatively slow moving masses of clay-rich materials. These features are complex, involving many components of different types of mass movement. In general, slump-earthflow movement occurs during the winter and spring where under fully saturated conditions pore water pressures are elevated and intergranular resistance is reduced. High clay content increases the cohesiveness of the material. Failure planes are generally deep (greater than 50 feet) with movement rates ranging from gradual to periodic pulses of rapid movement.

Sediment is usually transferred to the fluvial system near the distal end of the earthflow where channels have developed. Channel stability in the form of bank failure, active headcuts, and lateral gullies is common at the distal portion of most slump-earthflows. Earthflow movement rates are sometimes rapid enough to cause channel abandonment and migration on an annual basis.

Slump-earthflows are well developed in the small block melange of the Rattlesnake Creek Terrane. Many extend from the ridgetop to the streams, encompassing thousands of acres. These slump-earthflows are the dominate topography influencing processes within the small block melange.

Valley Inner Gorges

A valley inner gorge is defined as the slope adjacent to a streamcourse having a slope gradient greater than sixty-five percent which is separated from the upslope area by a pronounced break in slope. Valley inner gorges are formed through channel downcutting which produces an oversteepened slope which periodically fails through debris slides, avalanches or translational-rotational slides which "toe out" in the inner gorge. Active slides are commonly present in these areas.

Geologic Hazards

There are two types of Geologic Hazards present within the Upper Hayfork Creek watershed; Seismic hazards and slope stability hazards.

Slope Stability Hazards

Slope Stability Hazard, as defined by the U.S. Forest Service (Haskins and Chatoian, 1993) is the division of the land surface into areas and the relative ranking of these areas according to degrees of actual or potential natural hazard from landslides or other mass movement on slopes. Natural hazard means the probability of occurrence within a specified period of time, and within a given area of a potentially damaging phenomenon.

This type of hazard analysis considers the relative hazard of the landform component, such as the valley inner gorge, toe zone of a translational slide, debris slide prone slope and crown scarp, in conjunction with material characteristics, slope steepness, local groundwater conditions, and other local factors including seismicity and climate. Features are given a hazard rating on a scale of 1 to 10, with 1 being stable and 10 being extremely unstable. Slope stability hazards within a major portion of the project area are considered to range from none to highly unstable, according to the geologic and topographic conditions previously characterized.

Slope stability hazards exist within the Upper Hayfork Creek Watershed. Some areas such as those underlain by the small block melange have extreme natural hazards, while other areas have relatively low hazards. No Ecological Unit Inventory has been performed for the watershed, therefore, the hazard analysis has not been completed.

Seismic Hazards

Seismic hazards for the Upper Hayfork Creek watershed are tectonically related to the subduction of the Pacific plate beneath the North American plate, and the northern-most extension of "San Andreas" right lateral slip. Relatively deep epicenters of seismic events have been located in the vicinity of the watershed which are related to plate subduction. Recent investigations have revealed that significant events have occurred, and that there remains a threat of large magnitude deep seated earthquakes. The Grogan fault lies approximately 25 miles northwest of the mouth of the watershed. It is believed to be an active northern splay of the San Andreas Fault (Wallace, 1990). It trends north northwest, which is typical of faults in the Klamath and Coast ranges. In addition, the South Fork Mountain Fault, which separates the Coast Range from the Klamaths lies approximately 20 miles west of the watershed. Although evidence is lacking for recent seismic activity on the fault, it parallels the Grogan Fault, so may be a more inland splay of "San Andreas" tectonics.

Soils

Soils in the Upper Hayfork Creek Watershed are generally in good condition. The exceptions are areas of actively eroding soil, areas of compacted soil and areas that have under gone intense site preparation.

Current soil condition can best be described and conveyed in terms of the Land type Association Map.

LTA 2, Gemmill Gulch Land Type Association: This LTA has large areas of soils formed from diorite. These soils have a high to very high erosion hazard rating. Field trip observations show that there are actively eroding areas that need attention. Erosion control measures can be designed and implemented following Watershed analysis and NEPA to correct the problem.

LTA 6, Jones Burn Land type Association: Soil types in the LTA vary greatly due to topography, depth, parent material, and rock content. The one thing that is common to all soils is that the area was burned and heavily site prepared following the Jones Fire. Evidence suggests that there was significant soil displacement and organic matter removal following the salvage logging and site prep. Tree growth and needle retention indicate a site low in nitrogen. Further sampling and analysis would be needed to see if there is an opportunity to restore soil productivity through fertilization.

As for the watershed in general there are areas of compacted soil throughout the watershed from past logging and road building activities. The compacted soil has decreased infiltration and permeability rates, causing increased runoff, erosion and sediment reaching Hayfork creek. An inventory of the compacted areas would provide an opportunity to till the soils and restore the natural hydrologic function of the soil, thus reducing peak flows and cumulative watershed effects.

Water Resources

Physiographic Setting

The Upper Hayfork Creek Watershed drains a 92.7 square mile area from the headwaters of Hayfork Creek along the Red Mtn. - Brushy Mtn. divide to the confluence of Hayfork Creek and Carr Creek. This watershed is the headwaters of the Hayfork Creek watershed (386 sq. mi.) which flows into the South Fork Trinity River watershed (950 sq. mi.). The main stem of Hayfork Creek flows from south to north within the watershed.

The Upper Hayfork Creek Watershed is drained by a dendritic channel network. Major tributaries are generally small in area, flowing into the main Hayfork Creek channel along the elongated shape of the watershed. The largest of these tributaries is East Fork Hayfork Creek which has a drainage area of 23 sq. mi. Other tributaries have drainage areas of 10 sq. mi. or less. The watershed contains approximately 464 miles of stream channels. Of this total 62%, or 290 miles are ephemeral channels, 19% (87 miles) are intermittent channels, with the remaining 19% (88 miles) being perennial channels.

The drainage density for the Upper Hayfork Creek Watershed is 4.9 miles of stream per square mile. Drainage densities for the tributaries range from a low of 3.6 mi./sq. mi. to a high of 6.6 mi./sq. mi. This range is reflective of the variation in geology and soil types. The watersheds having more highly erodible soils have higher drainage densities than those with more resistant geology and soils with low erodibility.

Numerous springs and seeps occur throughout the watershed. Concentrations of springs and seeps are particularly high in the area affected by the Jones Burn and in clearcut blocks. Two prominent wet areas are at Hackney Spring in the Jones Burn and along Goods Creek where flows parallel Hwy. 36. The watershed contains just one small lake, Hell-to-Find Lake, in the upper portion of the watershed near Red Mtn.

Water uses within the watershed include numerous withdrawals from Hayfork Creek and East Fork Hayfork Creek for mostly domestic, agricultural and livestock watering purposes. Quantification of the amount diverted is difficult because only an estimated 13% of the water diverted from Hayfork Creek are under an appropriated water right. All of the other uses are under Riparian Rights, and have no public record of actual use.

Annual precipitation ranges from approximately 70 inches in the highest elevations of the upper watershed to less than 40 inches at the lower end of the watershed near Carr Creek confluence. Most of this precipitation falls as rain below 4000 feet and as snow above this elevation, although a winter long snow pack does not occur below about 5500 feet.

Stream Channel Conditions

Stream channel and streamflow characteristics vary somewhat throughout the Upper Hayfork Watershed due to the differences in soil and geologic composition. Streams draining the area defined in the Gemmill Gulch LTA are deeply incised and are frequently ephemeral or intermittent in flow. They are susceptible to down cutting and widening during peak flows and can be easily destabilized when the watersheds they are draining are disturbed by management. On the other end of the spectrum are the streams draining the Dubakella LTA area. These streams have stabilized in bedrock and are not easily altered by management activities. Streams in the other LTAs are moderately stable under natural conditions and have a moderate susceptibility to destabilization from management activities.

Current channel conditions have been affected in the last century primarily by mining activities within riparian areas, the Jones Burn wildfire and subsequent salvage logging, and the extent and intensity of timber management activities in the past 30 years. Mining activities have included both placer and hydraulic mining in the riparian areas, and hard rock mining in the Hall City area. Placer and hydraulic mining have had the greater affect in the lower reaches of Hayfork Creek and East Fork Hayfork Creek. Piles of mining tailings still line the channels of both streams, constricting flows in places, producing sediment sources, and reducing the proper functioning condition of the stream and associated riparian zone.

Cumulative Watershed Effects (CWE) analysis was performed for the watersheds and subwatersheds of the Upper Hayfork Watershed. Table A presents the results of the analysis. Most of the subwatersheds are well within the 14%-16% Threshold of Concern. The exceptions are found in the upper subwatersheds of East Fork Hayfork Creek, primarily due to the dense road network there. These subwatersheds are located on private land, however, and are not included in the recommendations for the analysis. The "Acres Available for Treatment" columns are derived from calculating the difference between current conditions and the amount of disturbance required to reach a given level of disturbance as expressed as a percentage of the TOC. These numbers are provided for consideration and do not imply goals or limits.

Table A - Cumulative Watershed Effects Analysis

(upper left part of a very large table)

Watershed/ Subwatershed Drainage/ Site Name	W/S Number	W/S Area (acres)	TOC (%)	Plantation Area (acres)	Rcvry (%)	Vegetation Mgt Area (acres)	Road ERA (acres)	Road Length miles	W/S Area (Sq Miles)	Road Density (M/Sq mi)
Upper Hayfork Creek	10101	2428	16	1360	90	136.0	172.4	19.0	3.79	5.00
West Fk Hayfork Creek	10102	1907	16	1149	90	114.9	155.4	17.1	2.98	5.74
Ultramafic	10103	2413	16	717	90	71.7	158.1	17.4	3.77	4.61
Drainage Totals	**101**	**6748**		**3226**	**90**	**322.6**	**485.8**	**53.4**	**10.54**	**5.07**
Upper Dubakella Creek	10201	1925	16	214	50	107.0	133.8	14.7	3.01	4.89
Lower Dubakella Creek	10202	2309	16	412	50	206.0	144.1	15.9	3.61	4.39
Drainage Totals	**102**	**4234**		**626**	**50**	**313.0**	**277.9**	**30.6**	**6.62**	**4.62**
Saddle Gulch	10301	3537	16	142	50	71.0	164.7	18.1	5.53	3.28
String Bean Creek	10302	1089	16	259	50	129.5	69.5	7.7	1.70	4.50
Goods Creek	10303	3371	16	566	50	283.0	253.7	27.9	5.27	5.30
Drainage Totals	**103**	**7997**		**967**	**50**	**483.5**	**488.0**	**53.7**	**12.50**	**4.30**
Hall City Gulch	10401	2342	16	116	50	58.0	133.2	14.7	3.66	4.00
Landis Gulch	10402	1744	16	142	50	71.0	130.9	14.4	2.73	5.28
Wilson Creek	10403	1805	16	205	50	102.5	111.2	12.2	2.82	4.34
Drainage Totals	**104**	**5891**		**463**	**50**	**231.5**	**375.3**	**41.3**	**9.20**	**4.48**
Gemmill Gulch	10501	2154	14	173	50	86.5	87.9	9.7	3.37	2.87
Chanchellula Gulch	10502	1783	16	103	50	51.5	56.2	6.2	2.79	2.22
Sheill Gulch	10503	1136	16	1	50	0.5	9.5	1.0	1.78	0.59
Upper Wildwood Rd	10504	2664	16	58	50	29.0	42.6	4.7	4.16	1.13
Drainage Totals	**105**	**7737**		**335**	**50**	**167.5**	**196.2**	**21.6**	**12.09**	**1.79**
Subwatershed Totals	**1**	**32607**		**5617**	**50**	**2808.5**	**1823.2**	**200.6**	**50.95**	**3.94**

(upper right of table)

Watershed/ Subwatershed Drainage/ Site Name	Veg Mgt ERA (acres)	Total ERA (acres)	Percent ERA (%)	Percent Plantations (%)	CAS acres	Acres Available for Treatment 60% TOC	Acres Available for Treatment 40% TOC	% CAS Acres Treated
Upper Hayfork Creek	24.5	196.8	8.1	56	2384	201	none	57
West Fk Hayfork Creek	20.7	176.0	9.2	60	1689	39	none	68
Ultramafic	12.9	171.0	7.1	30	1927	337	none	37
Drainage Totals	**58.1**	**543.9**	**8.1**	**48**	**6000**	**577**	**0**	**54**
Upper Dubakella Creek	19.3	153.1	8.0	11	2860	176	none	7
Lower Dubakella Creek	37.1	181.2	7.8	18	1541	225	none	27
Drainage Totals	**56.3**	**334.2**	**7.9**	**15**	**4401**	**401**	**0**	**14**
Saddle Gulch	12.8	177.5	5.0	4	429	900	271	33
String Bean Creek	23.3	92.9	8.5	24	662	65	none	39
Goods Creek	50.9	304.7	9.0	17	3	105	none	<100
Drainage Totals	**87.0**	**575.0**	**7.2**	**12**	**1094**	**1070**	**271**	**88**
Hall City Gulch	10.4	143.6	6.1	5	102	451	35	114
Landis Gulch	12.8	143.7	8.2	8	6	132	none	<100
Wilson Creek	18.5	129.6	7.2	11	0	242	none	n/a
Drainage Totals	**41.7**	**416.9**	**7.1**	**8**	**108**	**826**	**35**	**<100**
Gemmill Gulch	15.6	103.5	4.8	8	508	430	95	34
Chanchellula Gulch	9.3	65.5	3.7	6	39	587	270	<100
Sheill Gulch	0.1	9.5	0.8	0	66	553	351	2
Upper Wildwood Rd	5.2	47.9	1.8	2	1116	1155	681	5
Drainage Totals	**30.2**	**226.3**	**2.9**	**4**	**1729**	**2725**	**1398**	**19**
Subwatershed Totals	**505.5**	**2328.7**	**7.1**	**17**	**13332**	**5600**	**1704**	**42**

(lower left of table)

Watershed/ Subwatershed Drainage/ Site Name	W/S Number	W/S Area (acres)	TOC (%)	Plantation Area (acres)	Rcvry (%)	Vegetation Mgt Area (acres)	Road ERA (acres)	Road Length (miles)	W/S Area (Sq Miles)	Road Density (M/Sq mi)
Upper N Fk E Fk Hayfork Creek	20101	1284	16	642	50	321.0	155.1	17.1	2.01	8.50
Lower N Fk E Fk Hayfork Creek	20102	2177	16	1089	50	544.3	225.7	24.8	3.40	7.30
Upper East Fork Hayfork Creek	20103	1950	16	975	50	487.5	112.0	12.3	3.05	4.04
Byrons Creek	20104	1323	16	221	50	110.3	14.0	1.5	2.07	0.74
Sims Creek	20105	1087	16	181	50	90.6	67.0	7.4	1.70	4.34
Rose Gulch	20106	1966	16	983	50	491.5	138.1	15.2	3.07	4.94
Fulton Gulch	20107	1129	16	565	50	282.3	53.5	5.9	1.76	3.33
Upper Potato Creek	20108	2300	16	42	50	21.0	29.5	3.3	3.59	0.90
Lower Potato Creek	20109	1543	16	0	50	0.0	63.7	7.0	2.41	2.91
Lower East Fk Hayfork Creek	20110	2086	16	102	50	51.0	51.1	5.6	3.26	1.72
Drainage Totals	**201**	**16845**		**4799**	**50**	**2399.3**	**909.7**	**100.1**	**26.32**	**3.80**
China Gulch	20201	2904	16	110	50	55.0	74.3	8.2	4.54	1.80
Bridge Gulch	20202	2040	16	86	50	43.0	73.9	8.1	3.19	2.55
Carrier Gulch	20203	1234	16	4	50	2.0	87.5	9.6	1.93	4.99
Lower Wildwood Road	20204	1779	16	136	50	68.0	104.0	11.4	2.78	4.12
Deep Gulch	20205	1900	16	30	50	15.0	77.1	8.5	2.97	2.86
Drainage Totals	**202**	**9857**		**366**	**50**	**183.0**	**416.7**	**45.8**	**15.40**	**2.98**
Subwatershed Totals	**2**	**26702**		**5165**	**50**	**2582.3**	**1326.5**	**145.9**	**41.72**	**3.50**
Watershed Totals		**59309**		**10782**	**55**	**4851.8**	**3149.6**	**346.5**	**92.67**	**3.74**

(lower right of table)

Watershed/ Subwatershed Drainage/ Site Name	Veg Mgt ERA (acres)	Total ERA (acres)	Percent ERA (%)	Percent Plantations (%)	CAS acres	Acres Available for Treatment 60% TOC	Acres Available for Treatment 40% TOC	% CAS Acres Treated
Upper N Fk E Fk Hayfork Creek	57.8	212.9	16.6	50	0	none	none	n/a
Lower N Fk E Fk Hayfork Creek	98.0	323.7	14.9	50	0	none	none	n/a
Upper East Fork Hayfork Creek	87.8	199.8	10.2	50	193	none	none	<100
Byrons Creek	19.8	33.8	2.6	17	41	518	282	<100
Sims Creek	16.3	83.3	7.7	17	0	117	none	n/a
Rose Gulch	88.5	226.6	11.5	50	20	none	none	<100
Fulton Gulch	50.8	104.3	9.2	50	296	23	none	<100
Upper Potato Creek	3.8	33.3	1.4	2	393	1042	633	11
Lower Potato Creek	0.0	63.7	4.1	0	411	469	195	0
Lower East Fk Hayfork Creek	9.2	60.3	2.9	5	901	778	407	11
Drainage Totals	**431.9**	**1341.6**	**8.0**	**28**	**2255**	**2946**	**1516**	**<100**
China Gulch	9.9	84.2	2.9	4	1763	1081	565	6
Bridge Gulch	7.7	81.6	4.0	4	1248	634	272	7
Carrier Gulch	0.4	87.8	7.1	0	853	170	none	0
Lower Wildwood Road	12.2	116.2	6.5	8	1419	303	none	10
Deep Gulch	2.7	79.8	4.2	2	1088	570	232	3
Drainage Totals	**32.9**	**449.7**	**4.6**	**4**	**6371**	**2759**	**1069**	**26**
Subwatershed Totals	**464.8**	**1791.3**	**6.7**	**19**	**8626**	**5704**	**2585**	**60**
Watershed Totals	**873.3**	**4023.0**	**6.8**	**18**	**21958**	**11304**	**4289**	**49**

The Jones Burn wildfire has resulted in greater summer flows from the Jones Burn LTA. In some cases this has contributed to the frequency of slump earth flows in this area. There are several intermittent stream channels within the burned area that are still actively downcutting and/or have unstable banks. Salvage logging directly disturbed stream channels, increased runoff of peak flow events, and contributed fine sediments to the channel system. The logging resulted in contributing large quantities of large woody debris to the system initially, but left no standing trees for later large woody debris recruitment.

Timber management activities have occurred throughout the watershed, but have had the most impact in the East Fork Hayfork LTA and the Gemmill Gulch LTA. Extensive road building and use of tractor yarding harvesting systems in the East Fork have had the effect of increasing overland flow to stream channels and producing increased fine sediment loads to the Hayfork Creek system. Increased peak flows also occur because of the increase in drainage density resulting from inside road ditches and direct drainage from skid trails.

Erosion control and other watershed restoration activities have been conducted in the Upper Hayfork Watershed. In 1993 the Trinity River Restoration Program funded over 50 projects in the watershed, providing more than $30,000 in improvements. The work consisted of using erosion control netting, grass seeding and fertilization to stabilize eroding road prism cut and fill slopes, armoring ditches and culvert inlets and outlets, refurbishing drop inlets to culverts, streambank protection on a mile of stream, and the installation of rock check dams for channel stability. These projects were accomplished as high priority improvements although many sources of sediment related to unsurfaced, poorly drained roads still persist.

Hydrology

There is a limited amount of actual streamflow measurements in the watershed to characterize magnitudes of peak and base flows. The USGS maintained a continuous flow gage within the watershed on Hayfork Creek just downstream of Carrier Gulch from 1956 to 1965. The NRCS and TCRCD made a few low flow measurements in 1995.

Table B displays the lowest and highest flows that have been adjusted to account for the total drainage area of the Upper Hayfork Creek Watershed (USGS, 1971). Minimum flows do not account for water diversions further downstream than Carrier Gulch, including East Fork Hayfork Creek.

Water Year	Minimum Flow (cfs)	Maximum Flow (cfs)
1957	1.3	2052
1958	2.5	3485
1959	5.9	1593
1960	2.1	3004
1961	3.5	1261
1962	2.7	786
1963	1.9	2042
1964	4.6	1732
1965	2.2	5912

Flow measurements taken in Hayfork Creek above Deep Gulch in 1995 showed flows of 33.5 cubic feet per second (cfs) on July 11, 8 cfs on August 10, 5.6 cfs on September 29, 5.9 cfs on November 3, and 6.8 cfs on November 13 (TCRCD, NRCS, 1997).

Minimum flows as represented in Table A are relatively low for forested watersheds. They are low due to the geology of the watershed and the precipitation pattern. Soils are generally shallow and rocky, lying on top of competent bedrock, thus having a low water holding capacity. With the watershed being at an overall low elevation, mostly below 4000 feet most precipitation falls as rain and is quick to runoff into the stream system, leaving little water storage for low flows. The summers are hot and dry for several months running through the summer and into the autumn of the year. The accumulated effect of these factors results in very little water flowing in Hayfork Creek during the late summer and early autumn months of the year.

Maximum or peak flows occur in response to rainfall events, primarily in the months of December and January. The highest flow recorded was during the December, 1964 flood event when the flow was estimated at 5,912 cfs, nearly twice as much as had been previously recorded at the site. Estimates of the 1955 flood event indicated that the peak flow reached 4500 cfs. The 1964 flood resulted in considerable scouring of the channel bed and destruction of riparian vegetation. There has been no evidence of a flood event as large as the 1964 event since that time. Riparian vegetation has been steadily growing back since that event.

The watershed is susceptible to rain on snow events occurring between the elevations of 5500 ft. and 4000 feet. These events result when warm wet storms saturate existing snow packs causing greater than normal peak runoff events. Although these conditions caused considerable damage to other watersheds in the January, 1997 storm the Upper Hayfork Watershed did not receive abnormally high amounts of rainfall during this storm.

Water diversions in the lower reaches of Hayfork Creek and the East Fork Hayfork Creek have been recognized as being a detriment to downstream water quality and fish habitat, (Trinity County, 1987). It is generally recognized that the supply of water in the Hayfork Valley in dry years is not sufficient for current users and beneficial uses in Hayfork Creek (Trinity County, 1987). Trinity County declared the Hayfork watershed (from Little Creek to its headwaters) to be a Critical Water Resource area in 1987. The effect of this declaration was to prevent sub-division of parcels unless water rights could be secured by means other than riparian rights. In a report prepared in 1988 Trinity county also identified the East Fork Ranch Diversion of Hayfork Creek below Wildwood as the cause for significant water supply problems (Trinity County, 1988). In 1987 this diversion had completely dewatered Hayfork Creek downstream of its dam. Subsequent cooperative efforts with the Natural Resources Conservation Service (NRCS) and Trinity County Resource Conservation District (TCRCD) have resulted in improvements to prevent a repeat of such conditions.

Water Quality

Water quality data for this watershed is also limited. A report published by the TCRCD and NRCS provides some water quality information for the Upper Hayfork Watershed (TCRCD, NRCS, 1997). A summary of this data is given in Table C.

	TDS [1]	Spec Cond [2]	pH	Total Coliform	Fecal Coliform
Deep Gulch					
6-9-94	200	320	9.4	570	15
9-13-94	450	810	8.5	900	170
12-13-94	440	325	8.4	200	170
3-28-95	130	200	8.2	20	<5
5-23-95	150	250	8.2	20	10
8-15-95	210	400	8.3	40	8
11-13-95	155	260	8.3	10	0
5-23-96	148	220	8.2	100	30
8-28-96	300	420	8.1	110	30
11-25-96	140	230	8.3	900	10
Wildwood					
9-13-94	210	300	8.6	10	10
12-13-94	680	220	8.4	220	30
3-28-95	100	130	8.2	10	0
5-23-95	100	140	8.2	<5	0
8-15-95	140	260	8.4	10	20
11-13-95	200	330	8.1	5	0
5-23-96	100	130	8.2	20	<5
8-28-96	190	260	8.3	10	10
11-25-96	100	140	8.3	110	<5

1: Total Dissolved Solid
2: Specific Conductance

Data for Total Dissolved Solids (TDS) and Specific Conductance were collected in the Upper Hayfork Watershed for comparison purposes to data collected downstream. Both the parameters can show degradation of water quality when high quality water is withdrawn for irrigation purposes and lower quality return water flows back into the stream system. Generally these parameters suggest that the sampling location furthest upstream has the lowest figures and is of high quality for forest streams. There is no apparent degradation of water quality suggested by the sampling results. pH values of 8.0 and 8.5 are commonly recorded in streams within the South Fork Trinity River watershed (USFS, 1990). The level of pH indicates that there has been no reduction of water quality from acid mine drainage from the old mining sites in the analysis watershed.

Coliform counts (both total and fecal) vary widely as can be expected with such infrequent and time dispersed sampling. Fecal coliform counts fall within the range of acceptable limits for primary contact recreation waters. There appears to be no consistent problem with sewage disposal or concentrations of livestock along the stream sampled.

Water temperatures have been measured in the main channel of Hayfork Creek at four locations within the Upper Hayfork Creek Watershed. Three sites were measured in NRCS in 1995 and 1996 (TCRCD & NRCS, 1997), and one site by the Forest Service in 1994 (unpublished data). All of the data collected included daily high and low water temperatures between the months of

June and October. Generally water temperatures in the main channel of Hayfork Creek increase from the headwaters to the lower end of the watershed.

Based on data from TCRCD and NRCS (1997) the relatively low elevation of the watershed contributes to low water temperatures being in the low 60° (16-18° Celsius) during the summer months. Based on these data daily high water temperatures exceeding 20° (6° F) were common both years. Exposure of the water surface to direct solar radiation is largely responsible for increased temperatures during the day. Riparian vegetation partially shades the main stem of the stream. Large scale mining activities along the channel removed most of the vegetation decades ago. Subsequent flood events have prevented complete vegetative recovery along the damaged stream banks. High water temperatures may go down in the future with further growth of riparian vegetation, but not by more than a few degrees.

Sediment yield data is lacking for the portion of Hayfork Creek in the analysis area. Published reports discussing sediment yields (USBR & TRTF, 1994, CDWR, 1979 and CDWR, 1992) concentrate on the lower portion of Hayfork Creek and the main stem of the South Fork Trinity River. These reports have classified the Upper Hayfork watershed as having a moderate to low sediment yield.

Sources of sediment within the analysis watershed include erosion from roads throughout the watershed, especially from roads close to stream channels and roads having inside ditches. Rill and gully erosion associated with land uses have occurred in the highly erodible diorite soils in the Gemmill Gulch area. Landslides and mass wasting events have contributed sediment to the stream channels in the upper 1/3 of the watershed. Mining disturbances in the riparian zones continue to be a source of sediment as stream banks shift during high flows. The East Fork Hayfork Creek watershed contributes higher than normal sediment yields due to the high level of ground disturbing activities (based on storm flow observations).

Turbidity measurements taken during a storm runoff period in January, 1978 showed very low turbidity readings for five sampling sites along the main channel of Hayfork Creek and a moderate turbidity level for the sample taken in East Fork Hayfork Creek (CDWR, 1979). Low erosion hazards and resistant bedrock types were reasons given for the relatively low level of turbidities detected.

Fisheries

Hayfork Creek today supports anadromous runs of steelhead trout, Pacific lamprey, and chinook salmon. In the past it may have supported coho salmon. The reports from early settlement days just speak of salmon with little or no distinction between chinook and coho. Within the Analysis Area steelhead and lamprey are known to occur. Steelhead in particular are know to spawn in ephemeral and intermittent stream channels provided sufficient water is present at the time of spawning. Ephemeral and intermittent stream channels are common in the Analysis Area. Juvenile steelhead will rear in such streams until low water forces them to emigrate to larger and deeper stream channels. Dewatering of such channels by diversions can cause significant losses in annual production of juvenile steelhead.

The stream channels in the upper Hayfork drainage exhibit signs of disequilibrium as a result of early mining and road construction which altered channel configuration and large woody debris recruitment processes. There is strong evidence that shifts away from channel equilibrium can result in negative changes in the structure and function of stream ecosystems and their dependent fish populations (Bilby and Likens 1980; Schlosser 1982). Bisson and Sedell (1982) reported that where stream channels had become destabilized riffles elongated and in many cases extended through former pool locations resulting in loss of pool volume and large stable debris for cover. They suggested that declines in older fish may result due to their dependency upon deeper water habitats.

Removal of riparian forests for mining and roads, fire suppression and the practice of removing large wood from active channels following flood events has altered the amount and rate of recruitment of large woody debris into Hayfork Creek channels in the Analysis Area and downstream. The function of headwater streams and their importance to downstream supported fisheries has been reviewed by Bilby and Likens (1980) and Schlosser (1982). Their work suggests that organic debris dams are a important component of small stream ecosystems and that their loss results in considerable seasonal and annual variation in the trophic structure and total biomass of aquatic ecosystems. The results of several researchers suggests that by maintaining lateral and instream habitat complexity in association with channel stability in multiple sub-watersheds we can best provide for the persistence of viable populations of these sensitive species over time (Karr and Freemark 1983; Karr and Dudly 1981; Gorman and Karr 1978).

Structurally diverse streams in watersheds unmodified by human activity typically have a great deal of buffering capacity to sustain fish populations: channel pattern and bed configuration tends to moderate the effect of floods; pools in association with large woody debris offer excellent refuges for fish during summer low flows and winter high flows; and canopy cover moderates thermal loading.

In the Hayfork drainage the ecological processes that create and distribute fish habitat attributes and especially stream channel dynamic equilibrium, have been significantly modified by human activities. In particular mining, road construction, cleaning streams of large wood after each flood and stream diversions have had a synergistic effect of reducing the overall complexity and quality of fish habitat in the Analysis Area and probably effected smolt production although data are not available for smolt production.

The observed differences in relative abundance of habitat types such as pools, riffles, pocket water and run/glides in unentered and entered watersheds noted in other watersheds (Cross and Everest 1996; McIntosh et al 1994) suggest that it is human activities that have created the changes. The present habitat for anadromous fish in upper Hayfork Creek is the result of the cumulative effects of over ten decades or more of land management activities that have resulted in widespread loss of stream channel integrity and modification of vital fish habitat. Exceptions include the sub-basins of Potato Creek and Shiell Gulch where road densities are particularly low. These changes in ecological processes that in the past have created and maintained anadromous fish habitat in the Hayfork drainage, and other sub-basins of the South Fork of the

Trinity River, have led to high risk for a number of native anadromous fish stocks especially steelhead and coho salmon (MNFS 1997).

Commercial Timber

The Upper Hayfork Analysis Area contains commercial timber which contributes to the Forest Allowable Sale Quantity (ASQ) of 82 MMBF and the Forest goal to provide a sustained yield of timber and other wood products to help support the economic structure of local communities and to supply regional and national needs (FLRMP, Timber #35, page 4-5).

This commercial timber is located on lands identified as capable, available and suitable (CAS) for timber production, in FLRMP Management Prescriptions III, VI and VIII. The Forest LMP93 database indicates that there are about 10,636 CAS acres (after adjustments for riparian reserves), or about 23 percent of the total 47,194 acres of National Forest land in the Analysis Area.

Lands within the Late-Successional Reserve (Rx VII), Riparian Reserves (Rx IX), the Chanchellula Wilderness (Rx V) and the Natural Bridge SIA (Rx X), are not included in the CAS land base.

Table D is a summary of the CAS acres in the Analysis Area, by Management Prescription and timber strata.

Timber Strata	Timber Type	Size Class	Stocking Class	Rx III Acres	Rx VI Acres	Rx VIII Acres	Total Acres
M2G	Mixed Conifer	Poles	Good	0	202	38	240
M2P	Mixed Conifer	Poles	Poor	6.0	7	77	91
M3G	Mixed Conifer	Small/Medium Sawtimber	Good	56	1487	1611	3154
M3P	Mixed Conifer	Small/Medium Sawtimber	Poor	126	2135	2069	4330
M4G	Mixed Conifer	Large Sawtimber	Good	1.0	107	16	124
XX1	Plantations (0-10 years)	Seedlings/Saplings	All	0	233	439	672
XX2	Plantations (11-20 years)	Saplings/Poles	All	0	31	1860	1891
XX3	Plantations (21+ years)	Poles	All	0	43	91	134
			Total Acres	**189.0**	**4245**	**6201**	**10,636**

About 70 percent of the timber stands on CAS land are in the small/medium sawtimber size class, 28 percent in the younger age classes, and only 2 percent in the older age classes. Most of the older age class timber in the watershed is in the Late-Successional Reserve, outside of the CAS land.

A total of 173.6 MMBF of timber is estimated to be within the CAS lands.

Most of the mixed conifer stands in the Analysis Area are comprised primarily of Douglas fir and ponderosa pine, with lesser amounts of sugar pine, white fir, and incense cedar. The stands in the Mud Springs LTA are heavier to white fir and jeffrey pine. Other non-commercial species, such as grey pine and hardwoods, are typically found in many of the mixed conifer stands throughout the Analysis Area.

The productivity of the CAS lands is generally moderate or average site (Forest Survey Site Class 5 or Dunning Site Class III).

The medium and large sawtimber size classes are high priority for regeneration harvest primarily because they are growing poorly and/or poorly stocked. The densely stocked pole and small sawtimber size classes are priority stands for intermediate commercial thinning harvest.

Past logging, mostly partial cutting, has occurred throughout much of the Analysis Area outside of the Wilderness Area and the released roadless areas.

Most of the older plantations resulted from reforestation after salvage logging of the Jones Burn in the southern end of the Analysis Area. Plantations from past regeneration clearcutting are also concentrated in the southern end and in the Late-Successional Reserve. Very little regeneration cutting has occurred in the northern portion of the Analysis Area.

Much of the private land in the northeastern portion of the Analysis Area has been logged.

Forest Health and Stand Conditions

The pine plantations in the Jones Burn are approximately 37 years old. Growth projections indicate that this site should be completely biologically occupied at this age if the basal area reaches or exceeds 170 square feet. The fact that pockets of mortality have occurred over the past few years means that the plantation has already accumulated enough biomass that the supply of at least one critical resource (probably water) is no longer adequate. Radial growth generally begins to slow at about the same time that mortality begins to increase in a stand. Ponderosa pine is a shade-intolerant, early successional species. The maximum rate of production of fiber in a ponderosa pine stand which is not constrained by competition occurs at about age 38 to 40. Even if a stagnated stand is thinned at an older age, it will never achieve the same growth as a stand which is free to grow over its entire lifespan. The Jones Burn plantation is not growing at its full potential and most trees will not achieve maximum diameter sizes.

The LSR has an overstory which is predominantly large diameter, older Douglas-fir, in the 200-500 year age range. There are also aggregations of large diameter, older ponderosa pine and scattered sugar pine in the overstory. There are several layers of understory, which consists mostly of shade-tolerant conifers such as white fir, Douglas-fir and incense-cedar. There are also hardwoods such as madrone and several species of oaks which exist as scattered individuals or small aggregations in the understory. Mortality and top dieback are common in overstory trees. Top dieback can influence the future natural regeneration of the stand because the female cones are generally borne in the upper part of the crown of conifers. Mortality among the pines is disproportionately high. The current situation is that the older overstory is beginning to die at an accelerating rate and the stagnated, shade-tolerant understory will not provide similar replacement trees.

The Gemmill Gulch area appears to have had a stand structure similar to the LSR prior to the point at which it was harvested. Some units resulted in ponderosa pine plantations which are growing relatively well. Other units removed an overstory which was predominantly large-diameter ponderosa pine and left an understory which was predominantly small diameter Douglas-fir. This understory was 80 to 100 years old and had relatively short crowns at the point when the overstory was removed. Some of the units do not have the potential to produce a stand which is similar to the tree size, density or species composition of the overstory which was removed.

The northern end of the Upper Hayfork Creek watershed contains a mosaic of aggregations of chaparral fields, knobcone pine stands, gray pine aggregations, oak stands, and stringers of older mixed conifer dominated by Douglas-fir. Both knobcone pine and gray pine are fire-adapted species which rarely reach beyond 80 years of age. There are many acres of knobcone pine and gray pine in this area which are near or at the point of biological rotation. The stringers of older Douglas-fir dominated mixed conifer are strongly associated with riparian areas. Fire scars indicate that these trees survived many ground fires. Fire exclusion has allowed an encroachment of understory trees and shrubs in these stringers. The understory trees compete with the overstory for moisture, but do not have the potential to replace the overstory trees as they die. Both the understory trees and the number of dead overstory trees will provide a fuel ladder in the mixed conifer stringers in amounts which did not exist in the historic past.

Grazing

Settlers came into this area in the mid 1800's bringing with them various types of livestock; predominantly cattle, horses, sheep, goats and some swine and fowl. Lands of Public Domain were established in the late 1800's and were under the purview of the U.S. Government. Grazing during this era (1860-1905) was not closely administered and settlers took their stock onto these lands pretty much at will with very little control over numbers, types of animals or season of use.

During this time livestock owners utilized various management practices on their own lands as well as on Public Domain Lands including the use of prescribed fire to burn over/off areas that were grazed by their animals each year. While results of this are not entirely known, this type of treatment, which was also being used by the Native Americans when the settlers arrived on the scene, played a role in the ecological succession and condition of various vegetation types/species. One of the primary results was the loss or reduction of new conifer growth or regeneration on sites capable of producing such species.

Another management practice (1854-1865) was that of bringing in, accidentally or deliberately, seeds of non indigenous plant species. This coupled with grazing eventually resulted in a decline in native annuals and perennials and an increase in exotic annuals and perennials in the Mad River and Eel River areas some 20 miles to the south (Keter 1995). It is likely that such events also occurred in portions of the UHF area as well.

The Trinity National Forest was established as a National Reserve in 1905 and in 1906 was established as a National Forest. Between 1906 and 1910 the Trinity National Forest begin fairly active management of their range program (Contrary to Keter, 1995 page 8). The 1910 Trinity Range Report supports this supposition and outlines actions taken by the USFS on resource concerns in both the Yolla Bolla and Hayfork District sections of the report. Primary actions included 1) completing the first assessments of estimated carrying capacity and comparing that to existing use at the time these Public Domain Lands came into the National Forest Service (this type of analysis led to significant reductions in authorized grazing between 1906 and 1910 including the exclusion of grazing by sheep on the Yolla Bolla and Hayfork units almost entirely) and 2) the Forest Service stopped or attempted to stop the practice of permittees burning over grazing areas as they went out or came off of the allotments. The primary reason for this was to allow for the establishment and growth of new conifer forest areas (Trinity Forest Range Report 1910). This latter effort, of course, affected what we see vegetatively on the ground today, namely 90-year-old conifer stands.

During World War 1, there was a national demand for increased red meat production and grazing on the Trinity National Forest reached and sustained its highest levels of grazing (since 1906) from 1917 through 1923, after that grazing use for all classes of animals again declined. Sheep grazing was basically non existent by the mid 30's with cattle and horse use increasing slightly for World War II and then basically leveling off at pretty close to present day levels by the 1950s.

The UHF watershed has been predominantly occupied by two grazing allotments since 1910, Wildwood (1911-present) and Hayfork Canyon (1911-1953). These two allotments were or have been almost entirely permitted to cattle and horse grazing with the exception of two or three years of documented sheep grazing prior to 1923 on the Wildwood allotment. Use on these two allotments has pretty much patterned that described above for the Trinity NF.

Currently only Wildwood exists as an active allotment within the UHF watershed. A small portion of this allotment falls within the upper reaches of the middle fork of Beegum Drainage. This allotment permits 30 head of cows and calves and 8 head of horses/mules. Forage base for this allotment is primarily provided from transition range (old plantations i.e. Jones Burn) with some scattered open stringer type dry and/or wet meadows. Forage species are composed of both annual and perennial plants. Season of use for this allotment is from 5/15 - 10/15 which generates some 190 animal months (AMs) which is one adult animal for one month of use.

The permit for this allotment will come up for re-issue in the year 2000. At that time the NEPA process must have been completed or the permit is to be reissued at that time as per existing permit conditions. If upon completion of the NEPA process amendments need to be made in the permit they will be done at that time. There have been no major concerns identified with respect to grazing and its effects on other resources within the UHF area. Some minor concerns have been noted with respect to grazing within some riparian habitat areas. Present management direction and intent from the FLRMP including the ACS and recent consultation with the National Marine Fisheries Service (NMFS) are believed to be sufficient to handle these, thus range/grazing will not be discussed or considered further in this document. Biodiversity/Wildlife

Biodiversity:

Documentation from sightings, nest locations and habitat/distribution models (Timossi 1993) have indicated 303 species of wildlife are or may be associated with the habitat and elevations characteristic of the Upper Hayfork watershed (WL App 1).

This watershed was found to be fairly rich in the amount and type of habitats. Included are old growth, hardwoods, chaparral, dead standing/down woody material, caves, limestone outcrops, talus, riparian (springs, seeps, creeks, streams and small ponds or lakes), cliffs, wet/dry meadows (these are quite small except where created and maintained by man) and several vegetation types to be discussed in more detail below.

It should be noted that for vegetation analysis there were two systems available, LMP 95 and the Ecological Unit Inventory (EUI) system. Both were run and used for different aspects of the analysis. There are some major differences between the two data displays as a result of differences in definitions and data plots. One needs to be cognizant of this fact when using the two systems.

Using the Ecological Unit Inventory (EUI) system to map out vegetation resulted in the identification of 21 vegetation types/combinations with the largest being mixed conifer which makes up some 33,000 acres or 56% of the UHF watershed (Refer to EUI veg. map). Douglas-fir is attributed with some 10,000 acres (17%), Jeffery pine 4,337 acres(7%) and Douglas-fir/Pine for 2,600 acres(3%). The remaining 17 vegetation types/combinations account for the remaining 17%.

Using the LMP 95 data base, a display of seral stage groups is presented in Table E.

	Old Growth 4 & 5, N & G	Pot Old Growth, Mostly 3 N & G	Early/Mid Mature Shrub/ Seedling Pole	Early Grass/Forb young growth shrub	Total
Acres FLRMP	2,895	13,916	23,162	2,051	47,000

Looking at the FLRMP data Old Growth (4&5 N&G) makes up only 6% of the total watershed acres and approximately 16% of those acres capable of producing this type. These Old growth stands are found predominantly (greater than 60%) within LSR 331 and the Chanchellula Wilderness area (LTA's 2&4). Old growth stands within the LSR and Wilderness are comprised of fairly large blocks (>80 ac.) or contiguous intertwined stands. Most of the stands outside of these areas are less than 80 acres in size.

Potential and/or additional (dependent upon further verification) old growth/older mature stands (M3 N&G on good site) are found scattered throughout the UHF unit with concentrations in the LSR, wilderness and in a band just NW of the old Jones burn area (LTAs 6&7). Many of these stands are greater than 80 acres in size.

The Jones burn area at the southern tip of LTA 6 is made up of some 3,258 acres of regeneration stands, many of which exhibit "dbh" greater than eleven inches and more than 60% crown closure. In addition to the regeneration stands in the Jones Burn area there are several units within the LSR; primarily along the eastern edge below the wilderness and in the southern tip of the LSR (LTA 4) south of Highway 36. There are also a few regeneration units in the NW portion of the UHF unit.

There are over 15,000 acres of M3P stands scattered throughout the watershed including LTA5 which is a strip of large open crown pine stands on serpentine soils. These stands occur in blocks exceeding 100 acres, in some areas.

Hardwoods such as black oak and madrone are found scattered throughout most of the UHF unit often within mixed conifer stands. Neither the EUI or LMP data bases seem to reflect the true amount of these species.

Truly early seral stage (young shrubs, grasses and forbs) in areas with less than 5-10% timber overstory are very limited outside of some of the regeneration units.

Shrub/chaparral types occur in fairly pure stands and usually in areas with less than 10% timber overstory including hardwoods. Both the hardwood and chaparral/shrub types are found in greater abundance from the middle of the LSR north and northwest.

Wildlife Species/Groups Habitats

This section will address the selected emphasis habitat types, seral stages and species associated with them. Refer to **Table F**.

Diversity/ Habitat Type	Emphasis Species/Status	Primary Wildlife Uses	Mgmt. Implications/ Concerns/Opportunities
Early-Mid Seral			
chaparral seedlings saplings poles, grass forbs, shrubs meadows yg plantation	Deer Quail Bear Fisher Marten NTMB	Winter Range, Forage, Nesting Cover, Fawning Areas	Decadence, Loss of Access, Rx fire and Thinning Availability or amount
Mid-Late Seral			
CC 20-60% Poles, Mid sized timber, Older Plantations	Bear Goshawk NSO Quail Deer	Travel Dispersion, Nesting, Forage, Cover	Retention, Roads/Access, Connectivity, Rx use Fire, Thinning, i.e., Jones Burn area

Diversity/ Habitat Type	Emphasis Species/Status	Primary Wildlife Uses	Mgmt. Implications/ Concerns/Opportunities
Late-Older Mature			
CC > 60%, multilayer, larger tree, obvious decadency	NSO Goshawk Fisher Marten	Nesting/Forage, Denning, Dispersion	15% Retention Rule, Mgmt. to enhance OG, Connectivity to other OG Stands, LSR, CHU, Road Density.
Riparian			
Springs, Seeps, Streams, Creeks and Zone of Influence	NTMB Deer Bear WPTurt Rip Oblig PF	Forage, Nest, Fawning, Water Source	ACS, Buffers, Mgmt. for Rip Depend Species, Travel Corridors, Need for Protection/Mgmt.
Chaparral			
	Deer Bear Quail NTMB	Forage, Nesting, Cover, Travel, Escape, Thermal	Opp for use of Rx fire, Reduce Decadence, Increase Nutrition, Enhance Access within Stands
Special			
cliffs caves talus Dead Std/Dn · snags · down logs edge hardwoods	PF/T Bats Salaman " Cavity Nesters Deer Goshawk/S	Nesting Forage Cover	Protection, Maintenance, Access reduced, Density levels below standard, Fire Rx

Late-seral (Mature)/Old-Growth Dependant Wildlife Species

Several late-seral/old-growth (LS/OG) dependent species are known to occur within the Upper Hayfork Watershed (WL App 1). Suitable nesting/roosting and foraging habitat requirements (4&5 N&G, 3 N&G and 3 and 4P on Dunning Site Class 1,2&3 lands) for old-growth dependent species either exist or are expected to be provided through LSR, Unmapped LSRs, Riparian Reserves and Matrix/AMA' old-growth' retention guidelines. Suitable NR&F habitats as described above are also considered suitable for dispersion of species within this area. Refer to the vegetation section above for a description of amount and location of this habitat type within the UHF watershed also a more detailed discussion of this type will occur in the NSO section. (It is assumed that providing for this type of habitat in such a manner as to provide for the needs of the NSO will also help provide for the needs of other old growth dependant species occurring in the area).

Late-Successional Habitat

As with the distribution of Suitable Habitat, LS/OG dependant species are distributed through out the UHF unit.. Generally, the habitat these species are keying into includes late-seral multi-storied forested habitats with at least a portion of these stands exhibiting >70% canopy cover (lot of M3 G stands). Generally, in addition to above description of suitable; dispersal habitat is defined as mid to late-seral forested habitats with 40% or greater canopy closure.

Refer to vegetation section under biodiversity for additional information on amount and distribution of these types as well as to the Old Growth map. For both the old growth and potential old growth types a significant portion falls within the LSR.

Dispersal/Connectivity Habitat

Dispersal habitat can be provided through management of whichever strategy provides the greatest benefit, such as retention of 100 acre cores, riparian reserves, LSR's, or analysis of 50-11-40. Within the watershed, dispersal habitat was analyzed using the traditional minimal habitat requirement for dispersal (>11`` dbh and >40% canopy closure, as well as the following size/density stands: 4&5 N & G, and 3 N & G on Dunning Site Class 1, 2 & 3 lands). The riparian reserves (USGS base map, without unstable areas) make up an estimated 23% of the landscape and provide an estimated 1-2% of the currently functioning dispersal habitat. Within the UHF watershed, there are currently 7 known northern spotted owl activity centers, and 3 more known to occur within 1.3 miles of the UHF boundary. The portion of activity centers which is suitable habitat also plays an important role in dispersal opportunities across the UHF watershed.

Currently, 13,000 acres of the capable lands in the watershed are considered dispersal habitat, with another 18,000 acres expected to become dispersal habitat within 50 years. The majority of the capable dispersal habitat is found within LSR 331; the Chanchellula wilderness; in a band in LTA 6 just north of the Jones burn; and in bands to the north of the LSR on the east and west sides of the Wildwood Road, approximately 1/2 mile in width between the road and Upper Hayfork stream corridor.

Connectivity of LSR 331 to LSR 330 was assessed with a landscape approach, and integrated with similar analysis done for the Beegum and East Fork of the South Fork Watershed Analyses. Connectivity was also assessed between activity centers in the LSR, but outside the UHF watershed; and between activity centers within the UHF watershed, but outside the LSR and/or outside of the 1.3 mile activity centers of the UHF watershed. Results indicate that connectivity between LSR 331 and LSR 330 primarily exists within two broad corridors extending north from different portions of LSR 330. Connectivity is probable through LTA 6 and/or LTA 7. However, dispersal habitat connectors from those LTA's into the currently functional central portion of LSR 331 is questionable, since there is a band of older pine stands on serpentine soils (LTA 5) which may represent a barrier in the southwestern portion of the Upper Hayfork watershed. Also, connectivity to the southeast corner of LSR 331 from the northwest corner of the Beegum watershed is primarily composed of habitat best described as potentially suitable within the next 50 years. There are some residual existing suitable habitat stands in the area that may provide owls with dispersal opportunities to the extreme southern edge of LSR 331. However, connectivity from the southern portion of LSR 331 across Highway 36, and then north to the center of this LSR, is not currently available. Northern spotted owls may be able to disperse through limited areas of larger trees with crown closure less than 40% (i.e., in serpentine areas), but there is a significantly greater risk of predation. Future management options may also be able to enhance these linkages. In addition, a Forest LSR assessment may provide additional information on the role which riparian corridors play in assisting with additional connectivity.

Dispersal habitat is also important for species which use a variety of habitats, such as deer, bear, and several late-successional species which also utilize mature chaparral habitats and/or regenerated burn areas (i.e., the Jones burn), such as the fisher. Dispersal habitat is also important for species which travel from forested areas into other habitats, as well as across coniferous habitats which include saddles and ridges which may facilitate movement between drainages.

Early-Mid Seral or Multi Guild Species

Within the watershed, several species of hardwood, chaparral, shrub, and grassland associated species occur (Timossi 1991, App 1) including game animals, survey and manage species, snag dependant Species and neotropical migratory birds.

Snag Dependant Wildlife Species

Thirty-four (34) wildlife species believed to occur within the Upper HF watershed are dependent on snags for nesting (App 1). Several of the snag dependent wildlife species are primary excavators (species which create cavities) including the white-headed woodpecker and pygmy nuthatch. Snag densities are required to provide for these two species at the 100% population level (LMP 95). Forest observation records, breeding bird surveys, Christmas bird counts, and spotted owl surveys have confirmed their distribution within the Hayfork District. Three of the snag dependant wildlife species are bark cavity dwellers. This group includes two survey and manage bat species.

Current known snag densities

Preliminary surveys (including EUI 1996 data) within the Beegum WA area to the southeast of this unit indicate that snag densities there range from 2-4 snags/acre, sometimes reaching 6 and 8 snags/acre. How these compare to actual snag densities within the UHF area is not known and further verification will need to be completed on a project basis.

Suggested snag densities based on the S-T Forest model and FLRMP capability models indicates the following snag and recruitment densities are appropriate in this area for the cavity dependant species which are associated with them (**Table G**):

Habitat	Snag/Acre	Recruit/Acre
Hardwoods	2.5	7.5
Riparian	3.0	9.0
Jeffrey Pine	4.0	12.0
Ponderosa Pine	4.0	12.0
Mixed Conifer	4.0	12.0

Whether these snag densities naturally occur within the watershed for each habitat type is currently unknown. Also, whether snag densities are met on a 40 acre average is unknown. On the acre average, most of the areas impacted by past timber harvest or located on poor growing conditions are expected to be less than the numbers suggested. For areas of timber harvest, this may be a reflection of a 1.5 snag/acre retention guideline versus the current suggested retention. For poor growth areas, levels may just be naturally low than what is suggested. All other forested areas are expected to meet the current snag density suggestions, at least on the 40 acre average.

Most of the hardwood stands are considered non-commercial and emphasis has been on conifer trees, so, except for fuelwood cutting, harvest of hardwoods is expected to have a minimal impact on naturally occurring snag numbers. As a result, the snag density needs for wildlife within hardwood habitat is expected to be met.

Dead/Down Dependant Wildlife Species

Ten species of wildlife are dead/down wood dependent species (App 1). For a description of dead/down requirements for dependant species see App 3 of this document and FLRMP capability models in appendix G. The amount of dead/down within the watershed is unknown. Fuelwood loading analysis was not presented in this WA and therefore the amount of dead/down could not be analyzed. Only one report (Adamson & Ratledge 1992 from the adjacent Beegum WA) indicated that dead/down levels for part of that area were at 4-6 tons per acre. Many portions of the UHF unit are known to exceed this level.

Aquatic and Riparian Dependant Wildlife Species

Fifty-four (54) species of aquatic and/or riparian dependant species are believed to occur within the Upper HF watershed (App 1). These include, but are not limited to Pacific giant salamander, Pacific treefrog, American dipper, great blue heron, tree swallow, yellow warbler, beaver, and western aquatic garter snake. Species of Concern include the Northern red-legged frog, Foothill yellow-legged frog, tailed frog, and Northwestern pond turtle which is quite abundant in the area including Hell to Find Lake. Numerous stream systems are found within the watershed some of which have been drastically altered by mining practices (refer to fisheries section). Habitat requirements vary from intermittent standing water with varied amounts of vegetation and vegetation type to permanent, cool water, with instream cover and surrounded by dense riparian vegetation. Management of riparian reserves is expected to help provide for species listed in the aquatic and riparian guilds. Possible conflicts with aquatic conservation strategy objectives effecting these aquatic species include cattle grazing in meadows and riparian areas in the southern portion of the UHF that falls within the Wildwood allotment. These possible conflicts will be offset by the application of appropriate range management practices as per the FLRMP.

Threatened, Endangered, Sensitive Species of Concern

American Peregrine Falcon (Federally Endangered)

There is one suspected/known peregrine falcon eyrie within the east side of the watershed a portion of this area extends into the wilderness.

Spotted Owl (Federally Threatened)

Federal records show that 7 NSO activity centers (ACs) are located within the this watershed. An additional three ACs lie outside the watershed, but within the 1.3 miles of the boundary and an additional 4 lie outside the watershed but within 3 miles. It is expected that some of the owls lying outside of the unit but within 1-3 miles, may be using habitat within the watershed. Refer to Wildlife Appendix for additional information on UHF owls.

Within the watershed, three AC fall within the LSR and two within the Wilderness all ACs within the LSR are above 500 acres at the .7 mile radius and two are above 1336 acres at the 1.3 mile radius. The other AC has just over 1036 acres at the 1.3 mile radius. The other two ACs within the unit have not been assessed at this time.

According to the Beegum preliminary analysis (detailed analysis is being conducted outside of this and the Beegum WAs) indications were that LSR RC-330 has a larger amount of as well as less fragmented LS habitat than LSR RC-331 to the North. This indicates that RC-330 is more functional and will be fully functional sooner than RC-331. However; recent completion of portions of the outside analysis indicates that LSR 331 is not as fragmented as originally thought and in fact is considered to be functional now as is LSR 330. More detailed information on the status of LSR 330 & 331 will be provided later in the document and in the appendices. Refer also to suitability map and to writeup for LSR 331 in appendix.

Critical Habitat for the threatened northern spotted owl (Strix occidentalis caurina) is a legal designation identified under the Endangered Species Act, having been designated on January 15, 1992 (57 FR 1796). The intent of critical habitat is to provide the physical and biological features that were the basis for determining the habitat to be critical. Those physical or biological features are referred to as ``primary constituent elements," and may include, but are not limited to: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally (5) habitats that are protected from disturbance or are representative of the historic, geographical and ecological distributions of a species. The primary constituent elements for northern spotted owl critical habitat include: (1) forests which provide nesting, roosting, or foraging habitat, including stands which currently provide foraging habitat for resident spotted owls, even if the stand may not currently provide nesting conditions; (2) forest stands with adequate tree size and canopy cover to provide some protection from avian predators and at least minimal foraging opportunities. It is important to note some dispersal habitat may not provide nesting, roosting, or foraging habitat, though nesting, roosting, and foraging habitat will provide for dispersal; (3)

lands that have the potential to produce nesting, roosting, foraging, or dispersal habitat sometime in the future, though not currently in such a habitat condition.

Critical habitat within the analysis area includes #CA-36. This critical habitat unit is smaller in size than the former Habitat Conservation Area (HCA) from which it was drawn. Part of the original HCA was not included because it contained very fragmented habitat. This critical habitat unit is important in that it adds protected habitat around the Chanchellula Wilderness Area and fills a void in the southeastern part of Trinity County. It lies approximately seven miles north and east of #CA-36, and 11-12 miles southeast of #CA35 and #CA-34.

Approximately 60 percent of the watershed has been performed to protocol for calling routes, SOHAs, and tim ber sales, from 1990 to 1996. From 1989 to 1994 district biologists or private individuals conducted unofficial surveys within 80% of the watershed. About 40 percent of the watershed has not been surveyed for spotted owls.

Northern Red-legged Frog (FS Sensitive)

While systematic surveys specific to the northern red-legged frog have not been conducted within the watershed, personnel responsible for past stream and wetland surveys looked for this species. No sightings of this species have been reported within the area. Red-legged frog habitat has not been surveyed or mapped, however it is suspected that habitat for this species does occur scattered throughout the watershed.

Northern Goshawk (FS Sensitive, CA Sp. of Special Concern, Category 2)

Goshawk habitat does occur within the UHF unit and occupancy is suspected although not verified. Goshawks have been seen in adjacent areas to the unit.

Willow Flycatcher (FS Sensitive, California Endangered)

Willow flycatcher habitat has not been mapped, but may occur throughout the watershed in relatively small, narrow, fragmented patches primarily along the main stem of Hayfork creek and within the adjacent meadows. No surveys for this species or habitat has been conducted in the watershed and the presence of Willow Flycatchers has not been verified.

Pacific Fisher (FS Sensitive, CA. Spp. of Special Concern)

There have been sightings of this species has throughout the watershed with the Jones Burn area being an area reflecting high use by fisher.

American Marten (FS Sensitive, CA. Spp. of Special Concern)

There are sightings of this species within the watershed. True fir occurs along some of the higher ridges within the watershed in small scattered stands. Wet areas and meadows surrounded by forested habitat also provide habitat (Adamson & Ratledge 1992). Otherwise, current habitat conditions are similar to other late seral/old growth associated species.

Northwestern Pond Turtle (FS Sensitive)

Some systematic/monitoring surveys specific to this turtle have been conducted within the assessment area. Even with this work being completed population levels remain unknown. Hell to Find Lake has been documented as having a significant population of turtles. Hayfork creek within this area is one of the few areas within the state documented as having a reproducing population of this species.

Game Species

Black-tailed Deer

Management plans for the Hayfork Deer Herd were completed in 1966 and 1985 by the California Dept. of Fish and Game, Region 1 in cooperation with U.S. Forest Service, U.S. Bureau of Land Management and the U.S. Park Service. These plans indicate the population trends, suitable fawning habitat, and possible management for winter and summer range. This herd contains resident and migratory Colombian black-tailed deer.

Current Concerns: Current concerns for the black-tailed deer focus on the conditions of the shrub and oak woodland habitats in the transitional and winter range (Dave Smith, CA Dept. F&G, pers. comm. 1997). Deer use the watershed as both summer and winter range. They also migrate through the watershed from the Wilderness, upper elevation forested habitat, and forest/chaparral interface (summer range) down to lower Oak annual grass foothill areas. Most of the Northwestern portion of the UHF unit has been identified as comprising winter range. Especially those areas of chaparral and oak annual grassland. A lot of the chaparral areas are interspersed with different types of conifer and/or hardwood stands.

When migrating, the deer forage on grasses and forbs in the early spring and into the summer and early fall, acorns in the fall, and shrubs year-round. Migration is expected to be primarily along most major streams and in some cases along major connecting ridge systems.

Based on the knowledge that fire has been absent from the chaparral/hardwood community for the last 15 years, and limited prior to that with the onset of fire suppression, most of the chaparral community is expected to be in a decadent, non-palatable, low accessibility condition.

Bats

Eleven bat species may occur within this watershed, five of which are Survey are Manage species (long-eared myotis, fringed myotis, long-legged myotis, pallid bat and silver-haired bat). Some require caves, mines, abandoned wooden bridges and buildings (LMP 95) for roosting sites, others require snags (see Snag Dependent Wildlife Species - Bark Cavity Dwellers), still others utilize both types of roost sites. Foraging areas vary from shrub, chaparral and open fields to streams, lakes and or meadows; essentially, anywhere insects can be found. There are no confirmed sightings of any bat species in the watershed; however, suitable habitat exists.

Neotropical Migratory Birds (NTMB)

Seventy-five (75) NTMBs are suspected to occur within the watershed. Examples include Cooper's hawk, sharp-shinned hawk, yellow warbler, and yellow-breasted chat in the riparian guild, green-tailed towhee, golden eagle, prairie falcon in the open-shrub guild, killdeer in the open-grass guild and brown creeper, flammulated owl and varied thrush in the late seral guild (App 1). These species require breeding habitat and migration corridors. Because of alteration to breeding habitat and increased exposure to predation and parasitism many of these populations have undergone significant declines. Habitat preservation and restoration is the backbone of maintaining current populations of NTMBs. Following proper management of breeding habitat, exposure to predation and parasitism is expected to become reduced.

Fire

The historical fire regime for the Analysis Area was a short return interval/low intensity fire regime. High intensity fires were uncommon. The fire regime has transitioned to one of moderate to high intensity fires which are now occurring at more frequent intervals. Fire exclusion due to suppression activities has eliminated the large, low intensity surface fires. Current conditions reflect the absence of these fires with dense, overstocked stands of fire intolerant species and with a moderate to high accumulation of residual down woody fuels.

A fire regime is a consequence of the interaction of the frequency of ignition, weather, topography, and fuel loading and composition. The Analysis Area can be described largely by a single fire regime, however there are several individual components within the Analysis Area that result in site specific situations.

LTA 1 - East Fork Hayfork Land Type Association

This LTA is composed of mixed conifer stands on north facing slopes and a mixture of oaks, Ponderosa pine, grey pine, knobcone pine and shrub fields on the drier south facing slopes. The mixed conifer stands have a dense understory of fire intolerant species that form a fuel ladder from the ground to the crowns of the dominant conifers. Down residual fuel loadings range from moderate to heavy throughout most of these areas. The drier south facing slopes contain fire adapted species where the exclusion of fire has allowed for moderate to heavy accumulations of down residual fuels. Dead to live ratios for the shrub fields is high due to the absence of fire.

The Hazard/Risk rating for the LTA is Moderate/High. The patchy distribution of the shrub fields, pine stands and oaks provides for pockets of High/High areas. Risk (fire occurrence) for the LTA is high throughout. Human caused fires are concentrated along the County road and throughout the private lands in the eastern portion of the LTA. Lightning caused fires are concentrated along the major ridges.

LTA 2 - Gemmill Gulch Land Type Association

This LTA is composed of mid to late-seral mixed conifer/Douglas-fir forest with a mixture of Ponderosa pine, chaparral, and knobcone pine stands. The mid to late-seral stands have a dense understory of fire intolerant species that form a fuel ladder to the crowns of the dominant conifers. The exclusion of fire has lead to heavy accumulations of down residual fuels that will result in fire behavior intensities exceeding the natural characteristics of these stands. Fire exclusion has also resulted in dense, overmature knobcone pine stands and chaparral stands that have very high dead to live ratios.

The Hazard/Risk rating is Moderate/Moderate with the knobcone pine and chaparral stands providing pockets of High/Moderate. Human caused fires are low and scattered throughout the LTA. Lightning caused fires are high and evenly scattered throughout the LTA.

LTA 3 - Chanchellula Land Type Association

This LTA is composed of mid to late-seral mixed conifer and white fir with a patchy distribution of oak, shrubs and Jeffrey pine. The mid to late-seral stands are similar in fuel composition to those in LTA 2. The white fir stands have heavy accumulations of down residual fuels. The patches of oak and Jeffrey pine occur on the drier south facing slopes and have moderate levels of down residual fuels. Shrub patches are high in dead to live ratios due to fire exclusion.

The Hazard/Risk rating is Moderate/Moderate. White fir stands will tend to be more of a Low/Moderate rating due to specific site characteristics (moister climate) and the Jeffrey pine and shrub patches will tend to be more of a High/Moderate (drier sites). Human caused fires are very low due to inaccessibility and lightning caused fires tend to be concentrated on the major ridges.

LTA 4 - Wildwood Land Type Association

This LTA is predominantly late-seral mixed conifer. The deep productive soils have allowed for a very dense understory of fire intolerant species. Fire exclusion has lead to heavy accumulations of down residual fuels. The patches of Ponderosa pine and hardwoods have moderate accumulations of down residual fuels with some fire intolerant species in the understory.

The Hazard/Risk rating in Moderate/High. The drier south slopes tend to be more of a High/High rating. Human caused fires are high in this LTA and are concentrated in the Wildwood community and along the County Road and State Highway. Lightning caused fires are also high and are scattered throughout the LTA.

LTA 5 - Dubakella Land Type Association

This LTA is dominated by serpentine soils with sparse vegetation. Jeffrey pine with patches of incense cedar, hardwoods and shrubs have low to moderate residual fuel loadings due to fire exclusion.

The Hazard/Risk rating is Low/Low. Areas within the LTA that support pockets of dense vegetation will have a Moderate/Low rating. Fire occurrence for both Human caused and lightning caused fires is low.

LTA 6 - Jones Burn Land Type Association

This LTA is dominated by the pole sized Jeffrey pine plantations resulting from the Jones fire in 1959. Also occurring are pockets of mixed conifer and Douglas-fir. Although the down residual fuel loading is low, the continuity of the pole size pines leads to an increased potential for a large, high intensity wildfire. The pockets of mixed conifer and Douglas-fir have a higher down residual fuel loading due to fire exclusion.

The Hazard/Risk rating is Moderate/Moderate. Human caused fires are low and scattered throughout the LTA. Lightning caused fires are moderate and concentrated in both the southern and western portions of the LTA.

LTA 7 - Mud Springs Land Type Association

This LTA is dominated by late-seral mixed conifer/white fir. The higher elevations in this LTA are characteristic of stands with low fire occurrence. Due to this there are high accumulations of down residual fuels with a dense understory of fire intolerant species.

The Hazard/Risk rating is Moderate/Low. Fire occurrence within this LTA is very low.

Plant Species of Concern

Threatened and Endangered Plants (federally listed under ESA)

There are no federally listed Threatened or Endangered plant species known to occur on the Shasta-Trinity NFs. Water howellii (*Howellia aquatilis*), a listed species known to occur in seasonal ponds on the Mendocino National Forest, may also occur here. Informal surveys of several small natural and man-made ponds on the Yolla Bolla Ranger District in 1996 and 1997 by Shasta-Trinity botanists Julie Nelson, Maria Ulloa-Cruz, and Sue Pappalardo did not result in finding any water howellia populations. However, the surveys may have been done at suboptimal times for detecting the plant, and not all ponds on the District were visited, so the negative survey results are not conclusive.

Sensitive & Endemic Plants

Table H lists six sensitive and endemic plants are known to occur in the Upper Hayfork watershed. These are:

Known Sensitive & Endemic Species	Habitat
Serpentine goldenbush (*Ericameria ophitidis*)	Strongly associated with ultramafic (serpentine) soils of the Rattlesnake Creek & Hayfork Creek Terranes.
Dubakella buckwheat (*Eriogonum libertini*)	"
Niles's madia (*Madia doris-nilesiae*)	Strongly associated with ultramafic (serpentine) soils of the Rattlesnake Creek Terrane
Stebbins' madia (*Madia stebbinsii*)	"

Known Sensitive & Endemic Species	Habitat
Peanut sandwort (*Minuartia rosei*)	"
Pale yellow stonecrop (*Sedum laxum* ssp. *flavidum*)	Geographically limited to Rattlesnake Creek Terrane, but associated with various rock types

Current condition of known sensitive & endemic plant populations and habitat

Because of the melange of geologic units in the Rattlesnake Creek & Hayfork Creek Terranes, ultramafic areas are, by nature, scattered islands interspersed with other soils. In addition to this natural fragmentation, ultramafic habitat in the watershed is highly fragmented from past road building. The barren or open appearance of serpentine areas makes them attractive for parking, landings, equipment staging etc. These soils revegetate very slowly after surface disturbance, so tire tracks, bulldozer lines, skid trails, and decommissioned roads stay bare for many years. The majority of ultramafic-dependent sensitive and endemic plant populations in the watershed have suffered incremental losses of individuals because of these kinds of disturbances. A few local populations appear to have been extirpated. Sensitive plant populations may not expand into disturbed habitat until a favorable climatic cycle occurs (i.e. wetter than usual), because of the inherent harshness of the sites.

The best remaining large blocks of ultramafic soil suitable for sensitive plant habitat in the watershed are from South Dubakella Mountain down to the Wild-Mad Road, and from Upper Hayfork Creek east to String Bean Gulch; and in the Chanchellula Wilderness. These areas have not been entered for timber harvest. All the other sizeable islands of suitable habitat have been compromised by roads through or into their centers.

Current condition of habitat for suspected sensitive plant species (Table I)

Suspected Sensitive Plant Species	Habitat
Shasta pincushion	Strongly correlated with ultramafic (serpentine) soils, but not limited to Rattlesnake Creek Terrane; known occurrence in Smoky Creek watershed
Oregon willow-herb	Seeps and springs, usually on ultramafic soils; known occurrences in Beegum watershed
Umpqua green gentian	Seeps and springs, openings in white fir/Douglas-fir forest; known occurrences on South Fork Mountain.

Shasta pincushion: Ultramafic habitat in the watershed is fragmented, as described above. No surveys for this species have been done in this watershed, as it is of relatively recent conservation concern.

Oregon willow-herb: Seeps and springs are relatively plentiful on ultramafic habitat in the south end of the watershed. Their current condition is unknown. No surveys for this species have been done in this watershed, as the plant is of relatively recent conservation concern.

Umpqua green gentian: White fir/Douglas-fir forest suitable for Umpqua green gentian is found in the southwest end of the watershed, on Dubakella Mountain, and along Hwy. 36. It is currently fragmented by roads and timber entry over the past three decades. Project surveys for timber sales in this part of the watershed have not located Umpqua green gentian, and no surveys have been done for this species outside of project areas.

Survey and Manage (S&M) plants, lichens, and fungi

Known site information for survey & manage species is derived from the Regional Ecosystem Office (REO) Known Sites Database, version 2.0, 1997; plus additional information received by the Shasta-Trinity National Forests since 1997. See botany appendix for maps and data tables.

Current condition of known S&M vascular plant populations and habitat

Clustered or brownie lady's-slipper habitat is hard to pin down. Parent material appears to be unimportant, elevations range from 1300 to 5300 feet in California, sites can be damp or dry, rocky to loamy; plant communities include mixed evergreen, mixed conifer, Douglas-fir, pine, and black oak forests and woodlands (Appendix J2). The known populations in the Hayfork Creek watershed and adjacent watersheds are in old Douglas-fir forests, in inner gorges of perennial streams. Populations are very small, all fewer than a dozen plants each. Trinity County seems to be marginal habitat for this species, as populations farther north on the Klamath, in the Pacific Northwest, and in the Rocky Mountains may have thousands of individuals (**Table J**).

Known S&M Vascular Plants	Habitat
Clustered lady's-slipper (*Cypripedium fasciculatum*)	A wide variety of forested habitats; in Upper Hayfork watershed, known from shady riparian forests.
Mountain lady's-slipper (*Cypripedium montanum*)	A wide variety of forested habitats; in Upper Hayfork watershed, known from shady riparian forests.

The ecological amplitude of mountain lady's-slipper is similarly broad, but populations in this watershed are also in old Douglas-fir forests in inner gorges; at Natural Bridge the two orchids grow near to each other. This orchid also grows in very small populations in this part of its range, indicating that habitat here is marginal for the species due to some unknown factor.

Therefore, for these two orchids, suitable habitat may be found in older stands of conifers or oaks throughout the watershed, but optimal habitat in this watershed is in moist, shaded old Douglas-fir forests in inner gorges of perennial or ephemeral streams.

Current condition of habitat for suspected S&M vascular plants (**Table K**)

Suspected S&M Vascular Plants	Habitat
Sugar stick (*Allotropa virgata*)	A wide variety of forested habitats; most often on red fir.

Sugar stick has been reported from Douglas-fir, hemlock, grand fir, silver fir, and lodgepole pine vegetation series, ranging from 1500 to 5000 feet elevation (Appendix J2). I have heard reports of its occurrence along the mainstem Trinity River near Forest Glen (Everett, pers. comm.) but have not seen documentation. We are finding it associated with red fir in the Trinity Mountains and Medicine Lake Highlands, at elevations up to 7000 feet. It could be anywhere in the watershed that there are older conifers and plenty of large, rotted woody material on the ground.

Current condition of known and suspected S&M bryophyte populations and habitat

No survey & manage bryophytes are known from Upper Hayfork watershed. The lichen surveyor of the Upper Hayfork watershed in 1997 (see next paragraph) was also knowledgeable about bryophyte identification, and although he looked, he found no survey & manage bryophytes during that survey. Suitable habitat attributes are unknown for this area, so habitat condition cannot be analyzed.

Current condition of known S&M lichen populations and habitat

Nine survey & manage lichen species were found in the Upper Hayfork Creek watershed during a 1997 survey (Steiger, July 1997). One of these, *Lobaria hallii*, is a component 1&3 ("conduct extensive surveys & manage sites") species: The remainder are component 4 ("conduct general regional surveys") lichens. None of these lichens is a component 2 species requiring project-level survey (FLRMP Appendix R...Table L).

Known S&M Lichen Species	Survey Strategy	Habitat
Collema nigrescens	4	On live oak, black oak, white oak, & bigleaf maple in various conifer/hardwood associations.
Lobaria hallii	1,3	On bigleaf maple and black oak in Douglas-fir/black oak and Douglas-fir/maple associations. Known sites in S. Fork Goods Creek & Carrier Gulch will require protection under NW ROD and LMP S&Gs
Lobaria pulmonaria	4	On live oak & maple, in Douglas-fir/live oak & Douglas-fir/maple associations.
Nephroma helveticum	4	On live oak, black oak, & bigleaf maple in various conifer/hardwood associations.
Nephroma resupinatum	4	On live oak, black oak, white oak, & bigleaf maple in various conifer/hardwood associations.
Pannaria saubinetii	4	On live oak in Douglas-fir/live oak association.
Peltigera collina	4	On live oak, black oak, & bigleaf maple in various conifer/hardwood associations.
Pseudocyphellaria anomala	4	On live oak & black oak in various conifer/hardwood associations.
Pseudocyphellaria anthraspis	4	On live oak, black oak, white oak, & bigleaf maple in various conifer/hardwood associations.

Lobaria hallii was only seen in two places in the Upper Hayfork watershed; in one place (South Fork of Goods Creek) it was associated with a perennial stream; in the other (Carrier Gulch) it was at the upper end of an ephemeral drainage near the ridgetop dividing Upper Hayfork from Salt Creek watershed. Douglas-fir/black oak and Douglas-fir/maple associations are concentrated in the northern half of the watershed. In particular, the ultramafics in the southern part of the watershed are unsuitable habitat.

The other S&M lichens occupy hardwoods in Douglas-fir/canyon live oak associations, mostly in stands less than 150 years of age (Steiger, 1997). Suitable habitat for these lichens varied from 20-85% total cover, 10-85% hardwood cover, 5-50% conifer cover, and 10-60% slope. Aspect was also variable. Most live oak stands in the watershed are still intact except for having roads built through them; since live oak's commercial value is low, little has been removed in historic times. Douglas-fir/canyon live oak stands are plentiful throughout the lower half of the watershed, especially north of Highway 36.

Current condition of known S&M fungi populations and habitat

No survey & manage fungi are known from Upper Hayfork watershed, but no systematic survey has been done. Suitable habitat attributes are unknown, so habitat condition cannot be analyzed.

Transportation

The transportation system for the Upper Hayfork Creek Watershed is comprised of over 360 miles of road.

State Highway	4.2 miles
County Road	24.6 miles
Private Land Road	78.0 miles plus uninventoried
FS Land Jeep Road	29.0 miles plus uninventoried
FS System Road	225.1 miles

22.7 miles of the Level 1 road is currently closed, the remaining 36.8 miles are open and effectively in Level 2 status. 14.4 miles of the all year closure is by barrier and 8.3 miles is achieved by gate. An additional 6.0 miles of road is seasonally closed by gate.

The Forest Service lands have an adequate road system for land management needs with the possible exception of two areas. These are the Chanchellula and Salt Gulch Released Roadless Areas. Each of these areas has substantial unroaded acreage in the Adaptive Management Area.

The Forest Service system roads have the following surface types:

Asphalt concrete	8.7 miles
Chipseal	2.9 miles
Rocked	60.2 miles
Native	153.3 miles

Each road has been assigned one of four maintenance level designations ranging from Level 4 (high use, paved surface) to Level 1 (prescribed all year closure). The maintenance level totals are:

Level 1	59.5 miles
Level 2	113.6 miles
Level 3	40.4 miles
Level 4	11.6 miles

Due to the decrease in timber harvest activity, and the declining road maintenance budget, maintenance efforts have been focused primarily on the more heavily used roads. This has contributed to areas of concern due to surface erosion, and possible fill failure, which could affect water quality. These areas occur mainly on native surfaced roads that have been rutted by vehicle traffic, and by the lack of the needed maintenance to correct the problem. Also of concern is the relatively high road density in some areas, which may have a negative effect on both water quality and wildlife.

Road Density Total

All Roads (watershed):	360.9 + miles = 3.89 + miles/sq mile 92.7 sq. miles
All Roads (FS land only):	268.8 + miles = 4.04 + miles/sq mile 66.6 sq. miles
All Roads (Private land only):	91.7 + miles = 4.85 + miles/sq mile 18.9 sq miles
FS Roads (including jeep, FS land only):	252.6 + miles = 3.79 + miles/sq mile 66.6 sq miles*
Native Surface FS Roads (FS land only):	180.8 + miles = 2.71 + miles/sq mile 66.6 sq miles*
Open FS System Roads (FS land only):	202.4 + miles = 3.04 + miles/sq mile 66.6 sq miles*
All Year Closure Roads (Current prescription):	59.5 + miles = 0.89 + miles/sq mile 66.6 sq miles*

* excluding the 7.2 sq miles in the Chanchellula Wilderness area

Table Q - Road Density by Subwatershed

Subwatershed	
010101	19.63 miles = 5.18 miles/sq mile 3.793 sq mi
010102	17.90 miles = 6.01 miles/sq mile 2.979 sq mi
010103	18.04 miles = 4.78 miles/sq mile 3.771 sq mi
010201	16.11 miles = 5.36 miles/sq mile 3.007 sq mi
010202	16.23 miles = ?.?? miles/sq mile ?.??? sq mi
010301	15.99 miles = 2.89 miles/sq mile 5.527 sq mi
010302	7.12 miles = 4.18 miles/sq mile 1.702 sq mi

Subwatershed	
010303	30.58 miles = 5.80 miles/sq mile 5.268 sq mi
010401	14.32 miles = 3.91 miles/sq mile 3.659 sq mi
010402	13.52 miles = 4.96 miles/sq mile 2.724 sq mi
010403	12.30 miles = 4.36 miles/sq mile 2.820 sq mi
010501	10.80 miles = 3.21 miles/sq mile 3.366 sq mi
010502	4.51 miles = 1.62 miles/sq mile 2.787 sq mi
010503	0.00 miles = 0.00 miles/sq mile 1.774 sq mi
010504	4.66 miles = 1.12 miles/sq mile 4.163 sq mi
020101	16.10 miles = 8.02 miles/sq mile 2.007 sq mi
020102	25.38 miles = ?.?? miles/sq mile ?.??? sq mi
020103	11.36 miles = 3.73 miles/sq mile 3.047 sq mi
020104	1.10 miles = 0.53 miles/sq mile 2.067 sq mi
020105	3.17 miles = 1.87 miles/sq mile 1.699 sq mi
020106	8.67 miles = 2.82 miles/sq mile 3.072 sq mi
020107	6.59 miles = 3.74 miles/sq mile 1.764 sq mi
020108	0.64 miles = 0.18 miles/sq mile 3.593 sq mi
020109	4.24 miles = 1.76 miles/sq mile 2.411 sq mi
020110	6.13 miles = 1.88 miles/sq mile 3.259 sq mi
020201	7.51 miles = 1.65 miles/sq mile 4.538 sq mi
020202	8.55 miles = 2.68 miles/sq mile 3.187 sq mi
020203	10.82 miles = 5.61 miles/sq mile 1.927 sq mi
020204	10.95 miles = 3.94 miles/sq mile 2.779 sq mi
020205	5.56 miles = 1.87 miles/sq mile 2.969 sq mi

Heritage Resources

The Upper Hayfork Watershed Analysis Area is rich in heritage resources including archaeological sites, both historic and prehistoric, and ethnographic sites. Chanchellula Peak is the most important of the ethnographically recorded sites and is considered sacred by the present-day nor-el-muk. Traditionally it was used as a place where shamans and others went to seek power and communicate with the spirit world. Members of the nor-el-muk continue to journey to the top of the peak to gain personal inner balance and harmony. The Peak has been determined eligible for the National Register of Historic Places, and the tribe was instrumental in gaining wilderness area status for the mountain.

The Natural Bridge is also considered important to many of the nor-el-muk because of the 1852 massacre that resulted in the death of about 150 men, women, and children. This site, which contains prehistoric and historic components as well as a spectacular natural formation, has been nominated for the National Register of Historic Places.

Most of the public lands within the Analysis Area have been extensively surveyed for archaeological resources, documented in 53 Archaeological Reconnaissance Reports and addenda. Sixty-eight sites have been formally recorded. Many are located along Hayfork Creek and its tributaries, but others are found on ridgelines and mid-slopes. The distribution of recorded sites by subarea is given in **Table R**.

Forty-two of the sites, particularly in areas 5 and 7, are prehistoric or early historic Native American sites. Twenty-two, concentrated in areas 1 and 4, are historic and include mining sites, some with habitation debris, cabins or other habitation debris, ditches, and trails. Four sites have both prehistoric and historic components. Twelve of the sites have been determined eligible for inclusion on the National Register of Historic Places, 16 have been found to be not eligible, and the remainder have not been evaluated.

Table R - Distribution of Recorded Archaeological Sites by Subarea (Public Lands only)

Subarea	Number of Recorded Sites	Frequency of Sites in Acres	% of Archaeological Reconnaissance
1 East Hayfork	11	0.0006	Less than 50%
2 Gemmill Gulch	9	0.0007	Approx. 60% covered
3 Chanchellula	1	0.0005	No coverage
4 Wildwood	14	0.0013	Complete coverage
5 Dubakella	15	0.0048	"
6 Jones Burn	4	0.0005	"
7 Mud Springs	14	0.0055	"

Upper Hayfork Creek Watershed Analysis - Chapter 4

Reference Conditions

Geology

Black and White aerial photographs, at a scale of 1:20,000, which were taken in 1944, were used to assess landslide activity levels during that time period. Two flight lines which traversed the most unstable portions of the watershed were viewed in stereo. The area viewed was centered on the main stem of upper Hayfork Creek, from the confluence with the East Fork to the headwaters. It was apparent that the inner gorge between the confluence with the East Fork to an area north of Wildwood, was bedrock controlled, with extremely steep, bedrock outcrops, with little vegetation, extending several hundred feet above the channel. No active mass wasting was apparent in the canyon. Several large slump earthflows are visable upstream from the Dubakella Creek confluence, but no active, raw, hillslopes are evident. Hell to Find Lake existed back in 1944, as viewed on the photos. It is a slump pond located in a large slump-earthflow mass wasting feature, and attests to the relative recency of activity. No roads are evident upstream from Wildwood.

The 1995 color aerial photographs, at a scale of 1:15,840, were viewed for the same area. The canyon from the confluence with the East Fork remains stable. One minor slide was apparent at the Shiell Ranch which appears to be related to a road crossing on private land. No other active features were apparent in the canyon. No other raw hillslopes were evident in the remaining area viewed.

It is apparent that this watershed has been relatively stable geologically for the past 50 years. As discussed in Step 3, there are active slump-earthflows in the upper Jones Burn area, which likely were active in 1944 and remain active. However, they appear to be moving at relatively slow rates and have not been subject to catastrophic failure over the past 50 years. This is in spite of the occurrence of the Jones burn and salvage which removed the majority of vegetation and changed the subsurface hydrology for many years prior to successful revegetation. Earthflows often accelerate their movement following such a significant disturbance. Movement rates may have been increased for the so called "rice paddy" portion of the large Jones slump-earthflow, however, it does not appear to be significant. Therefore, in terms of largescale mass wasting activity, it appears that present activity levels are similar to those of 50 years ago.

Erosion Processes

Erosion processes in the Upper Hayfork Creek watershed prior to 1850 were controlled by mass wasting processes and the natural erodibility of the surface soils as influenced by rainfall events. Mass wasting processes were covered in the Geology discussion of historic conditions. Most of the watershed's soils are moderately erodible. The exception is the Gemmill Gulch LTA which has soils derived from quartz diorite bedrock. These soils are highly erodible and susceptible to high rates of erosion during intense rainfall events even under historic conditions.

Soils

LTA 2

Natural reference conditions for soils that are not actively eroding would be, a soil with 90 to 100 percent ground cover, consisting of either live vegetation or a one to two inch litter and duff layer. Undisturbed areas adjacent to the actively eroding areas can serve as natural reference conditions for each soil family.

LTA 6

Natural reference conditions for soils that have undergone intensive site preparation in the Jones Burn area would be soils that have an A Horizon in tack, that has not been pushed into piles during tractor piling operations and has not been compacted during salvage operations. Undisturbed areas adjacent to the Jones Burn can serve as a natural reference for the 1). A Horizon thickness, 2). Percent organic matter present in the soil surface and 3). ppm mineralizable nitrogen at the seven to nine inch depth.

Reference conditions for all compacted soils in the Upper Hayfork Watershed can be found on adjacent undisturbed soils of the same soil family. Natural bulk densities for soil in the Klamath Mountains formed on Metasedimentary parent material range from 1.0 to 1.2 grams per cubic centimeter.

Hydrology

Due to the lack of a long term streamflow record one can only speculate as to the nature of historical annual flows, peak flows, and minimum flows of the streams within the Upper Hayfork watershed. The topography, climatic conditions, geologic conditions and soil conditions would have determined the nature of the watershed's rainfall/runoff response.

Annual discharge from Hayfork Creek has most likely decreased since pre-settlement time. With the imposition of fire control policies the resulting increase is vegetation has resulted in more evapotranspiration with less runoff. This trend would have been damped, however, with the increase of roading and logging activity. Another complicating factor is the report that the climate has likely become more wet recently than 1000 years ago (Laudenslayer and Skinner, 1995).

Peak flows under historic conditions were likely influenced by rain on snow events for the largest flows and large frontal rainstorm events for the smaller peak flow events. Lack of any historical evidence precludes any speculation of the actual magnitude of the events.
The Upper Hayfork watershed has large areas of slump earthflow terrain in the Jones Burn and Mud Springs LTAs. These areas typically store snow in the higher elevations and have the capacity to store snowmelt in their deeper soils. There are many seeps and springs in the area that historically contribute to summer flows in Hayfork Creek and provide the majority of the minimum flows in the late summer months. Other areas in the watershed have historically contributed very little to minimum flows due to the low storage capacity of the soils.

Stream Channels

Historically stream channel conditions within the watershed were controlled by large precipitation/runoff events and mass wasting events triggered by these storms. The stream channels were stable in a state of dynamic equilibrium for long periods of time. That is they were in a state of constantly changing conditions at a low level of intensity for long periods of time with infrequent and irregularly timed peaks of major change.
The upper portion of the watershed and the steep side slopes of the rest of the watershed were sources of sediment for Hayfork Creek. Steep gradient stream channels transported sediment to the main channel of Hayfork Creek. Although Hayfork Creek in the watershed is confined by a steep walled canyon for some of its length there are areas in the lower part of the watershed where sediment deposition and storage occurred. These areas were the target areas for the placer gold mining activities in later years.

Water Quality

The quality of the water produced from the Upper Hayfork watershed was most likely excellent during historical conditions. There are no sources of naturally occurring pollutants that would have affected the water quality. Sediment flows and turbidity levels were minimal except during peak discharges. Conditions of impaired water quality would have been infrequent and brief.

Fisheries

Native fish populations sustained themselves in numbers sufficient to provide for lucrative commercial fishing enterprises in the mid to late 1800's in the Klamath Basin. Following the lead of Native Americans local settlers in the Hayfork basin made use of these returning adult fish annually, capturing them by net, weir or pitchfork. No data exists for the historical run sizes into the Hayfork drainage prior to the diversions, mining and settlement, but anecdotal information suggests the numbers were substantially greater than today.

Common natural disturbance processes that the native aquatic community evolved with during this reference period included floods, landslides and debris flows, and fire. These disturbance processes were distributed across the landscape spatially and their frequency and intensity was variable, with large events occurring only infrequently. These processes where critical to the recruitment of spawning gravels and large wood to stream channels which in turn created complex and diverse fish habitat features. Historical accounts and photos suggest that the ratio of resilient watersheds to impaired watersheds was high, supporting a metapopulation structure of native fish that was capable of responding effectively to stochastic events.

The status of steelhead in the Klamath basin has recently been assessed by the National Marine Fisheries Service (1996). The following summarizes that assessment. Historic trends in overall abundance within the basin are not clearly known. Wild returning adults have been substantially replaced with fish of hatchery origin, particularly in the main Trinity River. The populations of the South Fork and Hayfork Creek are for the most part wild with some hatchery straying. While absolute abundance remains fairly high, since about 1970 trends in abundance have been downward in most steelhead populations for which we have data, and a number of populations are considered by various agencies and groups at some risk of extinction. Declines in summer steelhead populations are of particular concern. Most natural populations of steelhead within the area experience a substantial infusion of naturally spawning hatchery fish each year. The NMFS was unable to identify any steelhead population that was naturally self-sustaining.

Forest Health Trends

Vegetation Dynamics in Upper Hayfork Creek prior to 1850

Prior to 1850, the major force which shaped the vegetation on a landscape level was fire. There were lightning-caused fires, and there was also Native American burning until the discovery of gold and the influx of settlers. Fire scar analysis in mixed conifer stands on the Klamath NF which are similar to mid-elevation stands in the Upper Hayfork watershed indicate an average fire return interval of approximately 8 years. The oldest conifers in the LSR and also in the East Fork of Hayfork Creek have large fire scars. The size and species distribution of these trees indicates a stand structure prior to 1850 which was generally an open stand consisting of large diameter ponderosa pine, sugar pine and Douglas-fir. During the period between fires, a woody understory of brush, conifer seedlings and sprouts of hardwoods such as madrone, California black oak, and Oregon white oak would grow. The root systems of some conifers can live for centuries if the tops are not suppressed, or are periodically rejuvenated. It would have been common in 1850 to find all of the above-ground hardwood stems in a given area date back to the last fire.

The serpentine areas are generally so unproductive that they rarely accumulate enough litter to carry a ground fire over a large area. Many of the open conifer stands on serpentine would have looked similar in 1850 to their current appearance. Large fires in adjacent stands on more productive soils will occasionally promote a stand-replacing crown fire in a stand on serpentine. Some of the younger conifer aggregations on serpentine soils could have been a recent burn, or a brushfield in 1850.

The pattern of vegetation in the part of the Upper Hayfork Creek drainage which is closest to the Hayfork Valley consists of patches of extremely diverse conifers, hardwoods, and shrubs. This pattern exists all the way to the ridgelines, and is not merely an artifact of the lower elevation along the Creek. This is the type of pattern which would be produced by very frequent fires. In 1850, there probably would have been some large areas in the north end of the Upper Hayfork Creek watershed which had been recently burned and were in very early seral stages.

Fir stands, such as those at the very south end of the Upper Hayfork Creek watershed and also in the Chanchellula Wilderness, tend to have irregular periods between fires. Large diameter fir trees have a corky bark which insulates them from a ground fire. Large fir trees will survive ground fires as well, or better, than ponderosa pine. When there are long intervals between fires, the fir stands will slowly accumulate biomass and tree mortality will increase. A large accumulation of dead material will set the stage for a stand-replacing crown fire. In 1850, the fir stands would have been a mosaic of aggregations of different ages ranging from recently burned openings to patches with large diameter, older fir trees.

Threatened, Endangered and Sensitive Plants

Reference condition of populations & habitats

Ultramafics

Naturally occurring islands of suitable ultramafic habitat for the species of concern existed in the Rattlesnake Creek and Hayfork Creek melanges--their geographic distribution on the landscape has not changed in historic times. What was different prior to the early 1900's is the level of soil disturbance. There were no roads to further fragment the habitat. Trees were not removed for human use. Vegetation on ultramafic substrate, where it is intact, is relatively unchanged from pre-European times. Open woodlands of Jeffrey pine and incense-cedar on relatively weathered ultramafic soils were interspersed with barren-looking ridges of serpentinized shiny blue rock outcrops and rocky soils, inhabited by wedgeleaf ceanothus and a sparse cover of grasses and herbs. Fuels in these open woodlands and barrens were too low to carry a wildfire even if lightning ignited one. Population levels of sensitive plants fluctuated according to broad weather and climate patterns. Succession in these systems was very slow, dictated by long-term soil weathering and erosion processes.

Rock Outcrops

Distribution of rock outcrops on the landscape also has not changed since pre-European times, unless those outcrops have since been excavated as borrow pits. Outcrops are also relatively impervious to fire, except for smaller outcrops that are under or adjacent to the forest canopy. Sensitive plant populations of rock-dwelling species fluctuated according to weather and climate, and to a smaller degree from changes in vegetation caused by fire patterns.

Seeps & Springs

Seeps & springs were probably plentiful in the south end of the watershed in pre-European times, since their presence is a feature of the ultramafic substrate there. Water flow may have been lower or higher, or have changed with tree cover and precipitation patterns. Sensitive plant populations would have fluctuated according to the availability of water; local extinctions in low water years would have been balanced by recolonization from surviving populations in good years.

Survey & Manage Plants, Lichens, & Fungi

Vascular Plants

Although the ecological amplitude of these species makes generalizing difficult, it's probably safe to say that before 1850 there were more acres of old growth Douglas-fir in riparian areas of this watershed, and that therefore there was a larger quantity of optimal habitat available for these species.

Lichens

The hardwood component favored by lichens of concern has not changed much since pre-European times. Frequent fires would have kept the live oak stands resprouting periodically, rejuvenating suitable stems for lichen habitat.

Bryophytes and fungi

Since we known almost nothing about current distribution and condition of these groups of species, nothing useful can be said about reference conditions.

Fire and Fuels

Fire is the most important natural disturbance which has affected vegetation in this analysis area. Studies by Carl Skinner (unpublished) in the Klamath Mountains indicate a pre-1850 fire return interval of 14-15 years in Douglas-fir/mixed conifer; 12 years in Jeffrey pine/white fir; 11 years in ponderosa pine/mixed conifer and 36 years in riparian zones. Initial data samples from a study by Skinner and Alan Taylor (Skinner, PSW Research Station, '95-'96) in the Jud-Rusch area of the Hayfork Ranger District indicates a fire return interval of five years or less. This is also likely representative of the analysis area.

Fire regime studies in the Sierra Nevada suggest that forest ecosystems are outside their historical range of variability as to fire frequency and severity and associated stand structures (Skinner and Chang, SNEP, Final Report to Congress, vol II.) This is primarily the result of fire exclusion due to suppression efforts since the early 1900's. The exclusion of fire has been successful in minimizing low-severity fires and most moderate-severity fires which were characteristic of the pre-1850's. This exclusion has resulted in an increase in shrubs and understory trees. These have become ladder fuels which can enable a fire to reach the overstory canopy resulting in stand replacement fires. This scenario in the Sierra Nevadas is also likely to be characteristic of the analysis area.

It was common for Native Americans to set fires for cultural purposes. It is likely that the Forests at that time were composed of a relatively open overstory of large mixed conifers with a sparse conifer and hardwood understory and a light shrub layer. There were probably fewer dead and down ground fuels and fewer ladder fuels composed of shade intolerant understory trees. Before fire suppression occurred in the early 1900's, it is likely that there were more annual fires and that they were generally of low severity and stayed on the ground.

Fire history records (1915-1996) for the analysis area show that 60% of the fires are lightning caused and 40% are human caused. The largest fire is the Jones Fire, a lightning caused fire that burned approximately 5000 acres in 1959. These records also show that 252 fires burned 100 acres or less and that 12 burned more than 100 acres.

Wildlife/Biodiversity

No historic records on wildlife population estimates, densities or distribution are known to exist for the Upper Hayfork Watershed, although there is some historic information on deer for the area in general(1966 and 1985 Hayfork Deer Herd Management Plans). While it is very difficult to estimate wildlife use, species composition and population trends prior to 1850 some general estimates can be made based on the habitat regime, known European influences on the watershed, and wildlife sighting records from 1971 to 1995.

Pre-European Settlement

Prior to settlement in the mid 1800's the transportation system consisted of trails associated with hunting, fishing, trading, and other activities of the native inhabitants. Some early explorers and trappers probably passed through this watershed in the early 1800's.

Many wildlife species that we are familiar with today were present at this time. Species that formed herds (deer/elk), had large home ranges (bear, wolverine and mountain lion), utilized special habitats (cavity nesters, bats) or were dependent upon old growth and late seral habitats may have been in greater numbers due to large expanses of habitat that was unencumbered by fences, settlements, or the mosaic of land use practices and associated activities such as hunting by the Europeans who were to follow. However it is known that animal populations cycle according to many factors and it is not easy to predict nor determine causes of high and low levels at any point in time. Climate plays a large role in population numbers and a lesser role could of been played by natural or man induced fires. It is assumed that populations and habitats were in fact dynamic during the time frame prior to 1850 as well as since.

Historic Overview

In the late 1800's, the railroad, timber harvest, livestock grazing, and homesteading began changing the native landscape. Wildlife species populations requiring special habitats and sought after for recreational or commercial use were effected by these changes in the watershed and surrounding area. Species that may have proliferated in the human altered environments are expected to be more common today than before European settlement (bullfrog, European starlings, coyote, raccoons). Refer to the section on range (page 20) for information on the possible role of fire and introduction of exotic seeds with the advent of European man.

Old Growth/Late-seral Dependant Wildlife Species

Pre-European Settlement

While it is likely that larger expanses of old growth/ decadent forest habitat existed throughout portions of the watershed, there may in fact be more timbered lands than existed throughout the 1800s due to the role of fire and the lack of intensive fire suppression. Old growth/late-seral dependant wildlife species may have been in greater numbers if expanses of old growth forest habitat like what is now inside the LSR did in fact exist prior to 1850. We know, due to age determination of some trees, that there are some stands which exceed 200 years or more in age.

We also know that early settlers used timber for many purposes but serious logging within this watershed probably did not occur until after 1950 and large existing trees available to the early settlers may not in fact have been the ones utilized for mining timbers, home building and fencing.

Historic

Prior to 1944 most of the forested landbase within this landscape component may have been more open,<60%cc, (Trinity National Forest Range report 1910 & 1944 Aerial Photos). Since the mid forties and early fifties timber activities have removed and may have fragmented some habitats related to older mature and other stands which are important in providing nesting habitat, thermal and hiding cover for species associated with these stands. Some fragmentation or breaking up of various habitats along stream corridors and bottom lands where occupancy by man and his surroundings has been more prevalent, including mining, clearing of timbered land and conversion to meadow type situations. The latter can in fact be beneficial to species which utilize edges between forested types and open forage areas including deer and goshawks. and dispersal habitat over the entire landbase, occurred. Fragmentation can create islands of suitable habitat and restrict movement between such islands.

With fire suppression, the buildup of slash on the forest floor may have limited the visibility and hunting effectiveness of predators such as the spotted owl and northern goshawk. Dense understory regeneration by shade tolerant species, also a result of fire suppression, would obstruct movement of avian predators, further reducing the suitability of the habitat. Very little of the fire suppression type of habitat changes is believed to occur within the watershed. Grazing practices which may have helped prevent the encroachment of young trees into meadows and glades (Grazing Summary and Report 1909 and 1910) Clearcut timber harvests have provided openings utilized by several early seral stage species. Such practices may also break up such stands or create mosaics of habitats more similar to what occurred on the ground in the early to mid 1800's.

Early-Mid Seral or Multi Guild Wildlife Species

Pre-European Settlement

Within the open shrublands and oak woodlands, deer foraged, small mammals created burrows and harvested seeds (rabbits, ground squirrels), and other open habitat/early seral dependant species thrived (California quail, green-tailed towhee, lizards). Oak and/or oak/conifer woodlands, found through out most of the watershed would have supported hardwood dependant species (gray squirrel, band-tailed pigeon). In these habitats, the influence of native Americans on the habitat was considered beneficial to wildlife, such as seasonal lighting of wildfires. Wildfires, both naturally and artificially started, usually burned cool and kept the hardwood understory relatively open, stimulated acorn production and vegetative growth, and maintained shrublands in a mosaic of seral conditions.

Historic

With European settlement, fire continued to be used as a tool especially in areas being grazed on a partial or year round basis, which was a significant portion of this watershed. This practice continued until the establishment of the Forest Service which begin immediately to stop such practices in hopes of establishing more forested lands (Trinity Grazing Report 1910). Most shrub habitats within the watershed existed naturally as a result of the geological makeup of the landscape and recurring wildfires. In the shrublands which underwent natural 'maturation', browse species were negatively affected as the shrublands became unpalatable and new growth became out of reach. Also, as the shrubland became decadent it provided less habitat for small to medium mammals, as branches near ground level matured or died. Mature shrublands also begin to lose their overall benefits for species like deer as access into and through the stands becomes difficult, availability of shoots becomes limited and nutritional factors begin to decrease with the age of the stand. Access to ground level species for aerial foragers (golden eagle, great-horned owl) also becomes reduced as less ground is exposed. Other species, such as NTMB and quail, which feed on berries or use shrubs as cover can benefit from the maturing shrubfields.

Within the oak woodlands, fire suppression reduced the amount of sprouting oaks which are utilized by deer and other wildlife browsers. Increased amounts of understory growth would also reduce the amount of precipitation available to overstory, acorn producing oaks, and hence, quite possible the production of acorns. Recruitment may also be hindered since understory growth, usually tempered by frequent fire, might compete to the point that there isn't any understory regeneration which is suitable to grow into a healthy large acorn producing oak, once released.

Reduction in the quality of shrub and oak woodland habitat would certainly affect those species dependant upon them. Based on 1944 and 1995 aerial photos the pattern of shrub and oak woodland habitats is generally unchanged. What is noticed is an apparent increase in denseness in both habitat types and a spreading out of the oak woodlands. This may be a factor of black/white photos versus color, scale, or actual habitat changes. The only indicators of wildlife health believed to currently exist are fawn to doe ratios. Current fawn to doe ratios reside at the CA Dept of Fish and Game, but a concern does exists about the need to improve the oak and shrub habitats.

Snags & Dead/Down Dependant Wildlife Species

Pre-European

Amount of existing dead/down material and density of associated species is unknown for this time frame. Both are estimated to have cycled as influenced by natural processes and the burning of selected areas by Native Americans.

Historic

Since the 1950s', within harvested areas, snag dependant species habitat was reduced. Snag retention within these areas varied over time, with only the later years (post 1980's) retaining snags for wildlife use. How much of the watershed has been harvested is unknown, but wherever harvesting occurred loss of existing snags occurred and recruitment for snags was eliminated or greatly reduced.

Aquatic and Riparian Dependant Wildlife Species

Pre European Settlement

Natural grazers/browsers, such as the deer, utilized meadow and riparian areas. Springs would have flowed naturally and created semi-permanent, widespread wet meadow habitat or maintained areas of moist duff. Species that were restricted to aquatic or riparian habitats (amphibians) may have been in greater numbers and more widespread due to habitat that was unchanged by settlements or the mosaic of land use practices of the Europeans who were to follow.

Historic

In the late 1800's cattle grazing and mining occurred unregulated throughout the watershed. Many springs were confined or developed into waterholes for livestock and stream courses dredged in an attempt to locate valuable minerals. Homesteads are often located near springs and seeps and as such were developed with associated human activities providing some disturbance factors. The condition of many such meadow and riparian areas declined.

Within the first 5 years after taking over the administration of the Public Domain Lands (1905) the Forest Service began reducing the number of cattle grazing, season of use and the use of prescribed permittee fire on Forest System lands (Report 1910). Springs and other wet or riparian areas continued to provide water to cattle in addition to troughs and waterholes. With the reduction in cattle, introduction of grazing regulations and periodic resting of the habitat it is expected that aquatic and riparian dependant species populations declined less quickly or stabilized. Much of the damage to riparian habitat, meadows and springs occurred in the late part of the 19th century or early part of the 20th century and it is possible that existing wildlife populations dependant upon such habitats have adapted, maintained or may have become locally extirpated.

Bullfrogs were also introduced into the ecosystem, though at what time is unknown. The damming of of springs for cattle or naturally by beavers or to improve human use may have facilitated the spread of the bullfrogs into systems where other native amphibians and small aquatic reptiles naturally occurred. Some native wildlife species may have been reduced in number or eliminated from the ecosystems inhabited by bullfrogs.

Reference Conditions/Human Uses

Pre-1850

There has been no archaeological research focused on the prehistory of the upper Hayfork drainage, and little is known about the area prior to the past few hundred years. Research in neighboring areas such as the Trinity River, South Fork of the Trinity, and South Fork Mountain, however, indicate a human presence for some 5000 years or more. These people, possibly the distant ancestors of the Chirmariko Indians, hunted, fished, and gathered plant foods, chert, and other natural products, but other than a few stone tools, left no imprint on the landscape.

At historic contact, the Hayfork Creek drainage lay within the territory inhabited and used by the nor-el-muk or Hayfork Wintu. The name, nor-el-muk, means southward uphill people, suggesting that they moved into the Hayfork drainage from the Trinity River in recent centuries, perhaps following the heavy anadromous fish runs that were basic to their economy. According to Wintu tradition, salmon traveled up Hayfork Creek as far as a 50-foot high waterfall, recently destroyed, which was located approximately one mile upstream from the confluence with the East Fork. The Wintu developed permanent villages focused on the collecting, preparation and storage of salmon and acorns. They deliberately burned vegetation to improve deer forage and basketry materials. Religious practices included the observance of sacred areas of which the most important to the nor-el-muk was Chanchellula Peak.

The first contact between the nor-el-muk and Anglo-Americans occurred when fur trapper and explorer Jedediah Smith with a party of 18 men and 300 horses and mules crossed from the Red Bluff area into the Hayfork Creek drainage in April 1828. They camped near Wildwood, again farther north on Hayfork Creek, and on the third night camped in the Hayfork Valley at the confluence with Salt Creek. Smith left a record of his encounters with the nor-el-muk, but little comment on plant and animal populations other than to note "good grass."

1852-1905

According to local tradition, Hayfork Valley was "discovered" in 1852 when a party of Weaverville miners tracked some Indians who had killed a local citizen and stolen some cattle to a village at Natural Bridge where in retaliation they massacred about 150 residents. White settlement began soon after with the establishment of several ranches including Big Creek Ranch, R. B. Wells place, the Ruch Ranch (later called the Carr Ranch and then the Dockery Ranch), Vaugh Range, B. M. George Ranch, Williams Ranch and others. Wheat, oats, hay, onions, and potatoes were produced in abundance and sold in Weaverville. Hayfork Valley was referred to as the "granary of the county." Most of this land is still in private ownership, lining many of the major stream courses throughout the Analysis area.

Gold mining was introduced in the mid-1850's and Hayfork gained a population of several hundred miners. Placer mining was initiated in 1857 at Carrier Gulch and soon after at other tributary creeks. Settlements such as Staffords at Carrier Gulch sprang up to service the miners. Hydraulic mining followed in the 1870's, and later many lode mines were developed including several claims in the Hall City area in the 1890's. Evidence of the mining history is preserved in a number of recorded mining sites and settlements, ditches, tailings piles, and extensive Chinese rockwork in the Carrier Gulch area.

Small saw mills arose to supply wood products for the ranches and miners. A saw and grist mill, A. D. Bayless and Company, operated in Hayfork Valley during the mid- to late-1850's. Using water power, it produced 100,000 board feet of lumber per season. Sawmills in the upper Hayfork Creek area included a water-powered mill built by Landis near the Wildwood Inn, a mill with a circular saw powered by steam built by Chambers east of the Wildwood store, and a mill at Gemmill Gulch, probably built around 1900. Many mines had their own sawmills.

The forested lands surrounding the valleys were public domain used as open grazing from around 1860. Stockmen established a pattern of burning the underbrush when the stock was removed to increase accessibility and promote new growth.

Lands in the watershed were surveyed by Government Land Office (GLO) surveyors between 1874 and 1893, opening the area to homesteading, cash entry purchases of previously occupied ranches, Indian allotments, and mining claims. The GLO maps show a number of mining claims, trails and ditches within the area.

1905-1945

The Trinity Forest Reserve was established on April 26, 1905 and the management of public forested lands transferred to the Department of Agriculture Bureau of Forestry, which became known as the Forest Service. Early Forest Rangers spent much of their time administering grazing allotments, examining homestead claims, building trails, and patrolling and fighting fires. Early Ranger Stations were often private homes of the Rangers. The 1907 Trinity National Forest Atlas shows Ranger Stations on Carr Creek and on East Fork. The Hayfork Ranger Station was established in 1913 on land donated by Jake Kelly. The 1934 Trinity National Forest map shows Ranger Stations on the East Fork at Bryon Creek, and Red Mountain, and at Shiel Gulch, the latter a recorded archaeological site.

Mining and stock raising were the chief industries on the Trinity National Forest in the early years, although timber production increased with time. The important commercial woods were red fir, sugar pine, yellow pine, incense cedar and white fir. A number of hardrock gold mines, located in quartz veins along the edges of the valley and canyon, continued operations in the decades after 1900 such as the Layman Mine which included a stamp mill. A number of mines, such as the Kelly Mine were very active during the depression. Grazing reached a peak just prior to World War II with sheep a significant factor. Burning on the allotments ceased by around 1920 under Forest Service regulations.

1945-1990

Timber production became a major economic interest after World War II with lumber products headed for national and international markets. The percentage of the population of Trinity County which was employed in lumber and wood products rose from 2% in 1940 to 36% in 1950. Grazing of public lands continued in the Wildwood Allotment with an emphasis on horses and cows. A number of gold mines continued to be operated within the Analysis area such as the Scorpion Mine and the Cope and Johnson Mine.

Environmental concerns of the 1970's gradually changed Forest Service management policies from a focus on timber production to one of ecosystems management.

Commercial Timber

Commercial timber harvesting in this Analysis Area was virtually non-existent until after World War II. Since then, timber has been a dominant industry within Trinity County, and management of much of the Upper Hayfork Watershed has been focused on supporting this industry. Much of the timber harvest history centered around the salvage of fire-killed timber in the early 1960's, as a result of the Jones Burn.

Harvest volume figures are not available for this watershed. The allowable sale quantity (ASQ) for the entire Trinity Forest was about 146 MMBF per year according to the Forests' 1975 Timber Management Plan. This trend continued until the implementation of the President's Northwest Forest Plan in 1994 when the ASQ dropped to about 30 MMBF per year for the Trinity Forest.

A major lumber mill was located within the watershed near Wildwood until its closure around 1992.

Upper Hayfork Creek Watershed Analysis - Chapter 5

Synthesis and Interpretation

Erosion Processes

Our analysis suggest that mass wasting is occurring at a rate similar to historic conditions and that trends are stable. Surface erosion has increased from reference conditions due to management activities that exposed soil surface. The trend for surface erosion is on a slow downward trend as a result of the implementation of BMP's. Increased risk of intense fire has the potential for increasing surface erosion.

Disturbance process	Change from Reference	Future trend	Comments
Mass wasting	→	→	No change from historic conditions
Surface erosion	↑	↑	Gradual decrease through mitigation by BMP
Peak flows	↑	→	Will continue higher than reference, but decrease will taper off over time
Base flows	↓	↘	Will continue lower than reference, but decrease will taper off over time
Fire frequency - natural	→	→	No change in natural starts
Fire frequency - human	↓	↗	Decrease in starts compared to Native American period
Fire intensity	↑	↑	Due to accumulated fuel
Fire size	↓	↗	Due to accumulated fuel
Pathogens	→	?	Not an issue
Insects	↑	↑	In absence of fire
Windthrow	→	→	No change over reference condition
Biomass accumulation	↑	↗	Fire suppression and simultaneous wetter climatic period; trend will continue at decreased rate

Disturbance process	Change from Reference	Future trend	Comments
Succession:			
Oaks	↓	↘	Continued decrease, but flatter rate
Early seral openings	↓	↘	Continued decrease, but flatter rate
Decadent chaparral	↑	↗	Continued increase, but flatter rate
Old growth conifers	↓	→	Quality will decrease until stands fall apart
Human uses:			
Mining	↑	↘	Continued residual effects from mining period, but rate of change has slowed
Logging	↑	↘	Combined FS/Private

Hydrology and Stream Channel Processes

The hydrology of the upper Hayfork basin has not been significantly altered since reference conditions. Water quantity has been altered by diversions on private land and stream channels and bank stability have been significantly altered by past mining. Mining has irreversibly altered riparian conditions in stream channels. Stream channels are still recovering from extensive and intensive mining and are not expected to reach a new equilibrium for decades. The process of recruiting large woody debris to stream channels has been altered first through the actions of mining and later by timber harvest. More recently the practice of removing most or all of the large wood that has recruited to stream channels during winter storms in order to protect roads and bridges has further altered this important ecological process. As a result, the structural complexity of many small streams has been simplified, compromising the quality of aquatic habitat for fish and other water depended species.

Forest Health Trends

Until the late 1800's, fire (from lightening and as used by native Americans) was the chief force which shaped the pattern and structure of vegetation in the upper Hayfork watershed. Early, mid and late seral aggregations shifted across the landscape in response to both fire and succession. Three major changes or events took place between 1900 and 1960 which caused major changes in the vegetative structure, both as patterns on the landscape, and internal stand composition in terms of abundance and ladder fuels. Two of these changes are related to the creation of the National Forest System: 1) There was a fairly successful effort to exclude native American fire starts and to control natural starts that created the extensive, frequent low intensity ground fires which historically had shaped the vegetation, and 2) artificial boundaries based on ownership patterns and dominant management themes were established (Trinity National Forest estab. 1907).

Establishment of administrative boundaries, combined with homesteading and patented mines made it more difficult for vegetation stages to shift across landscapes. A third change in California is documented in tree-ring analysis: The period from about 1900 through 1960 was the wettest 6 decades in the past 400 years. This allowed the proliferation of shade-tolerant trees (primarily white fir) even in areas where some burning continued. The current situation is: precipitation appears to be returning to a dry pattern, forest stands are stocked at maximum carrying capacity with species poorly adapted to low precipitation pattern and we have interrupted the one natural force (fire) which produced open stands of large trees. Imposition of political and ownership boundaries on a fluid vegetation pattern means that, although late successional forest will continue to move around on the landscape, the Late Successional Reserve boundaries cannot move with it. As succession runs its course, LSRs may no longer harbor late successional forests, and replacements may not be available on National Forest lands.

Our assessment suggests that without active management on those portions of the watershed in federal management, the structure and function of major components of these sub-basins including LSR's and Riparian Reserves are at risk of being altered. We are looking at a "moving picture", even though things may appear static from a human viewpoint. The process can be compared to a conveyor belt; if the focus is only on Late Successional stands coming off the end of the belt, it is easy to forget that unless somebody is loading early stages on to the other end of the belt, the belt will be empty at some point. We suggest a strategy that would prolong the life of what we have (reduce stress and reduce fuel by burning and/or cutting), and move to bringing the ratio of early, mid and late successional stands back into line.

The long-term sustainability of commercial timber production from matrix lands also relies on a distribution of size/age classes. This can be accomplished through scheduled regeneration harvests where appropriate over a period of time.

Because we don't have any new place to move to, we need to restore to the extent possible processes that would ensure that stands with the characteristics of early mid and late successional vegetation come on line.

The general trend in forested areas in the part of California with a Mediterranean climate is for stand densities and site biomass to constantly increase. The most common agent which reduced stand densities under historical conditions was fire. Frequent low intensity ground fires promoted open stands of shade-intolerant species. In the absence of fire, an understory of shade- tolerant species tends to develop. If fire is excluded from a stand for many decades, the trend is: increased competition for moisture causes the older shade-intolerant overstory to begin to die, the shade-tolerant understory begins to stagnate and die, and the accumulation of fuel places the stand at an increasing risk of a stand-replacement fire.

Data from the Land and Resource Management Plans for the National Forests in California shows that the annual tree mortality rate for many of the Forests is in the range of 0.2% to 0.7% of the standing biomass per year. This rate is generally sustainable, and makes it theoretically possible to develop and/or maintain old-growth stands. Mortality rates which exceed 1% of the biomass per year make it unlikely that the stand will persist long enough to produce a closed-canopy stand of older trees. In addition to the straight forward loss of trees from the stand, the accumulation of fuel increases the probability of loss of the stand due to fire.

Ponderosa pine in the Jones Burn plantation is 37 years old. Under historical conditions, it probably would have burned 3 to 5 times by 1997. There have not been any fires, thinning, or other treatments in the plantation. The amount of biomass on the site is exceeding the long term carrying capacity. Pockets of ponderosa pine are being killed by the western pine beetle, *Dendroctonus brevicomis*. There is no thinning effect in the stand between the mortality pockets. The stand is stagnated, and the capacity to produce large diameter trees is quickly being lost. Due to the amount of fuel, and the fuel ladders in the plantation, the Jones Burn plantation would not survive a summer fire at this point.

The 1997 aerial mortality flight on the Shasta-Trinity NFs detected two large areas of conifer mortality in the Upper Hayfork Watershed. An area of fir mortality about 150 acres in size is located in the southwest corner of the Chanchellula Wilderness near the upper end of Chanchellula Gulch. It is estimated that between 1% and 5% of the stand was died during 1997. Should this rate of mortality continue, the stand would be completely dead between 20 and 100 years from the present. The probability of a stand replacement fire would increase during that period.

A second large area of conifer mortality occupies about 150 acres around Wilson Point in the LSR. This mortality spot is comprised of large diameter Douglas-fir, ponderosa pine, and sugar pine. It is estimated that between 5% and 9% of the standing biomass in this stand died during 1997. At this rate, the overstory would be completely dead between 11 and 20 years from the present. The understory in this stand consists of suppressed shade-tolerant white fir and Douglas-fir which is not capable of replacing the overstory as it dies. Scars on the older trees indicate that ground fires were relatively common in this area in the past. The amount of fuel, and fuel ladders in this area greatly increase the risk to maintaining the Late Successional Reserve.

Fire Processes

Natural fire (lighting starts) and fires as a result of Native American burning were considered to be the reference conditions from which we would evaluate today's conditions. Fire starts have remained relatively stable from our reference period while the size of fires has decreased from reference conditions due to to fire suppression efforts. Vegetation has increased due to suppression and an increase in precipitation up until the 1990's. Acres burned has decreased from the reference period while intensity has increased due to increases in available fuels. The current trend for fire frequency is flat but acreage burned is expected to increase dramatically and without a change in management philosophy this trend toward larger more intense fires is unlikely to change.

Succession

There has been a decrease in the oaks and oak stands since the reference period of the 1850's as conifers have invaded oak stands and begun to shade them out. This is a direct result of fire suppression. Early seral stage vegetation has decreased since reference conditions and chaparral stands have increased and become decadent resulting in a decrease in forage and browse for graziers. The current trend for this process is for it to continue.

We believe that there is less Late Seral (>150 years) vegetation today than was present at the reference period of 1850. Factors that have created these condition include the Jones Burn and commercial logging on private and Forest Service administered land. The resiliency of Late Seral vegetation is lower than reference conditions due to increased fuel loads.

There is probably more Mid Seral (40-150 years) vegetation than was present at the reference period and its resilience to disturbance, especially fire is low. Early Seral vegetation (<40 years) is probably less than the reference period. Its composition has been altered due to the introduction of exotic plants and the loss of some native plants. Its resilience is low as a result of fire suppression.

Chaparral quantity has remained similar to the reference period with a slight increase as the exclusion of repeat burnings has changed grass/forb type to chaparral. The quality of chaparral stands has decreased due to fire exclusion resulting in more decadent stands of chaparral.

Wildlife/Diversity

Vegetative changes as a result of succession, fire suppression, fire history and management activities are covered in preceding discussions for chapter 5.

Vegetative condition and changes over time equate fairly well to the status of existing wildlife species/habitats. Two of these; 1) NSO/late seral, and 2) deer/chaparral/early seral, are worthy of some additional discussion as follows:

1) As was noted earlier LSR 331 has been assessed (preliminary FWS analysis) as being fully functional. Provided no catastrophic event occurs existing amounts of suitable (new definition included in appendices) habitat are considered to be adequate enough, for existing and future owls associated with this LSR, to be able to maintain themselves over time allowing that connectivity between LSR 331 and 330 remains at least as suitable as currently exists and/or improves over the next 50-100 years. However without active management to improve resiliency, the amount, condition and location of suitable habitat components is unlikely to be maintain and/or improve over the same time frame (refer to LSR assessment model and evaluation). The use of prescribed fire and or thinning (modeled for LSR) as a tool has the ability to enhance the suitability, location and amount of suitable habitat as well as to protect these components from the effects of an catastrophic event.

The 2,895 acres of old growth remaining in the Upper Hayfork Creek watershed are important to late-successional species and should be preserved, because of the scarcity of old growth in this watershed.

2) The loss of early seral habitats (grass, forb, young browse) openings has been previously mentioned. These types of habitats are very valuable for several species including deer. While logging activities have resulted in creating some of this type over the past 40 years most of it has

or is in the process of being overgrown as the result of succession. Succession & fire suppression has resulted in and/or contributed to the loss of the grass/forb cover type while chaparral stands and/or density may have increased during the same time frame however, a high percent of the later component has become decadent, unavailable and/or inaccessible. The use of prescribed fire as a tool could greatly enhance these areas. Such treatments tend to help existing populations/herds of deer to meet their present needs or provide for modest short term increases. Results are directly correlated to the amount of treatment being done ie. burning of 1-200 acres may provide for better forage conditions for existing animals but would not be considered sufficient enough to provide for nor sustain even moderate increases. A program that treated a few thousand acres each year has the potential to help provide for actual increases in the numbers of animals.

An additional vegetation/successional factor that has come about as a result of European and modern mans influence on the ecosystem is the introduction of numerous exotic plant species including some that are considered to be noxious weeds. Opportunities may exist to reduce the influence and/or density of some of these species through various management practices including fire. Which could contribute to negative results as well, i.e. the spread of a particular species.

Human Uses

Since the reference period of 1850 there has been a cultural shift from the Native American hunter gathers to permanent European settlements supported by agriculture, mining and timber harvest. Native Americans made extensive and frequent use of fire keeping light fuels and underbrush low. With the development of permanent town sites transportation systems shifted from trails to gravel and paved roads of a much higher density. Additionally landscape boundaries shifted to those established by politics and ownership.

Upper Hayfork Creek Watershed Analysis - Chapter 6

Recommendations

The following recommendations have been prioritized by the team they reflect consensus as to those management actions that, if implemented, are expected to result in the greatest chance of producing measurable improvement in the condition of basin ecosystem resilience and associated plant and animal communities. These recommendations are to be implemented under the overall guidance and direction of the Forest Plan.

1) To increase & sustain long-term ecological resilience of the Upper Hayfork Creek watershed, we recommend reducing the quantity of biomass accumulated as a result of fire suppression.

What: Reduce biomass, focusing on the upper third (in elevation) of the watershed, which would benefit most from treatment (see map 6.1).

Reduce biomass, focusing on the upper third (in elevation) of the watershed, which would benefit most from treatment (see map 6.1).

How: thinning and/or prescriptive fire

thinning and/or prescriptive fire

Where: Jones Burn plantation, portions of LSR and areas within the upper third elevation band of the watershed, including riparian reserves; also selected chaparral within deer winter range.

Jones Burn plantation, portions of LSR and areas within the upper third elevation band of the watershed, including riparian reserves; also selected chaparral within deer winter range.

2) To increase & sustain long-term recovery of stream channels, fish habitat, to improve wildlife security, and to reduce road maintenance obligations, we recommend that the unit develop a strategic travel plan for the analysis area.

What: The strategic travel plan will set priorities for road closure, obliteration, and road modification to address aquatic resources, wildlife security, fuels management, timber management, and road maintenance/culvert loss.

The strategic travel plan will set priorities for road closure, obliteration, and road modification to address aquatic resources, wildlife security, fuels management, timber management, and road maintenance/culvert loss.

How: Assume all paved roads will be kept. Other than that, start with blank slate and design road system to meet current and projected access needs. Overlay this analysis map with current transportation map and highlight the parts that don't match.

Assume all paved roads will be kept. Other than that, start with blank slate and design road system to meet current and projected access needs. Overlay this analysis map with current transportation map and highlight the parts that don't match.

Where: Focus "storm-proofing" road system in Dubakella Creek, Potato Creek, and headwaters of Hayfork Creek first (see Aquatic Strategy map for high priority subwatersheds).; then continue in the remainder of the Analysis Area.

Focus "storm-proofing" road system in Dubakella Creek, Potato Creek, and headwaters of Hayfork Creek first (see Aquatic Strategy map for high priority subwatersheds).; then continue in the remainder of the Analysis Area.

3) To enhance wildlife habitat, including connectivity for northern spotted owls between LSR 331 (Upper Hayfork) and LSR 330 (Upper South Fork), we recommend that two principal corridors and a third secondary corridor be maintained through intentional management for that purpose.

What: The unit will develop a strategy for long-term maintenance of stand condition and structure of LSR 331, and for establishment & maintenance of habitat, including corridors within the Upper Hayfork watershed and between LSRs 331 and 330.

The unit will develop a strategy for long-term maintenance of stand condition and structure of LSR 331, and for establishment & maintenance of habitat, including corridors within the Upper Hayfork watershed and between LSRs 331 and 330.

How: Use of Group Selection, thinning, and prescriptive fire will be needed for long term maintenance.

Use of Group Selection, thinning, and prescriptive fire will be needed for long term maintenance.

Where: Two primary corridors off the southwest and southeast quarters of the Upper Hayfork Creek watershed; an additional corridor extending out of the northwest quarter of LSR 331 to the north, connecting with a string of three activity centers between the Salt Creek Drainage ridge and Hayfork Creek (see map 6.2).

Two primary corridors off the southwest and southeast quarters of the Upper Hayfork Creek watershed; an additional corridor extending out of the northwest quarter of LSR 331 to the north, connecting with a string of three activity centers between the Salt Creek Drainage ridge and Hayfork Creek (see map 6.2).

Implementation of these recommendations can reasonably be expected to create and maintain some jobs and to produce an unquantified level of timber harvest opportunity in the Upper Hayfork Creek watershed.

Upper Hayfork Creek Watershed Analysis - Bibliography

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