Chapter III

Affected Environment

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III. Affected Environment

This chapter presents information on the resource components for the Monument. It describes the affected environment or existing condition of each resource.

The resource components are divided into three categories, as follows:

- Resource Management
  - Ecological Units
  - Air Quality
  - Caves
  - Fire and Fuels
  - Geology and Soils
  - Giant Sequoia and Mixed Conifer
  - Range
  - Rare Plants
  - Noxious Weeds
  - Watershed
  - Wildlife
- Human Use
  - Heritage Resources
  - Recreation
  - Scenic Environment
  - Socio-Economics
- Transportation
  - Roads

A. Resource Management

1. Ecological Units

The purpose of this section is to give an overview of the ecological processes and vegetative structure in the nine major vegetative plant communities found in the Monument. This discussion will help the reader understand other resource-specific discussions in both the Affected Environment and Environmental Consequences chapters of this statement. The nine plant communities are classified into ecological units. Ecological units are geographic areas used to stratify the Monument. They delineate areas with similar potential natural vegetation, soils, bedrock and surface geology, and geomorphology. In addition to physical characteristics, an ecologic unit is composed of areas with similar dominant ecologic processes such as fire and succession. By stratifying the Monument in this way it becomes possible to describe trends in these processes and properties over time.

Potential natural vegetation is the floristic community that would be established if all of the successional sequences of its ecosystem were completed under present

environmental conditions, without additional human-caused disturbance. Grazing by native fauna, natural disturbances such as droughts, floods, wildfires, insects, and diseases are inherent in the development of potential natural vegetation, which may include naturalized non-native species (USDA, 1991). Because of the many changes that have occurred since the early 1800s, the existing vegetation is not necessarily the potential natural vegetation. The existing vegetation is very similar to the potential natural vegetation, but recent ecological changes caused by fire suppression and disruption of the fire return interval have led to changes in key attributes such as species composition, age class distribution, and stand structure. The potential natural vegetation provides a baseline against which the current condition can be measured.

Landscapes in the Monument were grouped into nine ecological units based on similarities in fire regime, slope steepness, soil depth, and potential natural vegetation. These nine units repeat across the Monument wherever similar ecologic conditions and processes prevail. Their labels and acreages are summarized in the following table:

Table III-1: Ecological Units

Ecological Unit Vegetation Unit	Acres*
Blue Oak and Interior Live Oak (foothill woodlands)	20,020
Chaparral and Live Oak (interior and canyon live oaks)	32,860
Montane Hardwood and Montane Hardwood-Conifer	32,850
Mixed Conifer dominated by Ponderosa Pine	65,720
Mixed Conifer including Giant Sequoia	38,560
Mixed Conifer dominated by White Fir and Sugar Pine (with Giant Sequoia inclusions)	41,450
Upper Mixed Conifer Forest dominated by Jeffrey Pine (with Giant Sequoia inclusions)	42,090
Red Fir and Jeffrey Pine	17,230
Red Fir and Lodgepole Pine with Meadow Inclusions	34,620

*approximate

a) Ecological Unit Descriptions

Each ecological unit has a general description, a discussion of historic and current trends and conditions, and a discussion of overall vegetation and structure.

General Description. The general description provides an overview of vegetation, soil relationships, and geologic and climatic factors within the ecologic unit. Points of reference are given for each unit along with the unit's approximate acreage and median elevation with standard deviation around the mean. Where available, climate information is included along with general ecological conditions.

Historic and Current Conditions/Trends. These sections describe the dominant ecosystem processes that have formed the potential natural and existing vegetation in the ecological unit. These processes are primarily disturbance regimes

and succession, but the type, extent, and nature of disturbances and successional processes that shape forests in the Sierra Nevada vary considerably by forest type (Skinner and Chang, 1996; Fites-Kaufman, 1997). Disturbances are events or actions, such as fire, disease, logging, avalanches, or landslides, which can change vegetation structure and composition. Successional processes refer to changes in forest structure and composition over time, sometimes in response to disturbance, and include tree establishment, maturation, and death.

Vegetation composition and structure are affected by disturbance regimes. "With few exceptions, these disturbances have occurred for millennia, and plant species and communities have evolved and adapted to them over time. Disturbance performs important functions within the Sierran ecosystems… An insect outbreak within a stand not only regulates species composition and structure by thinning individuals and creating openings, it creates spatial diversity across the landscape and it can provide opportunities for shrubs, forbs, and other low vegetation to maintain species diversity through time… Because of these types of interactions, disturbances cannot be viewed as necessarily destructive or damaging. They are major processes that develop resources for use by other components of the ecosystem and establish system structure (Potter, 1998)."

For many vegetation types in the Monument, fire and/or fire exclusion has had a great effect on distribution, species composition, and stand structure. Historic fire return intervals and regimes are summarized for each ecological unit, followed by a discussion of how fire historically affected the ecological units distribution on the landscape and any current trends in that distribution. Since fire is a dominant ecosystem process and a process that needs to be restored in the Monument, fire regimes are described in detail. It is relatively simple to understand the influence of single fires on specific ecosystem properties, but the importance of fire as an ecosystem process is greatly amplified by the complex pattern of fire effects over long time periods, multiple fire events, and numerous ecosystem properties (Sugihara, 2002). Like any classification, fire regimes simplify the complex patterns that occur within ecosystems. The treatment of fire regimes presents a defined set of attributes that are divided into three categories: temporal, spatial, and magnitude. Temporal fire regime attributes include seasonality, the time of year when fires burn, and fire return interval. Fire size and the spatial complexity of the burns are the spatial attributes, while fire intensity, fire severity, and fire type are magnitude attributes.

It should be noted that fire return intervals are influenced by the size of the area studied. For example, a 10,000-acre area could conceivably have a fire occur somewhere within it every year, resulting in a fire return interval of one year. In this document, fire return interval refers to the number of years between fire events within an area five acres or less in size, unless otherwise stated. This is not meant to imply that the entire 5-acre area burned. Historic fire behavior is believed to have been extremely patchy in most vegetation types. However, it gives a perspective on the influence fire has had on the development of the Sierra Nevada vegetation.

Fire condition class is used to describe existing vegetation within an ecological unit. Condition class designates the degree to which an area has departed from historical fire regimes. It is a function of the number of fire return intervals (fire return interval departures) that have passed in an area without a fire occurring (See Figure III-5 in the Map Packet). Departures from historic fire regimes result in alterations of key ecosystem components such as species composition, structural stage, stand age, and canopy closure. One or more of the following activities may have caused this departure: fire suppression, timber harvesting, grazing, introduction and establishment of exotic plant species, insects or disease (introduced or native), or other past management activities. Condition class is divided into the following four categories (U.S. Forest Service, Cohesive Strategy 2000):

Category	Description
0	Water, rock, and other nonflammable areas
1	Fires are within an historical range and risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within an historical range. This is the assumed condition class of pre-1875 vegetation.
2	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one to five return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range.
3	Fire regimes have been significantly altered from their historical range. The risk of losing a key ecosystem component is high. Fire frequencies have departed from historical frequencies by multiple (more than 5) return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range.

Vegetation Composition and Structure. Vegetation composition is the unique combination of plant species that occur together under a specific range of ecologic processes and conditions. Species that are used to describe a given vegetation composition are generally the species that have the greatest effect on microclimate and ecologic processes, usually the trees and prevalent shrub species. Any single species may occur in more than one ecologic unit. However, it would be under different environmental conditions in the different units, and in combination with a different suite of species. For example, white fir may occur with other conifers to form the Sierran mixed conifer vegetation type, but it will also occur at higher elevations within the red fir vegetation type.

Vegetation composition can be described in terms of the existing vegetation or the potential natural vegetation. For most ecological units, it is assumed that potential natural vegetation is the historic, pre-1875 vegetation. Though today's climate differs from the pre-1875 era, the historic vegetation is considered a valid substitute. Exceptions occur along the boundary between chaparral and montane hardwood forest where today's overwhelming stand-replacing fire regime may preclude ever reaching the historic condition. Therefore it cannot be considered as potential. Comparisons of potential natural vegetation and existing vegetation are useful in that they can be used to demonstrate general trends through time.

b) Blue Oak and Interior Live Oak (foothill woodlands)

General Description. This foothill woodland unit is scattered along the western foot of the Sierra Nevada, generally where moderately steep slopes and open flats mix with steep slopes. The Hot Springs Ranger District office is a point of reference within the unit. The mean annual precipitation is about 18 to 30 inches. It is practically all rain. This unit is entirely within the thermic temperature regime and the mean annual temperature is about 52 to 64 degrees Fahrenheit. All but the larger streams are generally dry during the summer. Soils are largely deep and well drained, supporting a potential natural vegetation of blue oak and annual grasslands variably mixed with tree form interior live oak. Steeper inner gorge slopes with shallow, somewhat excessively drained soils have a potential natural vegetation of chaparral and a shrub form of interior live oak. The mean elevation for this unit is 3,911 feet.

(1) Historic and Current Conditions.

Fire Regime. Historically, American Indians used fire to manage populations of key plant species, including oaks and seed producing grasses, within foothill woodlands and grasslands. Low intensity fires were frequent, and likely formed large mosaics of burned and unburned areas. The introduction of non-native grasses altered the fuels pattern by adding more organic matter and creating a nearly continuous cover of easily ignited herbaceous material. Today, most of the area that burns does so in fires that are low intensity, with flame lengths less than 3 feet. A smaller proportion of the area burns at moderate to high intensity levels. Most of this area burns with surface fires as the flaming front. Some passive crown fire and ground fire are also present, but the flaming front is primarily surface fire. Persons using hand tools can generally attack the fire at the head or flanks. Fires are likely faster moving and burn across landscapes more completely because of the continuous fuels. Introduced annual grasses result in an expanded fire season because these species dry up and will burn months earlier than native perennial grass species. In this ecosystem the fire season is the longest of all the fire regimes in California, starting in May and lasting to November. It occurs with early spring warming and drying, where fire is primarily carried in the herbaceous fuel layer. This may make recovery after fires difficult for some species, particularly young blue oak. Early season fires could

occur before they have a chance to store the energy needed for re-sprouting. Conversely, exclusion of fire from foothill woodland and valley grassland zones may also allow chaparral species to expand into them.

Fire Regime Changes. The fire return intervals have been increased because these fires are relatively easy to suppress. Introduction of non-native annual grasses has extended the fire season into the early summer. Fire size is greatly reduced because firefighters can easily suppress fires before they grow. Complexity, severity, intensity, and fire type are probably not greatly changed.

Plant Community Response. Changes to the species composition and burning season have occurred due to the introduction of non-native annual grass species, which occurred in the mid-1800s. The effects of invasive, non-native species have probably played as great a role in causing change to the composition of the native plant communities as the change to the fire regime.

Trends. Landscape patterns in this unit are highly variable and complex, partly due to environmental conditions and partly due to variation in recent fire regimes. Foothill woodlands are currently believed to be relatively stable at the bioregional scale, but historical ranges of this zone are not well documented. Historic fire regimes characterized by more frequent fires, patches or stands of blue and interior live oaks would have likely been uneven-aged, with patch distributions determined by environmental conditions, such as soil depth, fire, and climate. Intensive American Indian management of oak-dominated areas may have maintained more open stands in some areas than exist today.

Based on soil surveys of the area, approximately 80 percent of this unit has the ability to support blue oak and California annual grassland (Bohna soils). Currently this type is mapped on 38 percent of the unit. Chaparral and live oak vegetation types currently make up around 55 percent of the unit, which may indicate that fire suppression has been the most prevalent force. Portions of this unit are a combination of tree live oak and blue oak, but are mapped as live oak.

Vegetation Composition and Structure. As previously mentioned, invasions of exotic annual plants into blue oak woodlands and the loss of perennial grass dominated ecosystems have changed fire behavior. Fuels are more continuous and support a longer fire season because annual grasses cure earlier than perennials. More continuous fuels cause today's fires to be larger and less patchy than historical fires. This means that, in any single fire, the chances of a small tree within the fire perimeter being burned are increased. Also, the lengthening of the fire season toward early season fires may have negative effects on plants because early fires burn when plants have less stored energy for recovery than in late season fires. Increased mortality of small trees, and higher stress levels on re-sprouting trees and shrubs, may prevent stand sustainability and reduce biodiversity in foothill woodlands.

Type conversion (where one vegetation type is replaced with another) in the foothill woodland zone is a dynamic process. In some portions of this zone, fire exclusion has allowed fuels to accumulate, generally as understory shrubs. Hence, when fire occurs, they tend to be more intense. Blue oaks are generally not adapted to high intensity fires and they do not readily sprout following stand replacing fires. Over time, this results in some foothill woodland vegetation types being replaced with chaparral, or in an increase of more fire tolerant interior live oak relative to blue oak. It is believed that this relationship between chaparral and foothill woodland is extremely dynamic, even under historic conditions.

c) Chaparral and Live Oak (interior and canyon live oaks).

General Description. This unit is at low elevations scattered along the western edge of the Monument in drainages and along steep inner gorges. Slopes in these areas are steep to moderately-steep and include the inner gorge slopes of the Middle Fork Tule River, the Kings River, and the Kern River. This unit is mostly within the thermic temperature regime and the mean annual temperature is about 52 to 64 degrees Fahrenheit. The mean elevation for this unit is 3,859 feet. The mean annual precipitation is about 18 to 30 inches. It is mostly rain and runoff is rapid to the major rivers and their tributaries. There is a complex of deep and shallower soils. Rock outcrops and openings are common and become dominant in steeper areas. The droughty nature of these soils is reflected in schlerophyllus (waxy-leaved) vegetation that dominates this unit. Common shrubs include white leaf manzanita, mountain mahogany, yerba buena, and wedgeleaf ceanothus (buck brush). Interior live oak and canyon live oak are prevalent in the mapping area with interior live oak more abundant on south facing, warm slopes and canyon live oak on north facing, moister slopes and at higher elevations.

(1) Historic and Current Conditions/Trends.

Fire Regime. Chaparral was among the first ecosystems where ecologists recognized the importance of fire in the ecosystem. This is because native chaparral species are highly adapted to periodic stand-replacing fire. Chaparral shrubs often form thickets and, once ignited, chaparral fires spread very rapidly. In chaparral fires, volatile organic compounds released from the burning foliage increase the intensity of the fires and cause the fire to spread. Most of the area that burns does so with fires that are mostly stand replacing where all or nearly all of the individual mature plants are killed. A small proportion of the area burns at lower severity levels. The intensity of the fire produces flame lengths between 10 and 13 feet, a fire too intense for direct attack at the head by persons using hand tools. This fire type is commonly an active crown fire. Most of this area burns with active crown fires as the flaming front. Fire season is generally late summer to fall when live fuel moistures are at their lowest. Fire occurrence and size are greatly influenced by east winds that most commonly occur during this fire season from September to early November.

Fire return intervals in chaparral types have been limited to estimates because the severe nature of the fires in chaparral renders the areas unsuited to the reconstruction of fire history with dendrochronological techniques (Minnich and Howard, 1984). Studies in chaparral types are limited to fire records from this century and previous anecdotal accounts (Parsons, 1981). Estimates are that pre-1875 fire return intervals depended upon local site conditions, proximity to areas of human use, and elevation. Fire return intervals were probably from twenty to fifty years with ranges of approximately ten to more than a hundred years (Keeley, 1982; Kilgore, 1987; Barro and Conrad, 1991).

Fire Regime Changes. Fire created mosaics of even-aged patches at fine scales and maintained the distribution of chaparral at landscape scales. Large even-aged patches currently occupy much of the landscape in the chaparral zone, and much debate centers on how the size of these patches has changed from pre-Euro American conditions. Frequent, low intensity fires in some types, particularly in adjacent ponderosa pine and foothill woodland zones, prevented encroachment of chaparral into these areas and so regulated its distribution. Currently chaparral fires tend to move into the mixed conifer ecosystems because of no discontinuity or variation of vegetation from the chaparral ecosystem to the mixed conifer ecosystem.

Vegetation Composition and Structure. The length and frequency of fire in chaparral ecosystems can differentially favor various plant species, depending upon their method of response to fire. In some areas, fires that occur too frequently can cause shifts in species composition, generally toward post-fire sprouting species or annual grasses. Over time, highly variable fire return intervals can lead to diverse patterns of vegetative communities, whereas short fire return intervals with little variation may lead to a reduction in vegetative diversity (Keeley, 1991). Regular fire regimes increase the clumpiness in shrub land landscapes by forming smaller patches than would be formed during longer fire-free periods. Longer fire return intervals are expected to push the chaparral landscape toward a more uniform distribution. Minnich (1987), for example, noted that shrub land fuels in the San Gabriel Mountains are more continuous than they were decades ago. Similar findings have been noted for the shrub lands of the Sequoia and Kings Canyon National Parks where, instead of a mosaic of different successional stands, old-age chaparral stands were found to be dominant across the landscape, and reduced fire frequency was suggested to be the cause (Vankat, 1970; Parsons, 1976; Vankat and Major, 1978). Fire return interval departure maps indicate 46 percent of this unit has missed five or more fire events, while 19 percent is within the historic fire regime.

Existing vegetation and potential natural vegetation are similar in distribution in this unit. Deeper soils support live oaks, and more shallow or rocky soils support chaparral species. Differentiation between where live oaks have taken the shrub form or tree form follows a similar pattern, with tree forms more prevalent on deeper soils and gentler slopes. Inclusions of California black oak and ponderosa pine may be found on the most mesic sites, like north facing slopes

at the unit's highest elevations. The transition area or ecotone between this unit and its neighbors was probably very dynamic, varying with fire frequency and drought.

d) Montane Hardwood and Montane Hardwood-Conifer.

General Description. This unit is scattered throughout the Monument in eight distinct areas that range in size from 758 to 11,061 acres. The mean elevation of this unit is 4,952 feet. Soils in this unit are often moderately deep and/or rocky. Rock outcrops and openings occur throughout the area. Soils tend to be in the warm mesic temperature classes and have low to moderate available water holding capacities that make them subject to drought in summer months. Mean annual temperature is about 50 to 60 degrees Fahrenheit, and mean annual precipitation is about 25 to 50 inches. It is mostly rain, and runoff is rapid to the major rivers and their tributaries. Potential natural vegetation is forest dominated by montane hardwood species, primarily California black oak with ponderosa pine present on deeper soils. Chaparral is prevalent on rocky, shallow soils and on more xeric, south facing slopes. Slopes in these areas are steep to moderately steep. They are dominated by mass wasting and fluvial landforms where rock falls, rockslides, debris flows, and channel erosion are the major geomorphic processes. Today, the high amount of disturbance and droughty soils help maintain a high proportion of hardwood species (California black oak, canyon live oak, and interior live oak) in the existing vegetation, even in areas where soils develop strong surface horizons. At higher elevations and on more mesic sites, this unit contains more of the conifer-dominated types of potential natural vegetation.

Historic and Current Conditions/Trends. Montane hardwood and montane hardwood-conifer forests are "disturbance climax" communities that only form true climax communities where conditions are too rocky or dry to support mixed conifer stands. They are composed of mostly shade-intolerant species, and depend on fire or other disturbance to maintain open, sunny stand conditions.

There are no published fire histories in montane hardwood and montane hardwood-conifer forests in the Sierra Nevada. Fire return intervals were probably similar to, if not longer and more variable than, those of more conifer dominated areas. They would tend to have less fuel accumulation and less continuous fuels because of the large amount of debris sliding and rock outcrops in these steep areas. The characteristic fire regime of this type of forest was probably one of relatively frequent, spatially variable fires of low to moderate severity. Additional management of this vegetation type by American Indians contributed to a frequent fire regime (Lewis, 1993). In a fire history study in steep ponderosa pine stands in the Klamath Mountains, median fire return intervals of eleven years (with a range of 3 to 55 years) were found on three sites by Skinner (Skinner, 1995).

Historically, variable fire intensities and fire patterns in this type of potential natural vegetation encouraged the development of heterogeneity in stand structure and age

across the landscape. Currently, fires are infrequent and are generally of high intensity and stand replacing. Landscape patterns at all scales are generally homogeneous where similar environmental conditions prevail. It is estimated that from five to ten fire cycles have been missed in this type. According to the fire return interval departure data, which characterizes a frequent and spatially variable fire regime, 73 percent of this unit has missed five or more fire events, while only five percent is within historic fire frequencies.

Fire exclusion in the montane hardwood and montane hardwood-conifer forests has allowed the chaparral zone to encroach into areas formerly occupied by these zones. Consequently, the presence of chaparral in these forests changes the fire regime to one characterized by high severity fires that favor chaparral. The result is an uphill expansion of the chaparral zone at the expense of these vegetation types. Currently conifers are mapped on approximately 40 percent of the unit, chaparral on 15 percent, and live oak on 35 percent.

Vegetation Composition and Structure. Potential natural vegetation in this unit is dominated by California black oak and ponderosa pine, with other hardwood species locally important. Secondary hardwood vegetation is mapped on approximately half of the conifer forests in this unit. Within a montane hardwood-conifer stand, conifer cover may have been as high as 35 percent, based on data collected in a similar vegetation type in the San Pedro Martirs of Mexico that has experienced little to no fire suppression (Stephens, 1999, personal communication). Conifer cover in existing montane hardwood-conifer stands in the Monument tend to be more dense than that, with only 23 percent having densities less than 40 percent.

Ponderosa pine was likely more prevalent in the potential natural vegetation in drainages, toward the tops of slopes above canyons, and in pockets of more stable soils. California black oak is commonly associated with ponderosa pine. Burning by American Indians is considered a primary factor in the maintenance of black oak stands (Anderson, 1993). Without such disturbance, it has been suggested that black oak would eventually be crowded out of most suitable sites and would retreat to scattered remnants in mixed conifer forests (McDonald, 1990).

Because of its proximity to Euro American settlements, historic logging in this type was intense, and most of the older larger trees were removed for use as building materials, firewood, and mine supports. These large hardwood and conifer trees played an important role in the landscape by providing shade and moderating environmental conditions. Interior live and canyon live oaks, and chaparral species are relatively more drought resistant than ponderosa pine and California black oak, so better adapted to the harsher, modern landscape. Existing vegetation includes approximately 55 percent of these drought tolerant types. Also, current stand replacing fire regimes favor species that regenerate through sprouting, like live oaks and chaparral species, over conifers, and to some extend, over California black oak. This ability has allowed them to persist in the landscape where conifers and California black oak were removed and to perpetrate the stand replacing fire regime

we see today. Debris sliding and debris flows in this unit, caused by the steepness of the slopes, also helps maintain existing chaparral species even in areas where soils have developed strong surface horizons.

e) Mixed Conifer Dominated by Ponderosa Pine.

General Description. This unit is scattered throughout the Monument in twelve distinct areas ranging from 1,290 to 27,500 acres in size. The mean elevation is 4,985 feet. Points of reference include the west slope of McKenzie and Pine Ridges in the north and Hatchet and Sugar Loaf Peaks in the south. This unit has slopes that are mostly moderately steep, but gentle and steeper slopes also occur. Soils are deep to moderately deep and are in the mesic temperature regime. Mean annual temperature is about 45 to 55 degrees Fahrenheit, and mean annual precipitation is about 30 to 60 inches. Much of the precipitation falls as snow. Runoff is rapid from most of the area. Maximum flow in these rivers is during the spring when snow is melting rapidly. This unit is mostly composed of relatively productive soils at low elevations in the mixed conifer and ponderosa pine forests. In addition to large areas of ponderosa pine potential natural vegetation, some giant sequoia groves, such as Deer Creek Grove and the most xeric portions of Converse Basin, are also found in this unit.

(1) Historic and Current Conditions.

Fire Regime. The historical fire return interval is generally short, with some infrequent long intervals present within the same regime. Fire frequency decreased in the ponderosa pine forests during the late 1800s due to several factors. Initially, a decline in American Indian populations reduced their burning practices. This was followed by a loss of fuels from the herbaceous layer through intensive grazing. Later, direct fire suppression activities contributed to decreased fire frequencies in this forest type. These changes in fire regimes have resulted in changes in species composition, forest stand diversity, forest structural diversity, and the distribution of ponderosa pine forest.

Fires generally occur in summer and fall fire seasons, with most of the area burning from July to October. Most of the area that burns does so with moderate-sized fires that range from tens to hundreds of acres. Smaller and larger fires do occur but account for a small proportion of the total area burned in the ecosystem. Mixed conifer burns in a highly complex pattern of burned and unburned areas and severity levels. Ponderosa pine burns at a more intermediate level of complexity, producing both fine and course-grained mosaics of vegetation.

Fire intensities are low to moderate, ranging from less than three feet to ten-foot flame lengths, with the average favoring the low intensities. Persons using hand tools can generally attack low intensity fires (less than 4 feet), but moderate intensity fires are usually too intense for direct attack at the head with hand

tools. Fires usually remain on the surface, although there can be complete consumption of understory vegetation. Fires range from low severity, where fires produce only slight to no modification to the structure of vegetation, to moderate severity, where stands are moderately modified. Most of the area that burns does so with surface fires as the flaming front, with some passive crown fires and ground fires. In areas of steep complex topography supporting conifer forest, active crown fire is often the flaming front when supported by surface fuel loadings.

Fire Regime Changes. Fires have been effectively excluded from this forest type for almost a century. Periods of intensive livestock grazing created discontinuous fuels in the herbaceous layer. This allowed stand densification and further fragmentation of the herbaceous layer fuels. Fire suppression has also been quite effective in this ecosystem. Fuels have accumulated on the forest floor and in the understory.

Fire return intervals are now greatly increased, with the longest intervals much longer than they were historically. Fires are far less likely to burn early in the season. The most common fire size is probably smaller and fire complexity lower, with most of the area burning in a few large fires. Fires are generally higher in intensity and severity. A mix of surface, passive crown, and active crown fires has replaced what used to be surface fires with occasional torching.

Plant Community Response. The changes in fire regime have resulted in a greater occurrence of longer fire-free intervals. These long intervals present opportunities for the less fire-resistant white fir and incense cedar seedlings and saplings to grow to a size that is fire resistant. The number of these species is greatly increased, as well as tree density and crown closure. There has been a change from ponderosa pine to a mixed conifer forest type. Low intensity surface fires are suppressed and now rarely occur. Fire in the ecosystem occurs as stand-replacing fires.

Trends. The potential natural vegetation of this unit, ponderosa pine forest, has trended toward extinction. At higher elevations and in mesic portions of the unit, pre-Euro American fire regimes largely eliminated white fir and favored pines. When fire was excluded from these forest types, fire-intolerant species, such as white fir and incense cedar, began to regenerate rapidly. This caused forests to become dense with more shade in the understory, a condition that further favored firs over shade-intolerant pines, hardwoods, and herbaceous species. Today, much of these formerly pine-dominated forests have been converted to mixed conifer stands, with a different structure and fire regime from the historic vegetation. The existing vegetation maps indicate that nearly half of the conifer forest in this unit is believed to include white fir and other conifer species. Currently, up to 74 percent of this unit has missed five or more fire events, and only nine percent is believed to be within the historic fire regime.

The changes to the ponderosa pine forest of the Sierra Nevada have been greatest at lower elevations. As previously mentioned in the montane hardwood and montane hardwood-conifer unit, decades of fire exclusion at low elevations have resulted in changes in fuel loading and fuel distribution. Following large severe fires, shrubs occupy sites for very long periods before the pine can again attain a superior position (Husari, 1980; Andrews, 1994). But instead of giving way to pine, these brush fields may also maintain a continual cycle of fire, therefore maintaining the brush type (Andrews, 1994) and causing the long-term retreat of the forest edge up the slopes of the Sierra Nevada. The ponderosa pine ecological unit is literally being squeezed from both sides. Current vegetation is mapped as 12 percent chaparral and 33 percent live oak types.

Fire return interval studies conducted in ponderosa pine vegetation types are not differentiated from studies conducted in the lower mixed conifer of the southern Sierra Nevada. Fire return intervals were found to range from eight to ten years on one-hectare plots (Kilgore and Taylor, 1979) and from five to seven years on 15 to 35-hectare plots (Wagener, 1961). Surface fires were most common, with occasional flare-ups occurring in brush patches or snags. Crown fires were unlikely in most stands and canopies were kept open with spaced trees in an uneven-aged structure (Husari, 1980). Long loosely packed pine needles and herbaceous species maintained frequent and mild surface burns. Landscape patterns were generally fine-grained, that is at the one-acre scale; small to moderate-sized openings were created generally by fire, where seedlings became established. When looking at the landscape as a whole (hundreds of acres), the pattern was fairly homogeneous overall. These forests are believed to have been more resilient to disturbance than the existing vegetation.

Vegetation Composition and Structure. The characteristic fire regime of much of the Sierra Nevada (frequent fires of low to moderate severity) favored the development of ponderosa pine-dominated forests on many different types of sites. Ponderosa pine (potential natural vegetation) existed where the sites were continually disturbed by fire or mass wasting, or were warmer, dryer, or had limited soil development, compared with other mixed conifer sites. Historic frequent low-severity fires created openings for pine and hardwood seedling establishment, thus maintaining their persistence. These fires also thinned saplings and maintained the relatively open understories documented by early settlers (Muir, 1894; Sudworth, 1900; Leiberg, 1902; Cooper, 1961). More open and diverse conditions meant that fires were generally less severe and that inter-tree competition was less intense than today. With less inter-tree competition, forests were better able to withstand drought and disease. Today, the denser stands have experienced extensive mortality resulting from droughts, either directly from drought stress or from stress-induced bark-beetle outbreaks (Weatherspoon, et al, 1992).

Montane hardwoods, particularly California black oak, are an important part of these forests and have been affected similarly to ponderosa pine. Though California black oak may persist for long periods of time under dense conifer

canopies, it generally does not reproduce under these conditions and experiences gradual loss of crown area, ultimately leading to death. Additionally, very old trees do not sprout vigorously, so disturbance plays an important role in rejuvenating stands and maintaining stand resilience. Trees grown from seeds, though infrequent, are important for maintaining the genetic viability of oak populations. Successfully sustaining California black oak in these stands relies on activities that open stand canopies and limit conifer competition. Fire exclusion has allowed these forest types to become denser with unthinned seedlings and brush. Effects to the herbaceous layer are unknown but, in areas of dense forest, the loss of species associated with open growing conditions is likely.

The established plantations of mixed conifer species are generally well stocked, primarily with ponderosa or Jeffrey pine. There has been a slow trend towards additional mixed conifer species as shade-tolerant white fir and incense cedar encroach into the plantations from adjacent stands. The plantations still do not meet desired conditions in such key elements as gaps and stand structure. Gaps within mixed conifer forests were historically small (1/4 acre to a few acres in size), whereas the average plantation is 12 acres in size. Within stands of this size under desired conditions, there would be a diverse mix of age classes and tree sizes. Currently these plantations, since they were started at the same time, contain little variation in tree heights or diameters. They are also highly susceptible to wildfire. The combination of heavy brush competition, low-lying tree limbs, and short crowns puts these stands at high risk of severe damage from wildfire. In plantations where trees have been thinned and brush has been controlled, this risk is greatly reduced. These kinds of plantations, with similar conditions, exist in the other mixed conifer and upper mixed conifer ecological units.

Pockets of giant sequoia can be found in this unit where soil and hydrologic conditions support them. Generally, mixed conifer (potential natural vegetation) will be found at higher elevations and in areas where cold air from above drains into and pools, creating cooler, more mesic conditions and slightly longer fire return intervals.

f) Mixed Conifer including Giant Sequoia.

General Description. This unit occurs predominantly in the northern portion of the Monument at a mean elevation of 6,044 feet. Points of reference include the Converse and Evans Complex Groves. This unit is in the mesic temperature regime, but is generally cooler than the ponderosa pine unit. Soils are moderately deep to very deep and have low to moderate available water holding capacities, but are usually not droughty in normal precipitation years. Potential natural vegetation is mostly mixed conifer forest: a combination of three or more conifer species, one of which is white fir. Areas of moderately deep or shallow soils will generally support more open mixed conifer forests with higher percentages of pines and hardwoods.

Snow line is often found in this unit during the winter months. Giant sequoia groves comprise about 18 percent of the unit. Greater detail concerning giant sequoia ecology can be found in the Giant Sequoia and Mixed Conifer section of this chapter.

(1) Historic and Current Conditions.

Fire Regime. In the southern Sierra Nevada, the fire regime was generally one of frequent fires of low to moderate severity, with occasional, typically small, patches of high-severity fires (Kilgore, 1973). Mean fire return intervals in five giant sequoia groves were found to range from approximately three to eight years (Swetnam, 1993). Importantly, fire scars used to document these fires were found generally in late wood, wood grown during late summer or fall. The longest fire-free interval in five of the giant sequoia groves was 30 years. Fire return intervals are believed to have been longer and fire intensities more mixed in those areas dominated by white fir and at higher elevations.

Fires generally occur in summer and fall fire seasons, most of the area burning from July to October. Most of the area that burns does so with moderate-sized fires that range from tens to hundreds of acres. Smaller and larger fires do occur but account for a small proportion of the total area burned in the ecosystem. Mixed conifer and giant sequoia mostly burn in a highly complex pattern of burned and unburned areas and severity levels.

Fire intensities are low to moderate, ranging from less than 3 feet to 10-foot flame lengths, with the average favoring the low intensities. Persons using hand tools can generally attack low intensity fires (less than 4 feet), but moderate-intensity fires are usually too intense for direct attack at the head with hand tools. Fires usually remain on the surface, although there could be complete consumption of understory vegetation. Fires range from low severity where fires produce slight to no modification to the structure of vegetation, to moderate severity where stands are moderately modified. Most of the area that burns does so with surface fires as the flaming front, with some passive crown fires and ground fires. In areas of steep complex topography supporting conifer forests, active crown fire is often the flaming front when supported by surface fuel loadings.

Fire Regime Changes. Fires have been effectively excluded from this forest type for almost a century. Periods of intensive livestock grazing created discontinuous fuels in the herbaceous layer. This allowed stand densification and further fragmentation of the herbaceous layer fuels. Fire suppression has also been quite effective in this ecosystem. Fuels have accumulated on the forest floor and in the understory.

Fire return intervals are now greatly increased, with the longest intervals much longer than they were historically. Fires are far less likely to burn early in the season. The most common fire size is probably smaller and fire complexity lower

with most of the area burning in a few large fires. Fires are generally higher in intensity and severity. A mix of surface, passive crown, and active crown fires has replaced what used to be surface fires with occasional torching.

Trends. The mixed conifer forests form a fairly continuous belt from north to south through the Monument. Breaks in this unit's continuity include river canyons, large burned areas, and private lands. Stand-replacing fires have created large homogeneous blocks of even-aged vegetation, whereas less variation used to occur at this scale. Historically, frequent fires maintained an ever-shifting mosaic of tree ages at a very fine scale. A single stand would include all age classes, from large individual trees to pockets of small regeneration. Today's fire regimes and vegetation management have created denser and more even-aged forests, substantially altering these historic fine-scale patterns. Fire return interval departure maps indicate that 74 percent of this unit has missed five or more fire return intervals, while less than two percent is within the historic fire regime.

Changes in distribution of conifer forests can be caused by a prolonged period of intense, stand-destroying fires. This is thought to convert mixed conifer ecosystems to a montane chaparral (Husari, 1980). Ten percent of this unit is currently mapped as chaparral or live oak, indicating that type conversion to chaparral does not appear to be pronounced.

Vegetation Composition and Structure. Mixed conifer forest (potential natural vegetation) in this ecological unit is highly variable in composition (Eyre, 1980), and the proportion of each species in a stand is thought to be determined by soils, elevation, precipitation, and fire frequency. More frequent fire favors a higher percentage of fire-adapted pines and giant sequoias; less frequent fire favors less fire-tolerant white fir and incense cedar. The density of white firs in the Sequoia and Kings Canyon National Parks have been observed to increase during times of reduced fire frequency (Vankat and Major, 1978). Today, some giant sequoia groves are so dense with white fir that understory species are all but absent. Typical understory species include Sierra chinquapin, white-veined wintergreen, Sierra gooseberry, false Solomon's seal, bracken fern, and California hazelnut. Mixed conifer, including white fir forest, is currently mapped as 65 percent of this unit. Ponderosa pine is mapped as 20 percent.

This ecological unit has numerous conifer plantations created primarily by harvesting and replanting in the 1960s through 1980s. The conditions in these plantations are described in the previous section (Mixed Conifer dominated by Ponderosa Pine).

Fire return intervals before European settlement were thought to maintain uneven-aged stands (Weaver, 1974), which were dominated by larger, older trees as compared with today's predominantly smaller, younger trees (Andrews, 1994). Present-day stands in Sierra Nevada national forests are significantly

younger than those found in national parks. This point demonstrates the changes in structure of today's forests and the documented loss of old growth forest on national forest system lands. Approximately 30 percent of the existing conifers in this unit are mapped as medium to large trees (diameters greater than 24 inches).

Before European settlement, these ecosystems were probably more open than they are today (Weaver, 1974) and sufficiently open to support a well-developed herbaceous community of forbs, perennial bunchgrasses, and dispersed shrubs. These understory components no longer exist and are impossible to describe in detail from available historical data. Systematic removal of sugar pine from this unit and higher elevation units has further changed the species composition of these forests.

g) Mixed Conifer dominated by White Fir and Sugar Pine (with giant sequoia inclusions).

General Description. This unit occurs in the southern portion of the Monument scattered in eight areas from Dillonwood Grove to Sunday Peak. It can be found in the North Fork of the Tule River, Bear Creek, Freeman Creek, and Deer Creek, and adjacent to the Tule Indian Reservation on its north and east sides. This unit has slopes that are moderately steep to steep. This unit falls mostly in the mesic temperature regime and has a mean elevation of 6,635 feet. Mean annual precipitation is about 30 to 60 inches, much of it falling as snow. Potential natural vegetation includes mixed conifer forests: forests that are dominated by at least three conifer species, one of which is white fir. This unit's soils are moderately deep to deep, and support mixed conifer with species compositions heavy to white fir due to the elevation. Sugar pine may make up a large portion of the species composition where site conditions are more open due to fire, shallow soils, or south aspect. Red fir may be present at upper elevations and in cold air drainages. Giant sequoia inclusions can be found on up to five percent of this unit, particularly in the southern portion of the Monument.

Historic and Current Conditions/Trends. In the southern Sierra Nevada, the fire regime was generally one of frequent fires of mostly low to moderate severity with occasional, typically small patches of high-severity fires (Kilgore, 1973). In the mixed conifer type, where white fir is well represented by large, old trees, the fire return intervals were likely to have been longer and more variable than those in areas where larger, older white fir would be found only occasionally. Studies in the southern Sierra Nevada found pre-1875 fire return intervals of seven to 20 years. Ignitions were likely higher than in the lower mixed conifer forests (Vankat, 1983). However, fire spread less readily because biomass accumulated more slowly, the fuel was more compact, and weather conditions that will support a fire occurred less often. Fire suppression actions are thought to have had less effect on this potential natural vegetation and the upper montane forest described below, because fewer widespread fires would have been expected, even without fire

suppression. However, the current fire return interval departure analysis does not reflect any difference between this unit and the more mixed conifer-dominated unit.

Stand-replacing fires occasionally occurred in fir-dominated areas of this unit where they initiated large associations of white fir and red fir. However, lower severity fires that created smaller canopy openings and, consequently, smaller patches of thinned saplings were the most common historically (Kilgore, 1971; VanWagtendonk, 1986; Taylor, 1993).

Vegetation Composition and Structure. The potential natural vegetation of this unit is differentiated from lower mixed conifer forests by its dominance of fir trees. Existing vegetation contains approximately 90 percent red fir or mixed conifer dominated by fir. Differentiation of red fir from white fir by remote sensing is problematic but, based on field observation, much of this is likely to be white fir. The cooler and more mesic conditions found in this unit allowed the generally fire-sensitive, young white fir to reach large size. On more xeric portions of the unit, lower-severity fires that created smaller openings also allowed for a large contingency of sugar pine. Much of this component was removed during the railroad logging days in the northern portion of the Monument. However, a large extent of the area remains dominated by sugar pine in combination with white fir in a fairly open forest condition.

This ecological unit has numerous conifer plantations created primarily by harvesting and replanting in the 1960s through 1980s. The conditions in these plantations are described in the previous section (Mixed Conifer dominated by Ponderosa Pine).

h) Upper Mixed Conifer Forest dominated by Jeffrey Pine (with Giant Sequoia inclusions).

General Description. This unit is located in the southern portion of the Monument and has a mean elevation of 6,691 feet. The largest area is located between Slate Mountain and the Kern River, from Indian Rock to Parker Pass. The other major area is located between Jordan Peak and Moses Mountain, along the North Fork of the Middle Fork Tule River. A smaller area is located between Dennison Peak and the Sequoia and Kings Canyon National Parks. Soils are shallow and excessively well drained, which tends to favor a potential natural vegetation of more drought-tolerant Jeffrey pine forests over white fir. The highest elevations of this unit will support red fir on the more moist sites. At the moderate and lower elevations, Jeffrey pine occurs on warm and/or droughty sites, but white fir becomes more important on north-facing slopes and in drainages. Large amounts of rock outcrops and shallow soils may help maintain an open stand condition and trees often grow in deep soil pockets among rocky areas. Drought and competition with drought-adapted shrubs will also limit the distribution of conifers to deeper soils and more mesic conditions. Sugar pine will occur as a part of the potential natural

vegetation at lower elevations wherever open stand conditions prevail. Giant sequoia inclusions are found on less than five percent of this unit.

Historic and Current Conditions/Trends. Historically, fires occurred less frequently in these potential natural vegetation types than in lower elevation forests because the fire seasons are shorter, the environments moister, and the fuels are more compact and less continuous. Large amounts of rock outcrops contribute significantly to the discontinuity of fuels in the unit. Fire return intervals are generally long in duration, but lightning ignitions are abundant. Sixty-six percent of this unit has missed five or more fire return intervals, while six percent is considered within the historic range of variability.

The use of even-aged management and the replanting of clear-cuts to pine species and other mixed conifer species were prevalent throughout the late 1960s, 1970s, and 1980s. Plantation establishment has been generally very successful, and there are many even-aged Jeffery pine stands reaching 20 to 30 years of age.

Vegetation Composition and Structure. Jeffrey pine is the dominant conifer in this unit in both the existing vegetation and potential natural vegetation. Typically it occurs in combination with other conifers, but on ridge tops and shallow soils it would likely be the sole dominant species. On southern or western exposures and/or on excessively well-drained soils, California black oak, canyon live oak, and sugar pine are typical associates of Jeffrey pine. Canopies with these species tend to be open, allowing for a well-developed understory of green-leaf manzanita, bitter brush, grasses, and other herbs. Little change in stand density and species composition corresponding with fire suppression has been observed in these areas.

For both the existing and potential natural vegetation, white fir is patchy, distributed in cool, moist drainages and valley bottoms, or northern and eastern exposures where soils allow. At higher elevations, white fir may mix with red fir. Where giant sequoia groves occur, they primarily occupy damp, concave slopes (valley bottoms, benches, and drainages) with deeper soils. Understory vegetation in giant sequoia groves include hydrophilic species like western azalea, bracken fern, and hound's tongue. Meadow and lodgepole pine are also found in the bottoms of some drainages, on areas of deposition, typically where soils remain saturated for a significant period of time.

This ecological unit has numerous conifer plantations created primarily by harvesting and replanting in the 1960s through 1980s. The conditions in these plantations are described in the previous section (Mixed Conifer dominated by Ponderosa Pine).

i) Red Fir and Jeffrey Pine.

General Description. This unit occurs primarily at higher elevations in the southern portion of the Monument. It has a mean elevation of 8,079 feet. Points of reference include Jordan Peak, The Needles, Mitchell Peak, and Chimney Rock. This unit falls in the frigid temperature regime and, where soils allow, conifer production is limited mostly by temperature and exposure. The mean annual precipitation is about 40 to 60 inches, mostly falling as snow. Mean annual temperature is about 35 to 50 degrees Fahrenheit. Runoff is rapid and maximum flow in these rivers is during the spring when snow is melting. Soils are deep and well drained to moderately deep, and somewhat excessively drained. Deeps soils found on metamorphic parent materials and are typically rocky. This unit falls in the upper montane vegetation zone, one of the least altered and most contiguous forested types in the Sierra Nevada. Similar to the existing vegetation, red fir as potential natural vegetation falls mostly on more productive and cooler locations, whereas Jeffrey pine occurs on shallower soils and warmer aspects. These two types are highly intermixed in this unit.

Historic and Current Conditions/Trends. Historically, fires occurred less frequently in these forest types than in lower elevation forests because the fire seasons are shorter, the environments moister, and the fuels are more compact and less continuous. Fire suppression is believed to have minimally affected the ecology of red fir and other upper montane forests because fire effects are variable and fire return intervals generally long in duration. The burn season is typically a late summer, short fire season and, while lightning ignitions are abundant, fuels are mostly sparse and discontinuous, resulting in few fires. Red fir trees are considered intolerant of fire and large stand-replacing fires are rare in this type. However, the small openings that lightning fires create in the forest canopy play an important role in allowing for the germination of new trees and in maintaining a mosaic of trees of different ages.

Don Potter (1998) listed several fire interval studies and stated that: “On the basis of a sample of 16 trees adjacent to three stands in the southern Sierra Nevada, Pritcher (1987) estimated an average return interval of 65 years with a range of 5 to 126 years. On the basis of 117 trees within 68 stands in the central and southern Sierra, an interval of 53 years with a minimum of 7 years and a maximum of 141 years was estimated (Unpublished data on file at Supervisor’s Office, Stanislaus National Forest, California).” Potter (1998) goes on to say that “Fire size in the upper montane ranges widely; however, the overwhelming majority of fires appear to be small. Thus, of 39 lightning-caused fires reported in the Emigrant Basin Wilderness Area of the Stanislaus National Forest between 1951 and 1973, nearly 80 percent were less than a quarter acre, and none were larger than 10 acres (Greenlee, 1973).”

Most of this unit (65%) is believed to have missed between one and five fire events, placing it at a moderate risk of losing a key ecosystem component. An additional 12 percent is considered within the historic fire frequency.

Avalanches may play an important role in the disturbance regimes of this unit. They are more common in years of heavy snowfall and typically originate on slopes greater than 40 percent where tree cover is sparse. Avalanche chutes are often located where previous avalanches have occurred. They provide important diversity at the landscape scale by providing refuge for open-growing herbaceous and shrubby species (Potter, 1998).

Vegetation Composition and Structure. Potential natural vegetation and existing vegetation are highly mixed vegetation types and reflect the mosaic of soil productivities and aspects in this ecological unit. Red fir, often in association with white fir, will dominate more productive sites, with Jeffrey pine occurring on rockier and more south-facing slopes. At lower elevations in the unit, soils with low site productivity or rock outcrops will generally support montane chaparral like huckleberry oak, *Prunus sp*., and bitterbrush. Wooly mule's ears and high elevation grasses may dominate shallow soils and openings at the higher elevations. Lodgepole pine will be present in drainages and on flatter terrain. At the lowest elevations in this unit, white fir and sugar pine may become important.

Regeneration is limited by temperature and exposure. Soil temperatures at approximately 8,000 feet elevation on the Stanislaus National Forest never exceeded 44 degrees Fahrenheit when measured throughout one summer. Red fir trees do not initiate root growth until soil temperatures are above 40 degrees, so the growing season is very short.

j) Red Fir and Lodgepole Pine with Meadow Inclusions.

General Description. This unit occurs in the higher elevations of the Monument between Grant Grove and Marvin Pass to Chimney Rock; between Quaking Aspen and Junction Meadow; and on the west side of the Greenhorn Mountains at Tobias Pass. It has a mean elevation of 7,543 feet. The mean annual precipitation is 40 to 60 inches, mostly falling as snow. The mean annual temperature is about 35 to 50 degrees Fahrenheit. This unit occurs frequently in broad canyon bottoms and slopes tend to be moderately steep to gentle. Meadows are a common inclusion. Small amounts of mixed conifer as potential natural vegetation occur at the lowest elevations in the unit, and Jeffrey pine as potential natural vegetation can be found on shallow soils. Aspen can be found in very limited locations and amounts in both the northern and southern portions of the Monument.

Historic and Current Conditions/Trends. Historic fire frequencies in this ecological unit were high, with many lightning-caused ignitions. However, similar to other upper montane units, spread of fires was limited and fires were generally small. This unit also has a certain amount of inherent patchiness due to the large

proportion of rock outcrops and poor soils. Fire suppression is believed to have had little effect on landscape patterns and distribution of vegetation types in this unit. Unlike at lower elevations, stand-replacing fires are still not common because of this unit's patchiness and cool temperatures. Lodgepole pine has likely increased in this unit over time, at the expense of pine or fir-dominated types. This is largely the result of logging, where tree removal followed by site preparation (either mechanical or burning) has encouraged the establishment of lodgepole pine where seed-bearing trees are nearby.

Lodgepole pine is considered a pioneer species. It is adept at regenerating in moderately sized openings created by fire, avalanche, or wind throw. Lodgepole pine is maintained in areas where severe disturbance regimes recur at relatively frequent intervals.

Vegetation Composition and Structure. Large portions of this unit are comprised of areas with gentle terrain where shallow water tables are common and the potential natural vegetation and existing vegetation are a mosaic of red fir-white fir forest, meadows, and lodgepole pine. Lodgepole pine in this area is a pioneering species that expands into areas where tree removal by logging, fire, or windthrow has raised the water table. As trees grow, transpiration increases and soil infiltration improves, allowing for hydrologic recovery and succession to red fir-white fir forest. Densification of red fir forests appears to have occurred with fire suppression (Potter, 1998). Where red fir is found growing in association with lodgepole pine, fire suppression appears to coincide with decreases in the pine. Today, canopies of red fir-white fir forest are generally dense and understory species include bitter cherry, chinquapin, and bracken fern. Because most of the Monument is at lower elevations, pure red fir forest, in the classic sense of a pure red fir canopy, occurs only on northern and eastern aspects at the highest elevations. Chinquapin and pine mat manzanita are common understory species in these stands.

Lightning fires create small to moderate-sized openings in the forest canopy that provide the necessary conditions for red fir germination. In addition, small lightning fires play an important role in creating uneven-aged red fir stands. The abundance of lightning-caused ignitions is believed to be similar to pre-Euro-American fire regimes. However, fire suppression has also had an effect. Fifty percent of this unit is believed to have missed one to five fire events, while an additional 40 percent is believed to have missed more than five and to be at extreme risk of losing a key ecosystem element.

2. *Air Quality*

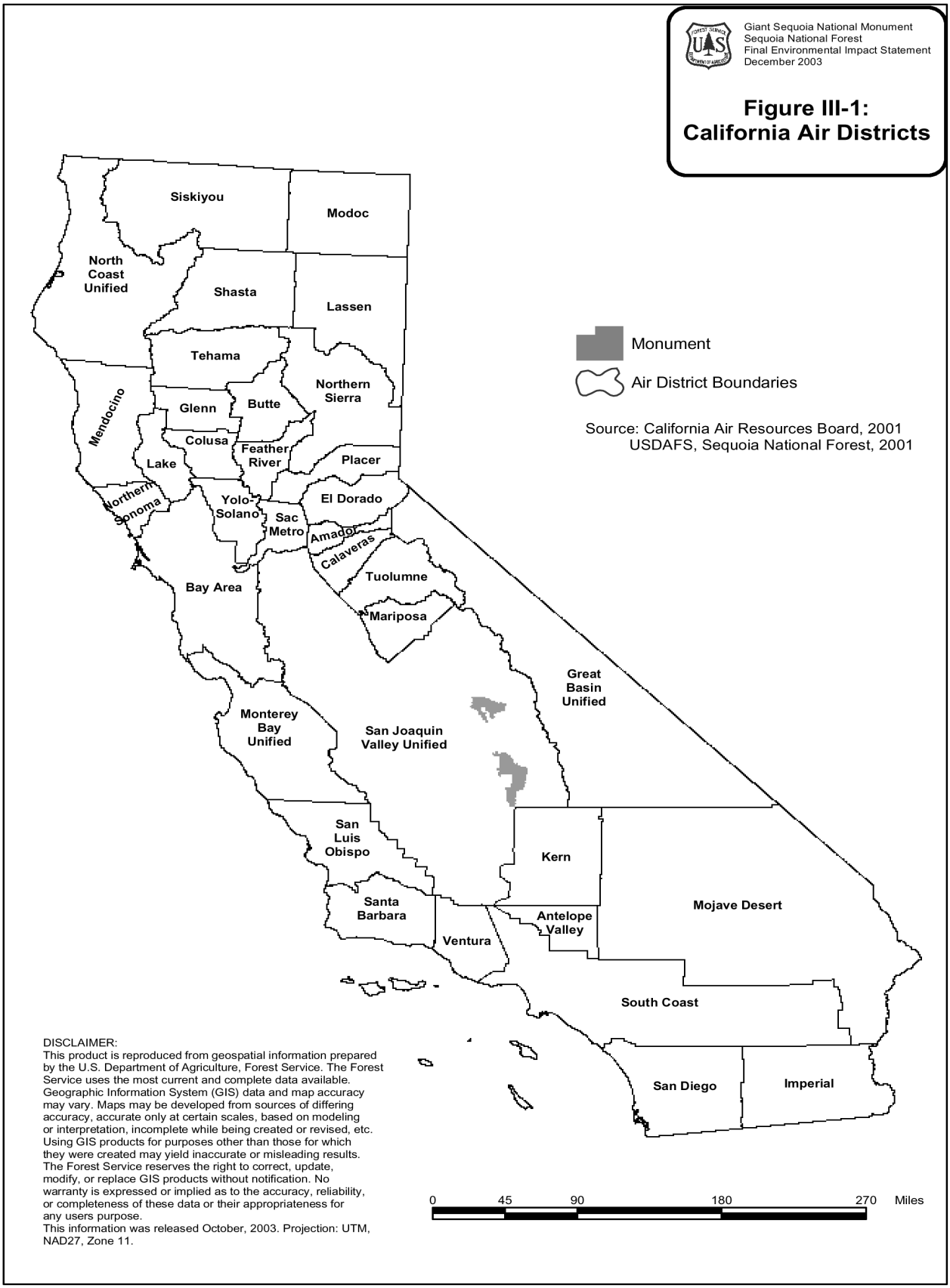
a) General Meteorology, Climatology, and Transport Mechanisms

The Monument lies within the San Joaquin Valley Unified Air District. The San Joaquin Valley has a northwest to southeast orientation, with approximate

dimensions of 100 miles wide by 300 miles long (see Figure III-1: California Air Districts). The district consists of 24,840 square miles, about 16% of California's geographic area. The California Department of Finance estimates that the San Joaquin Valley Air Pollution Control District (District) has a population of about 3,174,400. The major urban centers include Bakersfield, Fresno, Modesto, and Stockton.

Air pollution movement, including smoke, is restricted in both vertical and horizontal directions. Vertical air movement is restricted by radiation and subsidence inversions. In the valley, the inversion base is 500 feet or less (at the surface for a ground-based inversion) in the morning during all seasons. In winter, the inversion base is 1,000 to 1,500 feet or lower throughout the day because heating from the sun is reduced (lower sun angle). During the rest of the year, the inversion base is often lifted by mid-day to 1,500 to 3,000 feet or more. In the summer, the inversion layer can sometimes be entirely destroyed. Local nightly radiation inversions in mountain valleys are also common. Horizontal air movement is restricted on three sides by the mountains that surround the San Joaquin Valley. These include the Coastal Mountains to the west, the Tehachapi Mountains to the south, and the Sierra Nevada to the east. In the spring and summer when the marine layer is shallow, westerly winds enter through low coastal gaps, primarily the Carquinez Straits, and flow down the valley toward the southeast. Daytime wind speeds increase as the valley heats up and are strongest in the afternoon. During storm-free periods in the fall and winter, the airflow is more variable, with light wind speeds resulting in less air movement. These air transport mechanisms are responsible for daily and seasonal variation of air pollution and smoke movement.

During the day, air near the mountain slopes is heated, resulting in upslope and up-valley winds. With sunset, the process is reversed. Terrain-driven winds provide a means to diurnally transport pollution out of, and back into, the valley (Blumental, et al, 1985). Several tracer studies have demonstrated pollutant transport into the mountains (Lehrman, et al, 1994; Shair, 1987; Tracer Technologies, 1992). Similarly, other research suggests that pesticides applied in the valley are transported to the Sierra Nevada, with levels decreasing with increasing distance and elevation from the valley floor (Zabik and Seiber, 1993). The meteorology of the San Joaquin Valley has a significant influence on pollutant transport and ozone and secondary particle formation in the region. Weather patterns moving from California's central valley carry pollutants generated in the valley and deposit them


Giant Sequoia National Monument
Sequoia National Forest
Final Environmental Impact Statement
December 2003
Figure III-1:
California Air Districts
Monument
Air District Boundaries
Source: California Air Resources Board, 2001
USDAFS, Sequoia National Forest, 2001
Siskiyou
Modoc
North Coast Unified
Shasta
Lassen
Tehama
Northern Sierra
Mendocino
Glenn
Butte
Colusa
Feather River
Lake
Placer
Northern Sonoma
Yolo-Solano
El Dorado
Sac Metro
Amador
Calaveras
Tuolumne
Bay Area
Mariposa
Great Basin Unified
Monterey Bay Unified
San Joaquin Valley Unified
San Luis Obispo
Kern
Santa Barbara
Mojave Desert
Antelope Valley
Ventura
South Coast
San Diego
Imperial
0 45 90 180 270 Miles
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This information was released October, 2003. Projection: UTM, NAD27, Zone 11.

in the central and southern Sierra Nevada foothills and mountains (Zabic and Seiber, 1993). A nocturnal inversion forms in the San Joaquin Valley nearly every day of the year. During winter months, wind flows in the San Joaquin Valley are from the south, with stagnant conditions prevailing except during passage of winter storm systems.

Summer wind patterns in the Sierra Nevada Mountains are complex due to rugged terrain and intense daytime solar radiation. During summer months, the predominant surface wind direction in the San Joaquin Valley is from the northwest to southeast, down valley from Stockton towards Bakersfield. In Fresno, the morning surface flow is frequently from the south or west and is characterized by light wind speeds. Wind speed increases during the day, shifting towards a northwest to southeast direction, peaking around 5:00 p.m. Pacific Daylight Time (Ewell, et al, 1989.).

The general summer daytime flow can be slightly, but significantly, modified in the late evening and early morning hours. The modified pattern occurs when ozone concentrations in the valley are high. The influence of two major phenomena, the nocturnal jet and the Fresno Eddy, which regularly occur during the ozone season, have significant influence on ozone concentrations in the valley (Roberts, et al, 1990). The jet provides a mechanism for rapid transport of pollutants from north to south, while the eddy spreads pollutants throughout the southern part of the valley and possibly into higher levels. Computer modeling during a summer pollution episode showed that the bay area and Sacramento area contributed 27%, 10%, and 7% to the ozone exceedances in the northern, central, and southern valley, respectively (District, 1994).

An assessment of impacts of transported pollutants on ozone concentrations by California Air Resources Board (CARB) in 1993 indicates that transport of pollutants from the broader Sacramento Area, San Francisco Bay Area, and the San Joaquin Valley has overwhelming impact on the central and southern Sierra Nevada.

b) Demographics

Population growth plays an important role in the competition for air pollution capacity and the frequency of smoke-induced public nuisance episodes. During the time period from 1980 to 1999, the population of the San Joaquin Valley Unified Air District increased 58%, from about 2 million in 1980 to nearly 3 million in 1999. The statewide average growth during this period was 43%. During this same time, the daily vehicle miles traveled more than doubled in the district, rising from about 4 million miles in 1980 to over 9 million miles per day in 2000, a 125% rise compared to a statewide average of 87%. Because these growth rates are so much higher than the growth rates in other parts of the state, there has not been the same level of air quality improvement in the San Joaquin Valley Unified Air District, especially with respect to ozone (CARB, 2001).

c) Air Regulatory Structure, Principal Legislation, and Policy

The air quality regulatory structure and agencies responsible for compliance are as follows:

- Federal – Environmental Protection Agency (EPA).
- State – California Air Resources Board (CARB).
- Local – San Joaquin Valley Air Pollution Control District (District).

Environmental Protection Agency (EPA). The federal government sets air quality standards, oversees state and local actions, and implements programs for toxic air pollutants, heavy duty trucks, locomotives, ships, aircraft, off-road diesel equipment, and some types of industrial equipment. The role of federal, state, and local governments is defined in the Clean Air Act and its amendments of 1977 and 1990.

Some of the principal components, regulations, and policies related to the Clean Air Act that may directly or indirectly affect planning in the Giant Sequoia National Monument are discussed below.

- *National Ambient Air Quality Standards (NAAQS)* – These are standards for pollutants considered harmful to public health and the environment. The EPA has set the NAAQS for six principal pollutants, which are called "criteria pollutants" (see Table III-2, National Ambient Air Quality Standards). Smoke contributes to PM10 and to a lesser degree NO2, CO, and O3.
- *Class I Areas* – These include National Parks, Wilderness Areas, and some U.S. Fish and Wildlife Refugees that were in existence at the passage of the 1977 Clean Air Act amendments. These areas are provided special protection from new and modified major stationary sources. Federal land managers are mandated an affirmative responsibility to protect values that might be impacted by air pollution, including visibility (air quality-related values).
- *Regional Haze Rule* – These regulations require states to review how pollution emissions within the state affect visibility at "Class I" areas across a broad region. These rules also require states to make "reasonable progress" in reducing any effect this pollution has on visibility conditions in Class I Areas and to prevent future impairment of visibility. The states are required by the rule to analyze a pathway that takes the Class I Areas from current conditions to "natural conditions" in 60 years. "Natural conditions" is a term used in the Clean Air Act that means that no human-caused pollution can impair visibility. This program, while aimed at Class I Areas, will improve regional visibility and air quality throughout the country.

- *Conformity Rule* – This rule implements the Clean Air Act conformity provision, which mandates that the federal government not engage, support, or provide financial assistance for licensing or permitting, or approve, any activity not conforming to an approved State Implementation Plan. Federal actions will not:
- Cause or contribute to new violations,
- Increase the frequency or severity of existing violations, or
- Delay timely attainment or interim emission reductions.
- *EPA Interim Policy on Wildland and Prescribed Fire* – This EPA interim policy integrates two public policy goals: (1) to allow fire to function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems, and (2) to protect public health and welfare by mitigating the impacts of air pollutants on air quality and visibility.

Table III-2: National Ambient Air Quality Standards

Pollutant	Standard Value
Carbon Monoxide (CO) 8 hour average 1 hour average	 9 ppm (10 mg/m3) 35 ppm (40 mg/m3)
Nitrogen Dioxide (NO2) Annual arithmetic mean	 0.053 ppm (100 ug/m3)
Ozone (O3) 8 hour average 1 hour average	 0.08 ppm (157 ug/m3) 0.12 ppm (235 ug/m3)
Lead (Pb) Quarterly average	 1.5 ug/m3
Particulate Matter (PM10) Annual arithmetic mean 24-hour average	 50 ug/m3 150 ug/m3

California Air Resources Board (CARB). State governments are responsible for developing state implementation plans that describe how each state will achieve the requirements of the Clean Air Act. In California, the state implement plan is a collection of regulations used to clean up polluted areas. EPA maintains oversight authority, must approve each SIP, and can take over enforcement action if reasonable progress is not made. CARB has set more stringent standards, oversees state and local actions, and implements programs for toxic air pollutants, heavy-duty trucks, locomotives, ships, aircraft, off-road diesel equipment, and some types of industrial equipment.

The Smoke Management Guidelines for Agricultural and Prescribed Burning (Title 17) are the regulatory basis for California's Smoke Management Program. Amendments to California's Title 17 may directly or indirectly affect planning in the Giant Sequoia National Monument. The smoke management guidelines became

effective on March 14, 2001. Local air pollution control districts use these guidelines in local rule development.

San Joaquin Valley Air Pollution Control District (District). Local air pollution control districts in California develop plans and implement control measures in their areas of jurisdiction. These collectively make up California's SIP. These controls primarily affect stationary sources but do include sources of dust and smoke. The District also conducts public education and outreach efforts. The District is comprised of eight counties that share a common air district: Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, and Tulare Counties. The following District regulations may directly or indirectly affect planning in the Giant Sequoia National Monument:

- Public Nuisance (Rule 4102) – Prohibits air discharge of material that causes nuisance or annoyance to any considerable number of people.
- Prescribed Burning and Hazard Reduction (Rule 4106) – This rule was adopted June 21, 2001, in response to California's Title 17, and is designed to permit, regulate, and coordinate the use of prescribed burning and hazard reduction burning while minimizing smoke impacts on the public.
- Fugitive Dust (Regulation 8) – The existing Regulation 8 rules were developed to implement control strategies for major sources of dust. These include construction, demolition, excavation, extraction, handling/storage, landfills, paved/unpaved roads, and open areas. EPA has recently cited deficiencies in these existing rules and the District is evaluating a series of new rules aimed at further reductions in particulates.

d) Pollutants of Concern

Most of the pollutants that have damaged ecosystems and impaired visual conditions existed to some extent within natural systems. Thus, many native species and ecosystem processes evolved in the presence of these pollutants. In fact, trace amounts of many of these pollutants are required for many biogeochemical processes. However, changed availabilities (including amount and timing), and changed frequency and duration of exposure can have negative effects on ecosystem elements and processes. The important distinction between these differing effects occurs when amounts of air pollution become greater than historical levels.

The primary air pollutants that can cause detrimental effects to public health or ecosystems, or which can impair visual quality include particulates, oxides of sulfur and nitrogen compounds, elemental carbon and oxides, ozone, and toxic air pollutants. A more detailed discussion of these pollutants is provided in Chapter 3 of the Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement (January, 2001), pages 325 to 326. Air pollutants may result from natural or human

processes. Natural pollution may occur from forest fires, volcanic activity, decomposition of plants and animals, soil erosion, pollen and mold spores, volatile organic compounds emitted by vegetation, ocean spray, electrical storms, and photochemical reactions. Human pollution sources include industrial sources, prescribed burning, animal production, agricultural burning, residential and business development, and vehicle emissions.

Smoke from wildfire and prescribed fire can degrade air quality and impact public health. The literature suggests that ambient particles of the greatest concern to health are those smaller than 10 microns in diameter. Particulate matter produces physiological and pathological effects by a variety of mechanisms, including:

- Increased airflow obstruction
- Impaired clearance of lung pathways
- Changes in the epithelial lining of the alveolar capillary membrane
- Susceptibility to asthma and chronic pulmonary disease

Several subgroups within the population are more likely at risk. Children are more likely to have decreased pulmonary function while the elderly and those with existing pulmonary disorders may be subject to increased mortality.

e) Current Air Quality Conditions

District Designations. The District is considered to be in non-attainment (not meeting standards) federally for ozone and PM10 (particulate matter less than 10 microns in diameter). The District is considered to be in severe condition for ozone and serious for PM10. In addition to ozone and PM10, the District does not meet the state standards for carbon monoxide in the Fresno urban area. Smoke from various sources is a contributor to PM10 and ozone.

Visibility Conditions. Visibility conditions in the Sierra Nevada improve from south to north and from low elevations to high elevations. Sequoia and Kings Canyon National Parks, the southernmost and lowest elevation monitoring sites, experience some of the worst visibility conditions among western Class I Areas. Smoke can sometimes contribute to visibility impairment. The Interagency Monitoring of Protected Visual Environments (IMPROVE) site at Sequoia National Park is considered representative of visibility conditions in the Monument. This site shows high nitrate concentrations, indicating an urban influence.

Ozone Impacts to Vegetation. Amounts of ozone have increased in the San Joaquin Valley as a result of increased levels of nitrogen compounds and volatile organic compounds. The Forest Service and National Park Service have tracked injury to conifers in the southern Sierra Nevada since 1991. Some of the earliest plots have been evaluated for a period of over 20 years. The data confirms injury in Jeffrey and Ponderosa pines with the bulk of injury occurring in stressed trees. There is inadequate monitoring data to fully understand the physiological effects.

Sulfur and Nitrogen Compounds. Nitrogen compounds in the air have shown an overall increase compared to the native system, although the total amount has not been quantified. Bytnerowicz and others (in press) found that wet deposition of nitrogenous and sulfurous pollutants was the highest at elevations below 7,000 feet on the western slopes of the Sierra Nevada. Deposition from urban and agricultural sources may be approaching saturation in southern areas of the Sierra.

3. Caves

The Monument contains several caves, primarily located in the northern portion of the Monument, in Kings Canyon. They are found in Kings Terrain metamorphic roof pendants. The Kings Terrain consists of Triassic and Jurassic metamorphosed sedimentary rocks and sparse intermediate to silicic metavolcanic rocks. The dominant rock types in the Kings Terrain are phyllite, quartzite, schist, marble, gneiss and metavolcanic rocks (Matthews and Burnett, 1965). The marble is a metamorphosed limestone that is conducive to the formation of caves, and carbonate endemic flora and fauna may be present. Caves are found where stream channels cross the marble outcrop. This marble easily dissolves in Sierra Nevada waters and, if a marble outcrop is subjected to stream flow, a cave can result.

The location of fifteen caves is known; these include Boyden Cave, Church Cave, and several named and unnamed caves. There are probably as many as 100 caves located in the Monument (Despaine, personal communication). No caves have gone through the process of being evaluated as “significant” under the Federal Cave Resource Protection Act of 1988.

Boyden Cave is a commercially developed cave that is operated under a special use permit. The operators of the cave offer a 40-minute walking tour between April and November. Approximately 35,000 people visit the cave each year. A survey of Boyden Cave is nearly completed, with 0.63 miles of mapped cave features. This cave contains outstanding karst features including stalagtites, stalagmites, and flow sheets.

Church Cave is one of California's most important caves. As of 1997, the Southern California Grotto had surveyed up to 3.45 miles of the cave, and there are still many openings to explore and survey. The passages of Boyden Cave come within 400 feet of Church Cave. Church Cave is available to a limited list of authorized leaders to lead parties into the cave. Each trip has to be approved with an access permit.

Access to Windy Cave has been blocked to protect the features in this cave. Forest Service and National Park Service personnel know of several other caves, but their locations have not been formally documented. A cave survey has not been completed.

Some caves in the Monument may contain paleontological information from the last 50,000 years. These caves contain information on the prehistory of the giant sequoias

that is important to understand the paleoecology of this species. Some of these caves were used by prehistoric people, as attested to by petroglyphs near cave openings.

Caves are prime habitat for some wildlife species, including forest sensitive species such as the Townsend's big-eared bat, spotted bat, and pallid bat. Other bats use caves for hibernation and breeding and include the little brown myotis, Yuma myotis, California myotis, and big brown bat. Other rare and endemic species found in caves include spiders, other invertebrate species, tight coin snails, packrats, and cave-dwelling salamanders.

Caves may offer good opportunities for recreation and education if their natural resources can be protected. Boyden Cave is a good example of a recreational cave where the general public can study cave ecology.

4. Fire and Fuels

a) Fire History

Fire history on the Sequoia National Forest shows that almost twice as many fires are started by lightning as are started by human ignitions. In addition, almost four times the acreage burned is from human ignitions rather than the higher frequency lightning fires.

Figure III-2: Acres of Wildfires in the Last 33 Years

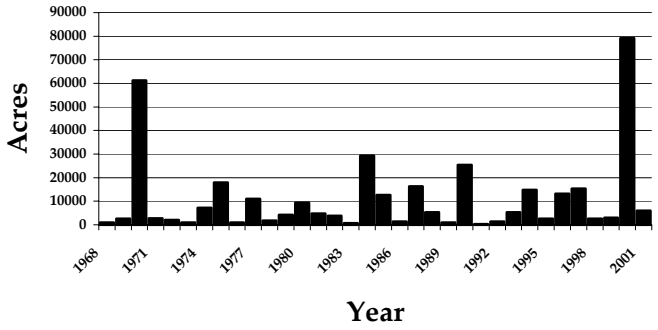


Table III-3: Percentage of Lightning and Human-Caused Wildfires by Administrative Area in the Last 34 Years

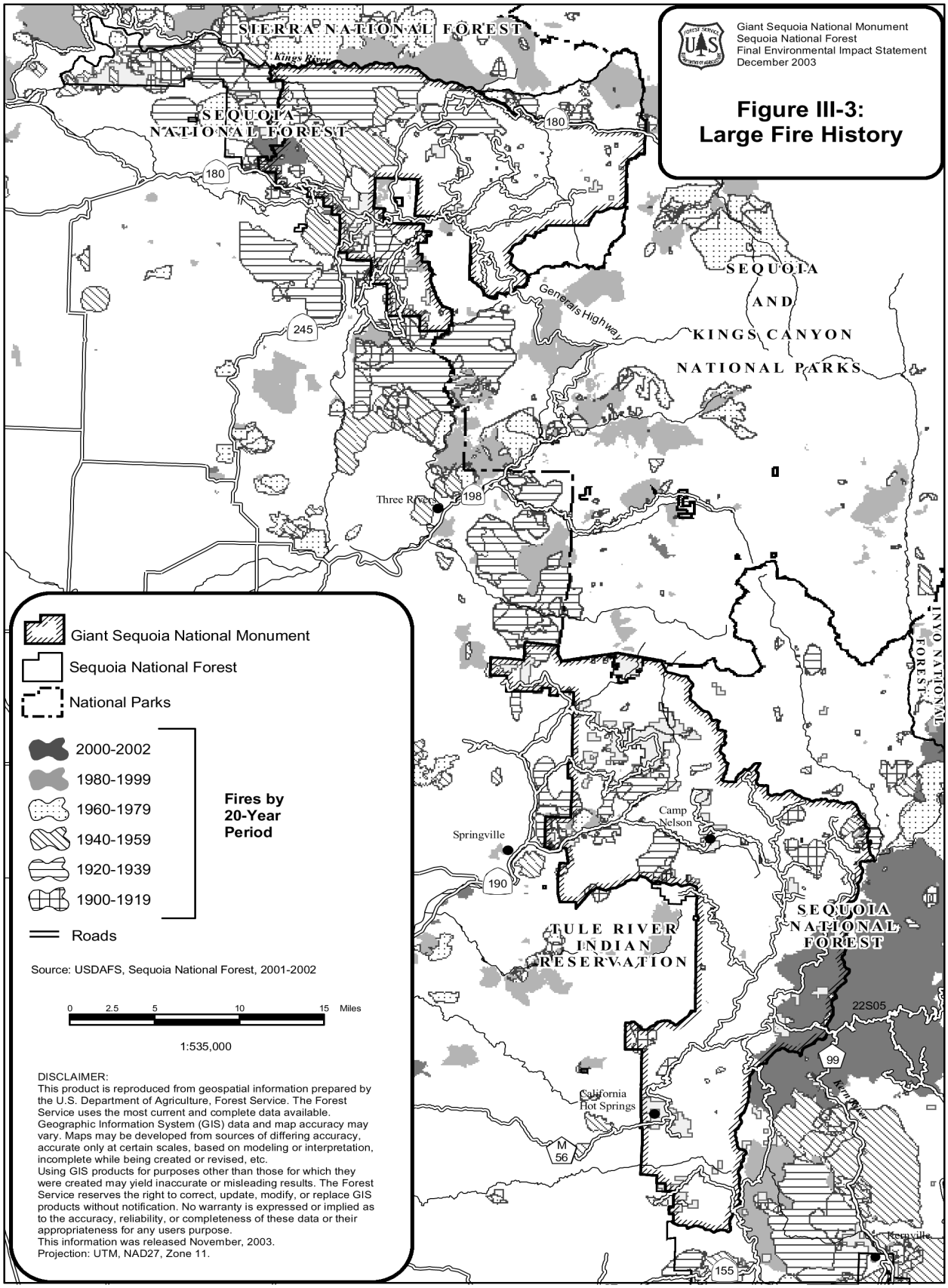
Administrative Area	Lightning-Caused	Human-Caused
Monument	25%	44%
Sequoia National Forest outside the Monument	75%	56%
Total	100%	100%

The percentage of lightning-caused fires is close to what would be expected given the amount of acres within the Monument. The human-caused fires, however, are a little higher than what would be expected given how the acreage is divided by administrative area. Table III-4 shows the acres and percentage of lightning and human-caused wildfires by administrative area.

Table III-4: Acres of Lightning and Human-Caused Wildfires by Administrative Area in the Last 34 Years

Administrative Area	Lightning-Caused	Human-Caused
Monument	6,043 (7%)	38,721 (9%)
Sequoia National Forest outside the Monument	76,853 (93%)	413,320 (91%)
Total	82,896 (100%)	452,041 (100%)

The acres burned historically by wildfires are lower within the Monument than would normally be expected for both human and lightning-caused fires (see Figure III-3). Although ignitions are plentiful within the Monument, these fires have a lower incidence of resulting in large fires as compared to the rest of the national forest. This can be explained by the number of initial attack resources within the Monument as compared to the rest of the forest. Table III-5 shows a comparison of suppression resources found inside and outside the Monument on the Sequoia National Forest. There are almost equal numbers of resources for different numbers of acres. The reasons for the larger number of resources within the Monument relate to loss of value. Historically, the risk of loss within the Monument was mainly the commodity value of the timber and communities threatened by hazardous fuel conditions.


Giant Sequoia National Monument
Sequoia National Forest
Final Environmental Impact Statement
December 2003
Figure III-3:
Large Fire History
SIERRA NATIONAL FOREST
Kings River
SEQUOIA NATIONAL FOREST
180
245
198
190
99
155
M 56
Generals Highway
SEQUOIA AND KINGS CANYON NATIONAL PARKS
Three Rivers
Springville
Camp Nelson
TULE RIVER INDIAN RESERVATION
SEQUOIA NATIONAL FOREST
22S05
California Hot Springs
Kaweah River
Kennville
INYO NATIONAL FOREST
Giant Sequoia National Monument
Sequoia National Forest
National Parks
2000-2002
1980-1999
1960-1979
1940-1959
1920-1939
1900-1919
Fires by 20-Year Period
Roads
Source: USDAFS, Sequoia National Forest, 2001-2002
0 2.5 5 10 15 Miles
1:535,000
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This information was released November, 2003.
Projection: UTM, NAD27, Zone 11.

Table III-5: Initial Attack Resources by Administrative Area

Administrative Area	Engines	Prevention	Type 1 IHC	Type 1 Crew	Helicopter	Total IA Resources
Monument (326,386 acres)	7	8	1	1	1	18
Sequoia National Forest outside the Monument (792,659 acres)	7	9	1	1	1	19
Total Monument & Forest	14	17	2	2	2	37

It is important to control fires and reduce the fire susceptibility in the chaparral that leads to the mixed conifer ecosystems, as these areas generally lay down slope of mixed conifer vegetation and giant sequoia groves. Fires in the chaparral tend to move into the mixed conifer ecosystems because of a lack of discontinuity or variation of vegetation from the chaparral ecosystem to the mixed conifer ecosystem (Sugihara, 2002). Treatment of mixed conifer forests prior to treatment of chaparral provides for a greater degree of protection to communities, giant sequoia groves, and wildlife habitat. This is because reduced susceptibility in the mixed conifer vegetation reduces the risk of damage from treatment of down slope chaparral stands.

b) Fuels Management

This section describes the elements of fuels that are key to the assessment of wildland fire behavior.

Fuels. Fuels are that part of fire behavior that can be changed or manipulated to meet the desired objectives of a management activity. Fuels consist of the vegetation of the ecosystem, both living and dead. They are usually quantified when there is more vegetation or down material than is normal compared to a historic condition.

Fuels are described in terms of arrangement such as vertical or horizontal, surface fuels, or crown fuels. Ladder fuel is a term for the vertical arrangement of fuels that provide continuity between surface fuels and crown fuels. Fuels can also be described in terms of stand structure and species composition (discussed more under Managing Fuels).

Fuel loading is a quantifiable measure of fuels in a given area, usually expressed in tons per acre by size class. Fuel loadings are often assessed before treatment to determine how much to reduce the fuels. Table III-6 shows six areas in the Monument that were assessed for average fuel loading. These inventories represent the range of conditions in the Monument. The averages range from 44 tons per acre up to 104 tons per acre and the values do not reflect the duff layer.

Table III-6. Surface Fuel Loadings found within the Mixed Conifer and Pine Forests of the Monument

Location	Size of Analysis Area	Date of Assessment	Average Tons per Acre*	Method of Inventory**
Big Stump Grove Analysis (HLRD)	380 acres	1997	50	Brown's Intercept
Hume Vegetation Management Project (HLRD)	5,120 acres	1998	44	Photo series
Rocks Timber Sale (TRRD)	4,200 acres	1999	50	Photo series
Saddle Fuels Reduction (HSRD)	28,800 acres	1999	46	Brown's Intercept
Starvation Analysis (HSRD)	435 acres	1970-1995	76 – 104	Brown's Intercept
White River (HSRD)	26,000 acres	1997	60	Brown's Intercept

HLRD-Hume Lake Ranger District
TRRD-Tule River Ranger District
HSRD-Hot Springs Ranger District
*Duff layer is not included in the average tons.
**There are two general types of inventory methods used in the Monument. James K. Brown's intercept method is a more detailed approach of inventory that involves counting all fuel within a plot. This method can be time consuming. The Photo series method is an ocular estimation by size class quantified in a photo set, where the person doing the inventory compares the analysis area to the set of photos.

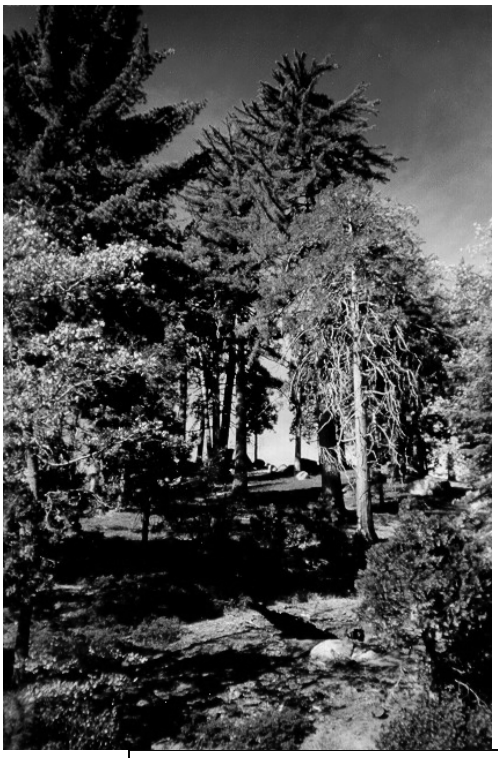
Fuels management is that part of the fire organization that takes the fire behavior assessment and develops goals and objectives to move the fuels situation toward the desired condition. The Forest Plan strategy from the last decade assumed that whether the forest was to be cut for timber or set aside for preservation as a natural feature, fires were destructive and should be prevented, the exception being in Wilderness Areas. The Forest Plan recognized the role of fire as a natural process and a needed component in these natural areas. However, even though the policy of appropriate suppression response was adopted in 1983 and adopted with the Forest Plan in 1988, the preferred choice of suppression on this national forest has continued to be control, even in Wilderness Areas (Husari, 1996). Outside of Wilderness, laws were passed to require the disposal of slash by safe methods in timbered areas (Wright and Heinselman, 1973).

Technically, fuels management can be viewed as managing potential fire intensity. Fire intensity refers to the amount of energy released by the fire (USDA Forest Service, 2001, Chapter 3, page 242) and is a physical parameter that can be related to flame length. It can be determined from the product of biomass consumption (energy) and rate of spread of the fire (Agee, 1996). Fire severity is a description of fire effects on the biologic and physical components of the ecosystem (Sugihara, 2002).

A natural baseline comparison of what fuel conditions should be is the historic fire regime (see Classification of Fire Regimes for Ecosystems in the Monument in the Ecological Units section). Each fire regime has a characteristic range of frequency and severity which influences, and is influenced by, the vegetation within it. The characteristics of the fire regime help define the mosaic of vegetation types, age classes, and succession stages on the landscape (Turner et al, 1993). Fuels managers often measure the spatial distribution of fuels in the current fire regime and relate it to the historic fire regime to determine the appropriate direction of fuels management (Sando, 1978). The characteristics of the historic fire regime are often represented by a fuel loading and structure that existed before European settlement.

c) Landscape Conditions

Fire Susceptibility. To quantify the shift of vegetation from a resilient fire dependent ecosystem to an ecosystem that is susceptible to wildfire, a fire susceptibility rating was developed on the forest. The rating uses severity, hazard, and risk to identify areas on the forest that have high, moderate, or low susceptibility to wildfire. This index is used for prioritizing areas that need treatment, particularly communities within high fire susceptibility areas. Figure III-4 in the Map Packet shows the high, moderate, and low fire susceptibility areas in the Monument.



Flame lengths in low susceptibility areas are generally below four feet.

Flame lengths in moderate susceptibility areas are generally between four and eight feet.

Flame lengths in high susceptibility areas generally exceed eight feet.

Severity and hazard typically quantify the amount and condition of fuels available for burning, fire behavior, and the timing for fuels to burn (USDA Forest Service, 2001, *Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement,* page 243). One of the contributors to intense fire behavior and fuel availability is the shift from fire-resistant species naturally found in the Monument to more fire-susceptible ones. Even-aged stand management, density of trees, and the kinds of tree and shrub species that have replaced ecosystems in place prior to 1875 have produced a forest more susceptible to catastrophic fire.

An index was developed on the Sequoia National Forest to provide a relative ranking of fire susceptibility to large, severe fire. This index is a tool for the forest in

prioritizing areas that need treatment, particularly for those communities within high fire susceptibility areas. Fire susceptibility was developed using three separate map layers: hazard, risk, and severity for the Sequoia National Forest (see Figure III-4 in the Map Packet).

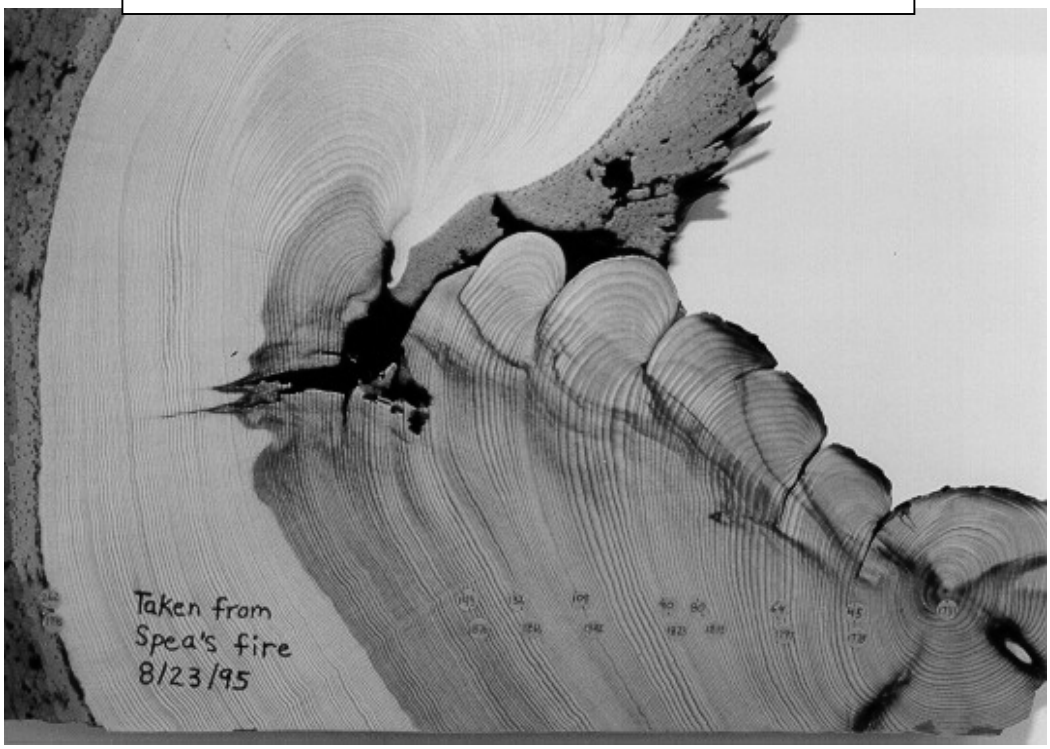
Table III-7 shows the acres of the Monument that currently have high, moderate, and low fire susceptibility. Fire susceptibility is the relative ranking to large severe fires (a more in-depth discussion of fire susceptibility is in the Measurements and Indicators section). Acres with high fire susceptibility would, under high fire weather, contribute to stand-replacing fire. Areas of low fire susceptibility, under high fire weather, would generally not contribute to stand-replacing fire. The giant sequoia groves are also at risk of catastrophic fire and do not meet desired conditions for the fire severity indicator (see the Giant Sequoia and Mixed Conifer section in Chapter III).

Table III-7: Acres of Fire Susceptibility (approximate acres including all ownerships within Monument boundaries)

	Fire Susceptibility				
	High	**Moderate**	**Low**	**Barren**	**Total**
Monument	96,412 (30%)	183,799 (56%)	37,601 (12%)	7,627	325,438

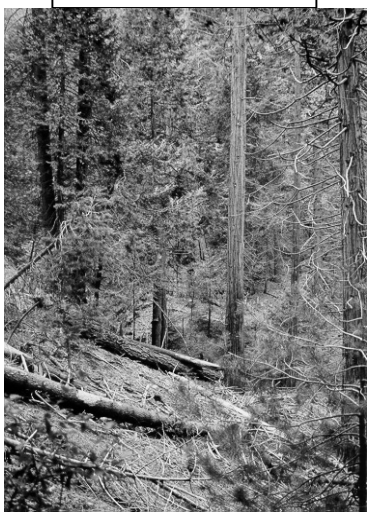
Fire Return Interval. Fire return interval describes how often fires occur in a particular location. This is a temporal attribute of the fire regime (see the classification of fire regimes in the Ecological Units section of Chapter III) that is measurable by determining when fire occurred last on each of the acres of the Monument. It is an indicator of how close the Monument is to the historic fire regime. Some attributes of the fire regime that would not be addressed by simply putting fire back into the ecosystem are: seasonality, severity, intensity, fire type, extend, and complexity.

This cross-section of an incense cedar tree shows it has been 126 years since the last scarring fire in 1876. The tree was killed during the Speas Fire in 1995.



High to Extreme FRID

Moderate FRID



Low FRID

A fire return interval departure map was developed by the Sequoia and Kings Canyon National Parks from vegetation, fire history, and historic fire frequency data to assess the departures from the historical fire return interval in areas within the Monument (see Figure III-5 in the Map Packet). A fire return interval departure index ranging from –16 to 1 was reclassified into five categories: extreme, high, moderate,

low and rock/water. Where condition class is a measure of departure from historical fire regimes, the following assignments were made.

Table III-8. Fire Return Interval Departures

Fire Interval Departures	Rating	Percent of Monument
-16 to – 5	Extreme	62
-4.999 to –2	High	5
-1.999 to 0	Moderate	23
.001 to 1	Low	8
1.001 to 99	Rock/Water	2

The ecosystem of the Monument has largely been protected from the effects of fire for almost a century. As a result, live and dead fuels have increased along with the development of denser conifer forests and chaparral ecosystems. Logging on Forest Service and private lands has been primarily of the large overstory trees, accelerating growth in the dense understory and increasing landscape-level homogeneity of fuel structure (Weatherspoon, 1996; McKelvey and Johnston, 1992). Therefore, compared with presettlement [1875] conditions, the current Sierra Nevada forests are generally younger, denser, smaller in diameter, and more homogeneous (McKelvey, 1996). Due to high productivity and various forest management activities, the lower and middle-elevation mixed conifer forests have likely experienced greater change in structure and fuels conditions than have either higher elevation forest or foothill vegetation (Weatherspoon and Skinner, 1996).

In the Monument the historic fire regime has been the guide for restoration of fire-dependent ecosystems. The underlying assumption is that the natural forest is one that has many biodiversity characteristics that need to be maintained in the future for viable animal populations and structural diversity (Agee, 1993). Old forests of mixed conifer and ponderosa pine developed with much more frequent and low severity fires. These forests had more open understories, fewer downed logs, and possibly fewer snags than currently exist (Agee, 1993). In fact, logs on the forest floor may have been consumed on a regular basis during frequent low intensity surface fires (Agee, 1993). The Sequoia National Forest, following Framework direction, still retains important biological legacies such as snags, down logs, and canopy cover to maintain important wildlife habitat characteristics. Wildfires do not always leave a significant component of snags and downed logs as compared to prescribed fires.

Spot Fire Potential. An analysis was conducted to determine the effectiveness of prescriptions in reducing the potential for lofting firebrands into sensitive areas (i.e., communities (wildland urban intermix), defense zones, and giant sequoia groves) to start spot fires. This analysis used both the 90th percentile and local prescribed fire weather and fuel conditions to model spot fire production from surrounding vegetation in the event of a wildfire or planned prescribed fire. The

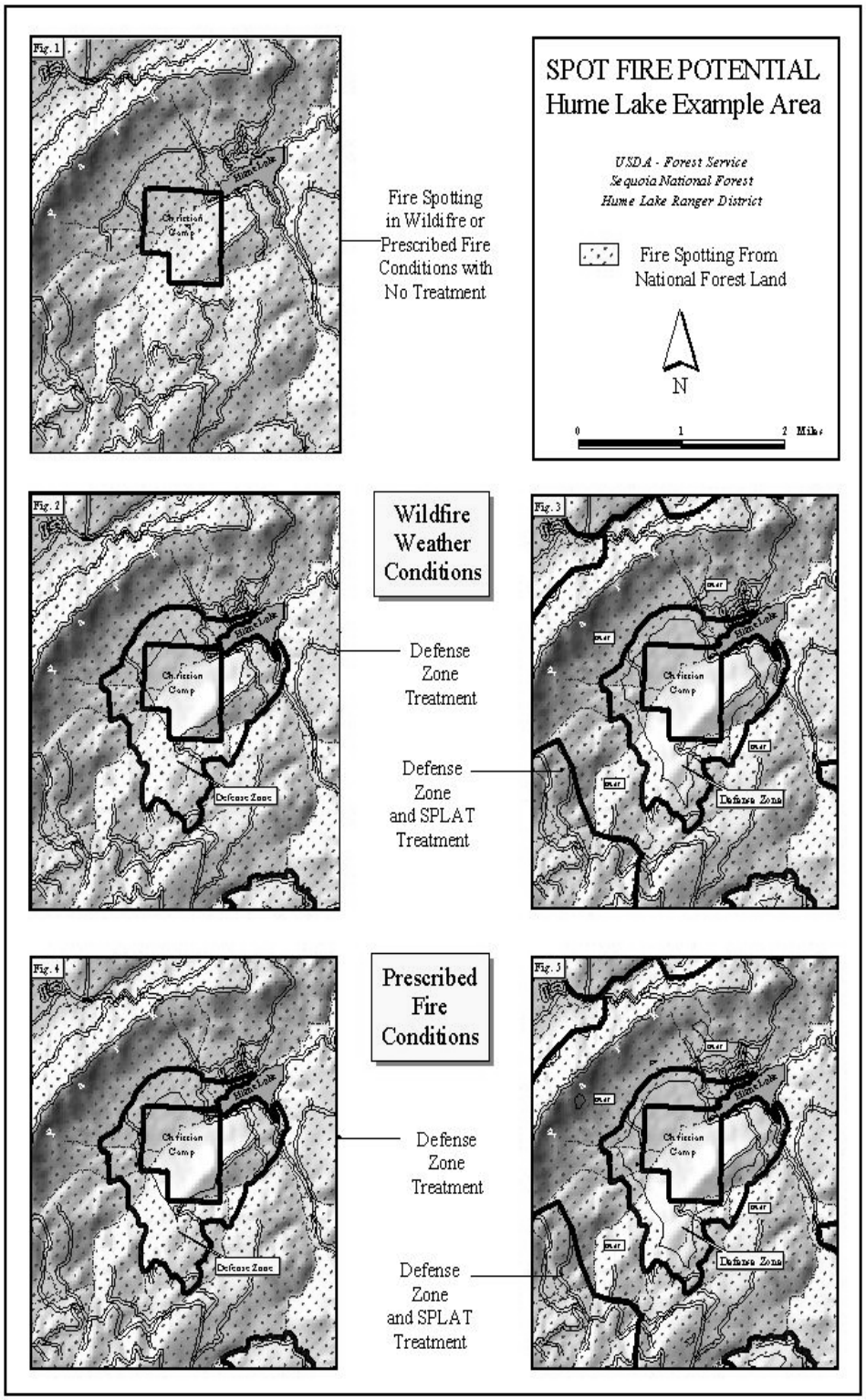
analysis displays spatially how various treatments and their placements can influence spotting potential when burning under different weather and fuel conditions. The 90th percentile fuels and weather conditions represent what a fire manager can expect during a wildfire. The prescribed fire fuels and weather conditions are what can be expected during the upper limits of prescribed fire operations. Both scenarios are used to give the fire manager the information to refine pre-treatment prescriptions, including the size and placement of the treatment unit to maximize protection for sensitive areas.

Observed spotting distances of wildfires occurring in the Monument (McNally, Edison, Choke, and Peppermint, among others) were used to validate the modeled outputs. Observed spotting distances of prescribed burns conducted within the Monument were also used to validate the model. The spotting distances modeled can generally be significantly reduced by regulating ignition techniques, but for this scenario, the unregulated spotting distance is applied. The scenarios in Figure III-6 make the following assumptions: all defense zones would be treated (therefore not sources of firebrands) and the SPLATs would exhibit a 50% reduction in spotting distance once they were treated. Additional assumptions in modeling the spot fire potential were: 1) the 90th percentile weather conditions allow fire managers to assess prescription effectiveness better than the more extreme weather percentiles, and 2) fire managers would not ignite a prescribed burn during weather and fuel conditions outside of the current parameters. The wildfires and prescribed fires used to validate modeled outputs burned under various weather and fuel conditions for various lengths of time, so it was necessary to generalize the observations. In addition, the BEHAVE fire modeling software was run under the assumption that the direction of maximum spread of fire is uphill.

Fig. 1 of Figure III-6 illustrates spot fire potential from firebrands being lofted into the wildland urban intermix on private land from national forest lands. Without a defense zone, many firebrands would be expected to fall within the wildland urban intermix. Fig. 2 shows a locally delineated defense zone without SPLATs in place around the wildland urban intermix, with the expected firebrand lofting at 90th percentile fire weather. Fig. 3 is similar to Fig. 2 except that SPLATs are in place adjacent to defense zones, which would be expected to reduce fire behavior by 50% at 90th percentile fire weather. Fig. 4 is similar to Fig. 2 where treatment consists of only a locally delineated defense zone around the wildland urban intermix, with the expected firebrand lofting with prescribed fire weather. Fig. 5 shows added SPLATs to reduce the spotting potential within the wildland urban intermix, modeled with prescribed fire weather.

The Sequoia National Forest ground and air suppression resources have historically been successful in suppressing wildfires during initial attack with “low” and moderate spotting distances (between 1/100 and 3/10 of a mile) such as in the Peppermint and Edison wildfires. National forest suppression resources have had limited initial attack success on wildfires with high spotting distances (in excess of 3/10 of a mile) such as in the McNally wildfire.

Figure III-6: Spot Fire Potential, Hume Lake Example



Condition Class: The fire return interval departure index contains the core attributes used to determine condition class. The performance measures for National Fire Plan Goal Three include the number of acres moved to a better condition class, that were identified as high priority in total, and the percent they are of the total acres treated. Condition Classes 2 and 3 are the targets for treatment. Condition Class 2 identifies those lands where fire regimes have been altered from their historic ranges, creating a moderate risk of losing key ecosystem components as a result of wildfire. Lands in Condition Class 3 are where the vegetative composition, structure, and diversity have been significantly altered because of missing multiple fire return intervals. These lands verge on the greatest risk of ecological collapse.

Table III-8 is converted below in Table III-9 to condition classes. The Extreme and High ratings for fire return interval are grouped into Condition Class 3. The Moderate rating becomes Condition Class 2 and the Low rating Condition Class 1.

Table III-9: Condition Classes

Condition Class	Percent of the Monument
3	67
2	23
1	10

Wildland Urban Intermix. Wildland urban intermix zones are areas where human habitation are mixed with areas of flammable wildland vegetation (USDA Forest Service, Pacific Southwest Region, 2001). Defense zones are locally determined buffers defined by topographic features and predicted fire behavior. There are an estimated 26,635 acres of defense zones in the Monument. These defense zones can be further delineated during site-specific project analysis. The defense zone allocation generally allows the removal of trees up to 30 inches in diameter to meet hazard reduction objectives for reduced fire behavior in close proximity to communities. Threat zones have also been locally delineated, based on predicted fire behavior on the forest and within the Monument, and total approximately 182,000 acres. The threat zones have more limitations on vegetation removal to meet wildlife habitat objectives. The standards and guidelines associated with spotted owl home range core buffers, the fisher habitat canopy cover rule, and late seral old growth canopy cover appear to be the most limiting.

d) National Fire Plan and Comprehensive Strategy

To respond to the wildland fires of 2000, the President requested and Secretaries of the Interior and Agriculture submitted, Managing the Impact of Wildfires on Communities and the Environment, A Report to the President in Response to the Wildfires of 2000 (September 8, 2000). This report and budget request, along with congressional direction for substantial new appropriations for wildland fire management for fiscal year 2001 and 2002 and the resulting action plans and

agency strategies, have collectively become known as the National Fire Plan. It has broad support with the present (and previous) administration, the Congress, western governors, and many other local and regional groups.

The National Fire Plan includes a discussion of national priority setting, funding allocations, accomplishment, and accountability mechanisms. It serves as a clearinghouse with links to other bi-partisan federal, state, tribal, and local fire management policies and funding initiatives. In August 2001, a companion document, A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment, 10-Year Comprehensive Strategy (Comprehensive Strategy), was developed by the Secretaries of Agriculture and Interior, and state governors. This document defined the core principles and goals of the Comprehensive Strategy. In May 2002, the secretaries and governors developed the Implementation Plan for the Comprehensive Strategy. This is the latest and most specific National Fire Plan document available. The National Fire Plan has evolved over the last two years from the USDA Forest Service's original "Cohesive Strategy" to the final version of the 10-Year Comprehensive Strategy Implementation Plan described above. The ability of the forests to implement an effective landscape level hazardous fuels reduction strategy is fundamental to contribute to effective implementation of this plan. The Regional Forester has decided to adopt performance measures outlined in the plan that can be used to evaluate successful outcomes. Federal, state, tribal, and local governments have endorsed the four goals of the Comprehensive Strategy. Forest Service units at the state and local level are working collaboratively with other agencies to accomplish the associated implementation outcomes by specific dates.

(1) Goal One - Improve Fire Prevention and Suppression, Implementation Outcome - Losses of life are eliminated, and firefighter injuries and damage to communities and the environment from severe, unplanned, and unwanted wildland fires are reduced.

One of the measures of success (performance measure) in attaining this goal is the number of high severity acres burned by unplanned and unwanted wildland fires. While this performance measure strongly relates to developing and maintaining an efficient and well-trained suppression organization with improved prevention programs, it is also inextricably linked to implementing a successful strategy to reduce hazardous fuels across the landscape. Successful performance is influenced by the ability to reduce hazardous fuels to significantly lower wildfire intensity and rate of spread, thus directly contributing to more effective suppression efforts, and fewer acres burned.

(2) Goal Two - Reduce Hazardous Fuels, Implementation Outcome - Hazardous fuels are treated, using appropriate tools, to reduce the risk of unplanned and unwanted wildland fire to communities and to the environment.

The number of acres treated, and the number of acres treated per million dollars gross investment in targeted areas are two performance measures for goal two.

(3) Goal Three - Restore Fire-adapted Ecosystems, Implementation Outcome - Fire adapted ecosystems are restored, rehabilitated and maintained, using appropriate tools, in a manner that will provide sustainable environmental, social and economic benefits.

Performance measures for this goal include the number of acres moved to a better condition class, that were identified as high priority in total, and as a percent of total acres treated. Progress in the accomplishment of this goal is a key component of the Regional Forester's performance.

Condition classes 2 and 3 are the targets for treatment. Condition class 2 is composed of lands where fire regimes have been altered from their historic ranges creating a moderate risk of losing key ecosystem components as a result of wildfire. The vegetative composition, structure and diversity of lands in condition class 3 have been significantly altered due to missing multiple fire return intervals. These lands "verge on the greatest risk of ecological collapse."

The current estimate of acres in condition class 2 and 3 across the 11 Sierra Nevada National Forests is over 7 million acres. Of this amount, about 3 million acres are estimated to be in condition class 3.

(4) Goal Four - Promote Community Assistance, Implementation Outcome - Communities at risk have an increased capacity to prevent losses from wildland fire and the potential to seek economic opportunities resulting from treatments and services.

One performance measure is the percent of acres treated to reduce hazardous fuels by mechanical means with by-products utilized. The current direction performs poorly relative to this measure.

The fire management objectives and priorities for fuel treatment in the Framework (USDA Forest Service, *Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement*, 2001) follow those of the Cohesive Strategy Report. Currently, the existing policy is designed to achieve the same goals of restoring more

characteristic fire regimes and reducing wildfire threats to people, property, and natural resources. However, there is a certain level of uncertainty in using Framework guidelines to meet the needs of fuel reduction at the same time as meeting the requirements for wildlife habitat.

Not only has there been a change in the belief that fire is a missing element within the ecosystem, but that recognition has also led to the Wildland and Prescribed Fire Management Policy of 1995. Direction now provides for using an appropriate management response when appropriate and within the parameters of a signed Fire Management Plan. Management actions on wildland fires will no longer be driven by fire type designation. Fires will no longer be extinguished under a default response but will be suppressed for specific reasons. The specific rationale for fires that are managed for resource benefits will be identified in the Fire Management Plan.

e) Collaborative Efforts with Outside Partners.

The effectiveness of fuels projects is enhanced when performed across administrative boundaries, where the projects can contribute to large-scale fuel reduction. In order to respond to large-scale fire hazard reduction, the Sequoia National Forest makes an effort to collaborate with neighboring agencies and private landowners. Local collaborative efforts include the Fire Safe Council, a California Department of Forestry program that brings all interested parties together to find ways to reduce fuels either on private land, public land, or both. The Tulare County Fire Safe Council has completed several demonstration projects that show the public how fuels can be treated on both private and public lands within the Monument to reduce the threat of wildfire to communities. Other efforts include working directly with communities inside the national forest boundary to reduce fuels, as well as providing assistance to communities to reduce fire hazard.

Other areas of collaboration with neighboring agencies include sharing resources on prescribed burn projects and implementing projects that cross agency boundaries. The effect of sharing resources is to increase the available number of local resources. Implementing projects across boundaries broadens the focus of fuel reduction. The Sequoia National Forest is a stakeholder in the Southern Sierra Geographic Information Cooperative (SSGIC). The group is creating a spatial database for coordinated fuels management planning utilizing a Geographic Information Systems (GIS) framework. The primary goals include improved firefighter and public safety, reduced fiscal costs to both government agencies and the public, and attainment of ecological and hazard reduction goals across jurisdictional boundaries. The project focuses on utilizing GIS and Internet technologies to overcome institutional and organizational barriers to interagency fuels management within very large, diverse ecosystems. Common geographic data and analyses are being developed to prioritize treatment areas based on value, hazard, and risk criteria. The framework will develop and test procedures to manage and update complex information and to institutionalize coordinated planning efforts.

5. Geology and Soils

a) Geology

The Monument is located in a seismically active region that is influenced by three major physiographic and geologic provinces. These provinces include the Sierra Nevada, San Joaquin Valley, and, to a lesser extent, the Coastal Range. While there are no active faults, several active or potentially active faults have been identified within 100 miles of the southern section of the Monument. Numerous earthquakes of magnitude 3.7 and greater on the Richter scale have occurred within 100 miles. Several minor faults are associated with Redwood Creek and the ridgeline separating the Kings and Kaweah drainages. Minor earthquakes (<5.5) have been recorded in the last 20 years near Shell Mountain and immediately south in the upper Kaweah drainage. At least 50 active or potentially active faults have been identified within 100 miles of Terminus Dam (the dam that holds the waters of Kaweah Reservoir), producing numerous earthquakes of magnitude 3.7 on the Richter scale.

The major active faults in the area are the San Andreas (81 miles west), Owens Valley (53 miles east), White Wolf (45 miles south), and Garlock (73 miles south). All of these faults have the potential to generate earthquakes of magnitude 6.5 or greater on the Richter scale (U.S. Army Corps of Engineers, 1999). They are distant from Terminus Dam but are known to be active with long-duration shaking. The San Andreas and Owens Valley faults would be the most likely to generate critical motions within an area of influence to Lake Kaweah. While greater amounts of ground motion would likely occur from the Owens Valley fault group, earthquakes are expected to occur more frequently from the southern segments of the San Andreas Fault. Past records indicate that the magnitude of any future earthquake from either of these faults could be in excess of 8 on the Richter scale (U.S. Army Corps of Engineers, 1996).

The Monument basins are composed of five major geologic groups: (1) the Paleozoic metamorphic Calaveras Complex and equivalents, (2) the late Paleozoic-Mesozoic Kings River ophiolite and associated Kings-Kaweah structure, (3) the Mesozoic metamorphic Mariposa and Logtown Ridge Formations, (4) the Mesozoic grandodioritic Sierra Nevada batholith, and (5) recent alluvial and colluvial valley fill deposits.

The Calaveras Complex is exposed as roof pendants to the Sierra Nevada batholith. The Calaveras Complex rocks had originally extended across much of the Sierra Nevada, but have been mostly stripped off by uplift and subsequent erosion. The Lemoncove schist and quartzite that underlie Terminus and Success Dams and form the isolated peak Lime Kiln probably belong to the Calaveras Complex.

The recent valley-fill deposits are unconsolidated sands and gravels averaging approximately 20 feet in depth at Terminus Dam and increasing to the west over the

river delta in the form of alluvial fan deposits. Sands in the region are predominantly grains of feldspar, mica, and quartz, while boulders are predominantly composed of granite, quartzite, and aplite.

The northern portion of the Monument in the Kings and Kaweah drainages is comprised of granitic and decomposed granitic rock, with protrusions of metasedimentary and metavolcanic rock along with marble in the Goddard and Kings Terrains located on the edge of the Sierra Nevada batholith.

b) Soils

Soils are somewhat acidic, with higher acidity in the region of caves. This is from the formation of carbonic acid as ground water flows through marble roof pendants. Granitic rocks form soils that are less acidic. Where granitic-derived soils are shallow, they are associated with less organic matter and have high runoff rates. Meadow areas and areas of high organic matter are more acidic. Soils have higher acidity in the mixed conifer and pine-dominated stands. The foothill chaparral and grasslands are generally near neutral in pH due to the limited amount and slow breakdown of organic matter, as well as minimal moisture.

In the northern Monument, high runoff is common in the southeastern portion and occurs because the infiltration rate of the soils is often exceeded by rainfall intensity. This has the potential to affect rainfall runoff amounts and timing. Soils are deeper in the northwestern portion and, as a result of the water holding capacity of the soil, so are infiltration rates. Caves have formed because the water reacts with marble to form carbonic acid. Rainwater and snowmelt disappear into fissures and later flow into underground rivers, eventually flowing into the Kings River downstream of the marble bearing formations.

Soil infiltration and depth is moderate to good due to generally moderate to deep soils on granite bedrock at the lower elevations in the Eshom area. Soil infiltration and depth is poor to moderate at the higher elevations around Stony and Woodward Creeks. Better infiltration is found where soils deepen in flatter terrain along the central portion of Eshom and Dry Creeks. Soils are shallowest in the northeastern portion and deepen in the southwestern portion of the Monument. Better infiltration is found where soils deepen in the basins formed by the upper middle portions of Tenmile, Converse, and Mill Flat Creeks. Soils are xeric in the northern and western portions and shallower due to steepness and dryness.

Soils found in the lower Sierra Nevada foothills are typically moderately deep, gently rolling to very steep, and well drained. The soils range from rock outcrops to coarse sandy loam to clay. The soils in the drainages consist of medium and fine-textured soils developed in alluvium weathered from igneous and metamorphic rocks. The soil chemistry varies in acidity from neutral to medium acid, with infiltration rates that vary from slow to moderate.

Soils in the Kern River Watershed are predominantly comprised of coarse sandy loam and sandy clay loam of the Glean Variant, Bald Mountain, Chaix, Chawanakee, Holland, Woolstaff, Wind River, and Hotaw series. These soils were formed in place from parent granitic bedrock and limited areas of metamorphic rock. Minor deposits of alluvium and colluvium occur at scattered locations throughout Monument.

6. Giant Sequoia and Mixed Conifer

This section describes the important ecological conditions in vegetation types of particular concern such as giant sequoia groves and associated mixed conifer forests, as well as those in other fire-adapted vegetation such as chaparral. It includes comparisons of existing versus desired conditions.

The Purpose and Need (see Chapter I) identifies the need to develop management direction to address two critical problems facing the giant sequoias and their ecosystems: 1) an unprecedented failure in giant sequoia reproduction, and 2) an unprecedented buildup of woody debris and surface fuels, leading to an increased hazard from wildfires of a severity that was rarely encountered in pre-Euro-American times. The management plan for the Monument is to provide proper care for the objects of interest as identified in the Proclamation, which include the giant sequoia groves and their ecosystems. For the purpose of this analysis, the giant sequoia groves in the Monument are defined by the boundaries that were located and posted as required by the Sequoia National Forest's Mediated Settlement Agreement (1990).

Within the Monument, there are approximately 327,000 acres of vegetation. Table III-10 summarizes the area covered by the major vegetation types. Additional information on these types can be found in the Ecological Units section of this chapter.

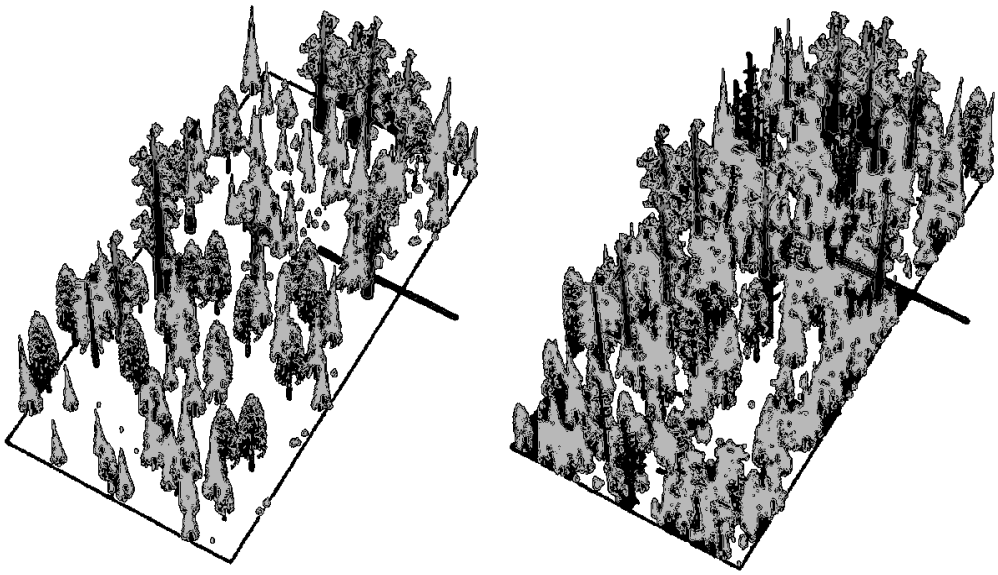
Table III-10: Acres by Vegetation Type

Vegetation Type	Acres
Annual Grassland	3,760
Chaparral	45,000
Mixed conifer dominated by Giant Sequoia	8,550
Lodgepole pine	3,600
Mixed conifer, with giant sequoias	15,500
Mixed conifer (general)	98,700
Ponderosa pine	44,600
Black Oak	2,250
Canyon and Interior Live Oak	62,450
Blue Oak	3,800
Red fir	38,500
Total	326,710

The current growing conditions for vegetation have been altered from that which existed prior to 1875. For example, current atmospheric CO^2 concentration is the highest it has been in at least 420,000 years (Appendix C, Advisory III). Global temperature is rising and the 1990s were probably the warmest decade in the last 1,000 years (Mann et al, 1998; IPCC, 2001). In the Sierra Nevada, temperatures are also rising and are among the warmest of the last millennium (Graumlich, 1993).

Mixed conifer forests are subject to recurring interactions from a wide range of environmental events ("stressors" to ecosystems) such as insects, diseases, and climatic events (wind, rain, snow). The forests are most resilient to these agents when structures and natural processes reflect conditions similar to those that existed prior to 1875 (Appendix C, Advisory III). Under lower stocking conditions such as then, there was less inter-tree competition for available sunlight, nutrients, and growing space. This reduced competition allowed trees to be more stable and resistant to severe alteration by stressors and to be more resilient as they responded to stressors. Currently, much of the forested landscape is much more dense and has much more surface fuel than before 1875, which reduces the forest's resilience and stability and increases the risk of catastrophic wildfire. Restoration of structural conditions and natural processes (using pre-1875 as reference conditions) would allow natural events to operate within an historic range of conditions and maintain healthy growing conditions (Fullmer et al, 1996). The work of Dr. Tom Bonnicksen in Redwood Mountain Grove provides insight into the change in stand conditions over the last 100 or more years (see Figure III-7).

Figure III-7: Computer-generated Picture of a 2.5-acre Portion of Redwood Mountain Grove (figures courtesy of Dr. Tom Bonnicksen)



Rendition of the structure of the same stand approximately 100 years ago. Note the scattered openings in the stand and lower tree densities.

Forest structure of a stand based upon actual stand data from 1983. Note the lack of openings and the generally dense smaller trees.

All of the groves and surrounding mixed conifer forests in the Monument have been affected to varying degrees by human activity, whether by the disruption of the fire return interval or by logging. The ecological effects of logging have been threefold.

From the 1960s until the mid-1980s, approximately 18,000 acres of plantations were created following harvesting. The areas were planted primarily with ponderosa and Jeffrey pine. Lesser amounts of other species were planted, including white fir, rust-resistant and non-rust-resistant sugar pine, incense cedar, red fir, and giant sequoias. When comparing the species mix of the established plantation with the reference conditions likely to have existed prior to 1875, the planted mix is different in that ponderosa and Jeffrey pines were not the overwhelmingly dominant species 100 years ago. In addition, white fir and other shade-tolerant species were less dominant than in the stands that existed just prior to harvest. These plantations contain young trees that were established in openings much larger than openings or gaps created by fire, the dominant natural process that created openings prior to 1875. The current scientific understanding of the sizes and amounts of gaps that were created by a pre-1875 fire regime indicates that gaps were typically less than two acres in size. Larger openings did occur but less frequently. The openings created by harvesting are not consistent with this pre-1875 reference condition, as they commonly ranged in size from five to 20 acres.

Associated with these harvested areas are roads, landings, and skid trails. Some of these areas may be in need of treatment to move them toward desired conditions. And, in some areas where partial harvesting or salvage logging occurred, some activity-related fuels were left untreated. These fuels, in combination with naturally accumulated fuels, make these areas highly susceptible to catastrophic wildfire.

There are approximately 38,150 acres of giant sequoia groves scattered throughout the Sierra Nevada mountain range. Approximately 29,400 of these acres are under national forest administration and about 27,000 acres are located in the Monument (within the Sequoia National Forest). Three groves, covering approximately 2,400 acres, are located on other national forests (the Sierra and Tahoe National Forests).

The 27,000 acres of giant sequoia in the Monument are within 34 groves or grove complexes. A grove complex is a grouping of two or more groves in very close proximity to each other. There are approximately 19,400 acres of giant sequoia groves in the Monument, as measured by their tree-to-tree or tree line boundaries. Surrounding most of the groves is an administrative boundary, generally 500 feet from the tree line. This administrative boundary was established as required by the Sequoia National Forest Mediated Settlement Agreement of 1990. This posted boundary represents the area within which, if conditions allow, giant sequoia trees and other associated species can spread seed in order to adapt to changing environmental conditions. It is also an important area in which to manage fuel loadings to reduce the potential catastrophic effects of wildfire and to encourage a more natural fire regime. There are approximately 7,600 acres of this administrative boundary.

Approximately 70% of the Monument grove acreage has been continuously protected from both fire and logging. The disruption of the natural fire regime, along with the elimination of any other large-scale disturbances, has led to a cessation of giant sequoia reproduction on this acreage (Harvey, et al, 1980; Stephenson, 1996). The dramatic changes in certain climatic growing conditions for giant sequoia during the last 130 years or so have not been mirrored by continual pulses of natural regeneration. Since reproduction is the primary process through which species adapt to changing environmental conditions, it appears that much of the grove acreage has missed opportunities to establish new reproduction and allow genetic adaptation to occur.

Twenty-five percent of the grove acreage has been logged but has had little or no prescribed fire. Of this 25%, the vast majority was logged near the turn of the 20th century and was concentrated in several groves (Converse, Grant, Indian Basin, and Big Stump) in the northern portion of the Monument. These harvested groves have re-vegetated with conifers and second-growth giant sequoias are a significant component of the stand composition. Since the logging, however, no other disturbances have occurred to promote the establishment of additional new generations of giant sequoia.

During the last 25 years, four percent of the grove acreage in the Monument has experienced disturbance from logging and subsequent burning for fuel reduction and site preparation, leading to the regeneration of giant sequoias, associated mixed conifer species, and other vegetation. After harvest, these areas were planted with

primarily ponderosa and/or Jeffrey pine. Survival and growth of young trees is excellent in almost all areas, and naturally occurring giant sequoia seedlings have become established in close proximity to overstory "monarch" giant sequoias. In addition, shade-tolerant species have begun to encroach from natural seeding, providing opportunities for a mixed species stand as time passes. Although the openings created by logging have led to successful establishment of young trees, the openings are generally not consistent with desired conditions. These openings range from a few acres in size up to approximately 15 acres. Desired conditions (see below) are for gaps to be typically ¼ acre to 2 acres in size, with larger openings occurring less frequently. There is a need to move these existing openings towards desired conditions, particularly in terms of the sizes of gaps, the species composition, and the diversity of age and size classes.

There is considerable information available on the range of existing conditions in the Monument, particularly those problem areas emphasized in the Proclamation (a lack of giant sequoia reproduction and a risk of catastrophic fire). These include but are not limited to: stand-level and detailed inventories of the ecological conditions of giant sequoia groves and other vegetation types; reforestation; stream and riparian conditions; fuel inventories and recent fire history; geographic information systems (GIS) maps of vegetation types, land use, ownership, aquatic and wildlife habitat, managed stands, and plantations. This robust set of data provides a high degree of certainty regarding existing conditions in the Monument. However, we are aware that individual groves are unique in their histories and their conditions. Additional information may be needed for specific project proposals. The proposed scientific research strategy (see Appendix G) acknowledges that there are key scientific questions that must be answered to further our understanding of ecological conditions in the Monument.

a) Desired Ecological Conditions

Desired conditions for the Monument are established in this document and are described in Chapter I of this FEIS. For the most part, the desired conditions and their associated indicators as presented in the DEIS were accepted by the Scientific Advisory Board (Board), with the exception of the "gap frequency" indicator. It is clear that there is uncertainty within the scientific community regarding this particular topic, as demonstrated by the discussion at the March 2003 meeting of the Board. There is also uncertainty regarding the desired fire return intervals for some vegetation types. Developing this knowledge is a key part of the monitoring and adaptive management strategy.

Chapter I provides a broad discussion of the general desired conditions. More specific and quantifiable measures (indicators) are helpful in order to compare the alternative management approaches to ecological restoration. This section describes these indicators and the existing conditions. These indicators are based on advice received from the Scientific Advisory Board (Appendix C), the document "An Ecological Foundation for Management of National Forest Giant Sequoia

Ecosystems" (Piirto and Rogers, 1999), and a review of current scientific literature. Indicators are used where there is general scientific agreement and information regarding these indicators. The indicators proposed for use in the FEIS are consistent with restoration target conditions proposed for the draft fire management plans for Yosemite National Park and the Sequoia and Kings Canyon National Parks (USDI, 2002a; USDI, 2003).

The Board, in their formal advice to the Forest Service, affirmed the appropriateness of using the pre-1875 era for reference conditions (Appendix C, Advisory III). The advice recommends reducing the dense forest conditions and reducing fuel loads to better reflect those conditions. Forest inventories specific to the Monument show that the large majority (about 95%) of the trees less than 30 inches in diameter were established since 1875, when the natural fire regime was significantly altered and other anthropogenic influences were taking effect. Recruitment of new trees and shade-tolerant trees flourished when wildland fires were suppressed and, over the decades, these trees have grown without the influence of fire. Thus the current density of trees is much higher than in pre-settlement forests.

While using the preceding assumptions, we recognize that we do not have a complete picture of what the forests of the southern Sierra looked like before fire suppression (Stephenson, 1999). Any recommended diameter limit for tree removal should be applied with reason and prudence because the range of conditions in the Monument is considerable. Measurements during later landscape analysis may show that trees either larger or smaller than 30 inches in diameter were established since fire suppression, the size of trees being dependent upon their species and site potential. For example, grove-specific inventories currently indicate that many trees as large as 30 inches in diameter were established in the last 130 years of fire suppression in the region.

There are other vegetation types with relatively small acreage amounts, such as lodgepole pine, black and blue oak, and annual grasslands. Specific restoration conditions for these types have not yet been formulated and will be developed through the adaptive management process in conjunction with additional research and scientific evidence.

b) Existing Ecological Conditions

This section summarizes the status of key ecological conditions (indicators), both within the giant sequoia groves and in the surrounding mixed conifer forest. For the purpose of this analysis, these conditions are considered key ecological indicators of change and will be used to quantify and compare the effects of each alternative. The Proclamation noted the lack of regeneration of giant sequoia and the risk of catastrophic fire. It also noted the changes in the forest due to past harvesting and the exclusion of fire. Special attention is given in this section to important characteristics of structure such as species composition, age class distribution, and

fuel loading. The foundation for these ecological indicators is the report "An Ecological Foundation for Management of National Forest Giant Sequoia Ecosystems" (Piirto & Rogers, 1998). This report describes specific structural and process indicators in the mixed conifer-giant sequoia forest ecosystems in the Monument and provides a recommended range of management variability (RMV). The ecological indicators and their recommended ranges of variability for key terrestrial elements are as listed in Table III-11.

Table III-11: Summary of Ecosystem Elements and Desired Conditions

Vegetation Mosaic Ecosystem Elements	Description of Desired Conditions (recommended range of management variability, or RMV)
Indicator #1: Gap and patch size. This indicator addresses the spatial characteristics of the vegetation.	Most gaps and patches of vegetation that arise from them should be on the order of 0.2 acres. The RMV should range from 0.1 to 2.0 acres.
Indicator #2: Plant community indicator. This indicator addresses the amount of giant sequoia reproduction and other species associated with mixed-conifer/giant sequoia forests.	**Species:** Sequoias (GS) 55-75% of basal area within groves; other species (WF, IC, PP, JP, SP, BO) 25-45% of basal area, with WF the largest component; GS 55-75% of basal area and at least 10% of total number of trees. **Density of GS:** Approx. 8 trees/acre < 8 inches dbh; 5 trees/acre 6-17.7 inches; 4 trees/acre > 17.7 inches. **Density of other mixed conifer species:** see plant community indicator; should follow similar pattern as GS.
Fire Ecosystem Elements (see Fire and Fuels section for a discussion of the Fire Return Interval Departure)	
Indicator #3: Fire severity.	Between 10 and 25% of the grove area in high potential severity; remainder moderate to low.
Indicator #4: Fire Return Interval Departure.	Return interval for moderate-to-low fire intensity is 5 to 20 years.

(1) Gaps and Patch Size Indicator.

This indicator addresses the occurrence of open spaces in the forest canopy (gaps) and openings that have been occupied with vegetation (patches). The absence of fire and the scope and magnitude of harvest treatments in the groves have led to structural conditions and natural processes that are not consistent with desired conditions. The elimination of a low intensity-high frequency regime of fire (characteristic of pre-1875 conditions) has led to major changes in stand structure. Piirto and Rogers state that "Giant sequoia mixed conifer forests now have: 1) more smaller trees with higher proportions of white fire…and incense-cedar…than were present historically; and 2) increased levels of fuel both on the forest floor and as fuel ladders (McKelvey et al, 1996; Skinner and Chang, 1996; Stephenson, 1994)." In addition, the elimination of an historic fire regime has produced a more continuous forest cover structure, rather than a highly variable

stand structure with a variety of gaps, patches, and age classes which were typical prior to 1875 (Piirto and Rogers, 1999). The vast majority of recent gaps and patches in the groves were created in the 1980s by harvesting. These gaps typically range from five to 25 acres in size, with an average size of 12 acres. It is within these gaps that regeneration of giant sequoia and other mixed conifer species has occurred. The desired range is much smaller than this, with average gap sizes of 0.1 to 2.0 acres in size (Piirto and Rogers). Larger gaps are to be expected, but with reduced frequency (Fry, 1933, 1948; Stephenson et al, 1991; Stephenson, 1994, 1996).

The Sequoia National Forest has an ongoing grove-specific integrated inventory program. Table III-12 displays data for five groves within the Monument. These groves are representative of conditions in other groves that have had no significant recent disturbance. The data for these groves were analyzed to determine the extent and characteristics of existing gaps and patches that exist within the undisturbed portions of the groves, rather than openings from harvesting.

Table III-12: Percent of Grove Area by Basal Area Stocking (square feet/acre)

Grove	0-20	20-60	60-100	100-140	>140
Packsaddle	9%	4%	13%	19%	56%
Starvation	9%	0%	9%	30%	52%
Deer Creek	0%	2%	2%	2%	92%
Long Meadow	6%	10%	16%	8%	61%
Landslide	13%	3%	7%	17%	60%

These data indicate that, in four of the five inventoried groves, there appear to be sufficient gaps in the forest where there is almost no stocking of trees (<20 square feet of basal area per acre). These openings were examined further to determine the nature of the vegetation that was within these non-stocked or very poorly stocked gaps. The data indicate that the vegetation in these gaps is brush and scattered small trees, with the large majority of the trees being white fir and cedar less than 6 inches in diameter, species already well represented in adjacent well-stocked areas. These results also indicate that some groves may have sufficient existing openings to initiate new age classes of giant sequoias and other mixed conifer species with little or no disturbance of the adjacent better-stocked forest. Establishment of new trees in these gaps could meet the desired condition of between 1% and 10% of each grove in trees less than ten years old. Establishment of subsequent new pulses of young trees in future years would generally need to occur in gaps created in adjacent stands in order to promote the establishment of a range of age classes.

(2) Plant Community Indicator.

This indicator addresses the type of species and density of vegetation. Inventory data and field observations of numerous groves indicate that existing conditions do not meet the desired conditions. There has been a sustained and dramatic increase in shade-tolerant species such as white fir and incense cedar and a concurrent reduction in shade-intolerant, fire-dependent species such as giant sequoia and pines (sugar, Jeffrey, and ponderosa pines). For both percent of trees per acre and basal area per acre, almost all groves were outside the recommended management variability documented by Piirto and Rogers. The only exception was in Long Meadow Grove, where the basal area of giant sequoia is within the recommended range. However, the amount of other mixed conifer species, specifically white fir, is greater than the recommended range. See Table III-13 for a display of data for each grove, both existing and desired.

Table III-13: Amounts of Giant Sequoia and Other Mixed Conifer in Five Inventoried Groves (% of trees per acre and basal area per acre)

	Grove Structure (% of trees)		Grove Structure (% of ba/ac)	
Grove	**Current**	**Desired**	**Current**	**Desired**
Deer Creek	GS - 1%	5-15%	GS - 40%	55-75%
	MC* - 99%	85-95%	MC** - 60%	25-45%
			WF - 45%	15%
Packsaddle	GS - <1%	5-15%	GS - 40%	55-75%
	MC - 99%	85-95%	MC - 60%	25-45%
			WF - 47%	15%
Long Meadow	GS - 3%	5-15%	GS - 70%	55-75%
	MC - 97%	85-95%	MC - 30%	25-45%
			WF -14%	15%
Landslide	GS - 2%	5-15%	GS - 31%	55-75%
	MC - 98%	85-95%	MC - 69%	25-45%
			WF - 42%	15%
Starvation	GS – 3%	5-15%	GS – 2%	55-75%
	MC – 97%	85-95%	MC – 54%	25-45%
			WF – 44%	15%

* = All mixed conifer species except giant sequoia
** = All mixed conifer species except giant sequoia and white fir

(3) Fire Severity Indicator.

The RMV for this indicator is that between 10 and 25% of the grove area be in the high to extreme range for fire severity. Fire susceptibility was calculated for the entire area of the Monument and is used as a measure of the risk of catastrophic fire. Of the 34 groves and grove complexes, 24 do not meet the RMV. Sixteen of the 24 have extremely high percentages of high susceptibility (typically >50%). Ten of the 34 meet the RMV. Table III-14 compares the groves that do or do not meet the RMV for this indicator, and also recommends a

priority for fuel reduction treatment based solely on their fire severity indicator status.

Table III-14: Groves by Fire Severity Indicator

Groves that Meet Fire Severity Indicator (10-25% high fire susceptibility); low priority for treatment.	Cherry Gap, Abbott, Upper Tule, Packsaddle, Evans Complex, Upper Tule, Middle Tule, Grant Grove, Landslide, Redwood Mountain
Groves that Do Not Meet Fire Severity Indicator (% of high generally > 50% of grove acreage); moderate priority for treatment.	Black Mountain, Mountain Home, Peyrone, Long Meadow, South Peyrone, Wishon, Red Hill
Groves that Do Not Meet Fire Severity Indicator (% of high generally > 50% of grove acreage); high priority for treatment.	Agnew, Alder Creek, Belknap, Bearskin, Big Stump, Burro Creek, Converse, Cunningham, Deer Creek, Deer Meadow, Dillonwood, Freeman Creek, Indian Basin, Monarch, Silver Creek, Starvation

Note: see Fire and Fuels section for a description of fire susceptibility.

c) The Status of Giant Sequoia Reproduction

The status of reproduction of giant sequoia and other species associated with the mixed conifer-giant sequoia ecosystem is examined in two perspectives: 1) the overall status of broad age classes based on the forest's response to the recent disturbance regimes, and 2) the status of trees based on current inventories. Although the problem of giant sequoia regeneration (or lack thereof) is well documented (Stephenson, 1996), different groves exhibit this condition to varying degrees and may benefit from different management strategies and prescriptions.

The groves can be categorized into four general groups based on the amount and status of sequoia reproduction, as well as other structural conditions. These four classifications reflect the groves' conditions since being subjected to altered disturbance regimes (primarily fire suppression and harvesting) since their discovery by Euro-Americans in the 1800s. They apply only to national forest lands within the Monument.

Group 1: Groves protected from or not subjected to wildfires and/or harvesting. These groves have very little reproduction of giant sequoia or other shade-intolerant species such as Jeffrey, ponderosa, or sugar pine, because of the lack of new openings from disturbance. Of the 27,000 acres of giant sequoia groves, there are approximately 12,860 acres (70%) in this group. The groves and associated mixed conifer forest have dense canopies with generally very high fire susceptibility. Grove inventories indicate that there are very few young sequoias. Young sequoias have been found on field visits, but they are few, as are seedlings and saplings. When these groves are subjected to fire, these trees will be highly vulnerable and,

considering their low numbers, there is little likelihood that they will be sufficient to sustain the population.

Group 2: Groves logged between approximately 1880 and 1920. The disturbance from heavy logging has led to a pulse of regeneration in these groves. There are approximately 8,060 acres (25%) of second growth giant sequoia-mixed conifer reproduction, all about 100 years old. The vegetation in these groves is heavily dominated by trees averaging 90 to 100 years old. Stocking is very heavy due to the lack of significant processes that would control stocking, such as understory fires or thinning. This overly dense condition results in high inter-tree competition for water, sunlight, and nutrients and some trees are weakened, leading to higher susceptibility to outbreaks of insects, mortality from drought, and generally less healthy forest conditions. Of the total acres, 82% are in only two groves (Evans Complex and Converse). These areas have very high levels of mixed conifer stocking and are in need of fuel reduction to reduce the risk of catastrophic fire. Overall tree health and vigor, as well as growing conditions, could be improved by thinning excess trees.

Group 3: Groves logged or burned by wildfire between 1950 and 1980. Between approximately 1925 and 1980, giant sequoia groves on the Sequoia National Forest were not heavily disturbed by either logging or wildfire. The McGee Fire on the Hume Lake Ranger District burned through the Cherry Gap Grove and, as a result of this event, young giant sequoia and other vegetation were established. There are a total of 170 acres in this area, representing less than 1% of the 27,000 acres of groves in the Monument. The vegetation is typically 50 years old.

Group 4: Groves partially logged from 1980 to the late 1980s. The Forest Service began active management in approximately 13 of the groves by harvesting, followed by site preparation and planting. These activities led to the establishment of approximately 1,040 acres (4%) of regeneration in the 27,000 acres of groves. Of these 1,040 acres, about 640 acres were planted with young giant sequoias and other mixed conifer species. On the remaining acreage, mixed conifer species were planted that did not include giant sequoia. Natural regeneration was relied upon for the re-establishment of giant sequoia. Natural regeneration was successful where openings were adjacent to seed-bearing mature giant sequoia. Survival and growth of young trees is excellent in almost all areas, and giant sequoia seedlings have become established in close proximity to overstory monarch giant sequoias. In addition, shade-tolerant species have begun to encroach from natural seeding, providing for a stand of mixed species as time passes. Although the openings created by logging have led to successful establishment of young trees, the openings are generally not consistent with desired conditions. These openings range from a few acres in size up to approximately 15 acres. Desired conditions are for gaps to typically be ¼-acre to 2 acres in size, with larger openings being less frequent as their size increases. There is a need

to move these existing openings toward desired conditions, particularly in terms of the size of gaps, the species composition, and the diversity of age and size classes. The amount of each grove with young giant sequoia (1-20 years old) ranges from 3.12% to 23.42%. These openings have large numbers of young trees and early seral stage brush. Fuels continue to accumulate. As the vegetation increases in size, options will become more limited for controlling fuel accumulation and preventing overcrowding. Many of these openings have large amounts of pine and are not moving toward the desired condition for species composition.

Table III-15: Giant Sequoia Grove Groups

Grove Group	Acres	Groves Included
Group 1: groves protected from major disturbances	12,860	Agnew, Alder Creek, Belknap Complex, Burro Creek, Cunningham, Deer Creek, Deer Creek Meadow, Dillonwood, SE portion of Evans Complex, Freeman Creek, Maggie Mountain, Middle Tule, Monarch, Upper Tule, Mountain Home, Red Hill, Silver Creek, South Peyrone, Wishon
Group 2: groves heavily logged between approximately 1880 and 1920	8,060	Converse Basin, Abbott Creek, Big Stump, Cherry Gap, NE portion of Evans Complex, Grant Grove, Indian Basin
Group 3: groves logged or burned from 1950 to 1980	170	Cherry Gap
Group 4: groves partially logged from 1980 to the late 1980s	5,730	Bearskin, Black Mountain, Landslide, Long Meadow, Packsaddle, Peyrone, Redwood Mountain, Starvation Complex

Of the 34 groves and grove complexes in the Monument, only 13 have had significant disturbances in the last 120 years that have led to new pulses of regeneration. The remaining 21 groves have had little or no regeneration.

The structure of the regeneration established in the last 120 years is very different from regeneration established prior to that time. The primary disturbances in the

thousand-year period before 1875 were low-intensity, high frequency fires. This fire regime typically created a mosaic of vegetation and gaps, with the gaps ranging in size from less than ¼-acre to two acres. Larger gaps were more infrequent, although intense wildfires occurred that were possibly several hundred acres in size (Swetnam et al, 1992; Caprio et al, 1994). The variability in gap size provided a range of growing conditions that led to a variety of species, from shade-intolerant (pines, giant sequoia, black oak) to shade-tolerant (incense cedar, white fir). The shift to logging as the primary disturbance regime led to a shift in the structural characteristics of openings. For instance, the Converse Basin Grove was completely cut over and the re-growth is an almost continuous 120-year old, 4,000-acre stand with little variability. This is an extreme case; however, other groves such as the national forest portions of Big Stump, Indian Basin, and Cherry Gap all exhibit similar gap size characteristics that are outside the range of natural variability as described by Piirto and Rogers.

This same situation is displayed in the openings created by logging in the 1980s within, and immediately adjacent to, some giant sequoia groves on the Sequoia National Forest (now within the Monument). The approximately 1,000 acres of openings average 10 to 15 acres in size, and many of these openings were re-planted to pines and lesser amounts of other species such as white fir, sugar pine, and giant sequoia. Recent stand exams and field observations indicate that other species are becoming more common through natural succession. However, these openings are still dominated by the planted trees and the average gap sizes are outside the range of natural variability (Piirto & Rogers, 1999).

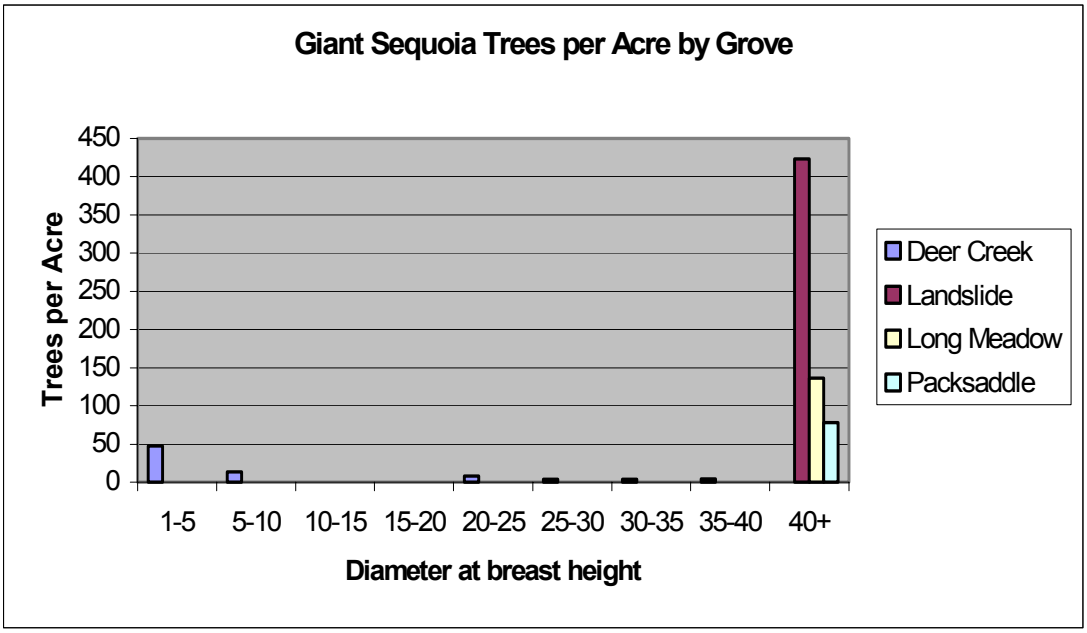
d) Current Amounts of Young Giant Sequoia Trees

This section describes the current regeneration and stocking status of giant sequoia. Although the focus is on their status within the naturally occurring groves, the status of giant sequoia outside of the groves will be discussed as well.

(1) Status of Giant Sequoia within Naturally Occurring Groves.

Of the groves inventoried, only Deer Creek Grove has a significant number of small trees (approximately 60 trees less than 10 inches in diameter per acre). See Figure III-8 for the diameter distribution of trees in inventoried groves. These data are not meant to imply that there are no young sequoias in the inventoried groves or in other groves, but to give a grove-wide perspective on the status of young sequoias. When specific projects are considered for each grove, more information will be needed to validate the site-specific conditions in that grove.

Figure III-8: Distribution of Giant Sequoia Trees by Diameter Class in Inventoried Groves



(2) Status of Giant Sequoia Outside of Naturally Occurring Groves.

Giant sequoia seedlings have been planted in many areas outside of groves in the mixed-conifer forest where growing conditions are generally similar to those found within the groves. These plantings have occurred for several decades and are located where harvesting created openings. Some of the planting sites are in immediate proximity to groves, while other sites are several miles form the nearest grove. Typically, giant sequoia seedlings were intermixed with other species, primarily ponderosa or Jeffrey pine. Some of the largest and oldest planted sequoias are over 16 inches in diameter and 70 feet tall, although these are exceptional. The majority of the trees were planted in the 1980s in openings created by harvesting and the trees are typically 15 to 25 feet tall, intermixed with other conifer species. The giant sequoia seedlings are the fastest growing of the planted trees. The largest single planting of giant sequoia occurred adjacent to the boundaries of the Monument, in the area of the Stormy Fire of 1990. The site of the Stormy Fire is farther south than the southernmost grove (Deer Creek Grove) and farther east than the easternmost grove (Freeman Creek Grove). As part of the re-establishment of the mixed-conifer forest, several thousand giant sequoia seedlings were planted in areas with a wide variety of site conditions. These trees are generally the fastest growing of the planted stock and are surviving and growing extremely well

(3) An Overview of the Current Age, Size, and Density of Mixed Conifer Vegetation:

One of the goals of the Monument Plan is to manage the vegetation that is a direct or indirect result of the last 130 years of disrupted fire regime (i.e., the exclusion of fire as a natural process). The results have been two-fold:

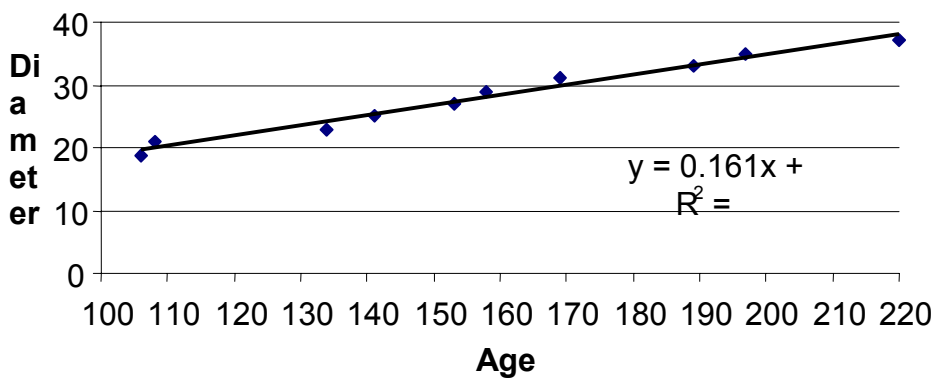
- Trees that would have been killed in a natural fire regime have survived, so there are more live trees that were established both prior to 1875 and after 1875 than would have been established under a natural fire regime.
- These trees are primarily shade-tolerant fir and cedar, and the majority of them are between 90 and 130 years of age.

In order to understand the characteristics of this vegetation, forest inventory information was analyzed to answer these questions:

- **What is the average diameter of a 130-year-old tree?**

There are 1,291 measure trees located across all sites and mixed conifer vegetation types. Measure trees are randomly selected during the plot inventory process and the inventory plots are located on a grid system that covers a broad range of growing conditions. The average site productivity (or site classification) for the forest-wide inventory data, on a scale of 1 to 5, is Site Class 3. The following is a graph of the correlated data and the associated linear regression equation that defines the relationship between diameter and age.

Figure III-9: Forest-wide Diameter/Age Correlation



Using the regression equation y = 0.161x + 2.6175, where

y = diameter to be determined

x = age of tree (in this case, 130 years old)

The average diameter of a 130-year-old tree on an average site is: .161 (130) + 2.6175 = **23.6"**

- **Given the wide variety of site conditions in the Monument, what upper diameter limit would be appropriate to provide flexibility in managing the vegetation less than 130 years old?**

The following table displays the percentage of the trees 130 years old and younger that would be covered by different diameters.

Table III-16: Percent of Population by Diameter

Diameter	% Of Population
24 inches	78%
26 inches	81%
28 inches	85%
30 inches	95%

7. Range

There are 25 grazing allotments within or partially within the Monument (see Table III-17). They are organized into 19 functional allotments. Approximately 18,000 animal months (AMs) and 3,200 head of livestock are permitted within the Monument.

The majority of the allotments and forage are based on annual grasses in the foothills below and/or well removed from the sequoia groves. Four montane allotments overlap with the sequoia groves. The majority of grazing within allotments overlapping sequoia groves is based on moderate use of intermixed meadows.

Current condition and trend transects have been established in 18 meadows within the Monument. Transects show vegetation, rooting depth, and soil elements meet high to mid seral ecological conditions. Condition and trend are not applicable to vegetation that is highly variable season to season as are annual grasslands. In annual grasslands, soil conditions are monitored. Stream condition has been evaluated for many of the streams within the grazing allotments and is discussed within the affected environment for watershed.

The Proclamation states, "Laws, regulations, and policies pertaining to administration by the Department of Agriculture of grazing permits … shall continue to apply …". Grazing within the monument is administered under the guidelines identified in the

Framework and the general discussions on the effects of grazing addressed in that document apply. Site-specific environmental analysis and documentation will be prepared for each allotment within the Monument by 2010, under the direction in the 1995 Rescission Act rider.

Table III-17: Grazing Allotments in the Monument

Allotment	All. #	Stock #	Stock Type	Season Of Use	AM	Total Acres	NFS Acres	Primary Range	Min. Elev.	Max. Elev.	Est. Riparian acres
Hume Lake RD		554			4,648						
Buck Rock	01	190	C	05/01-09/20	906	46,585	44,195	4,400	4,000	9,000	1,836
		50	C	06/16-09/15	153						
		70	C	05/01-10/31	429						
Hoist/	02	100	C	06/01-09/15	357	13,530	13,490	2,525	5,000	6,000	744
Converse		100	C	05/01-09/15	460						
		25	C	06/01-09/15	89						
Horse Corral	04	57	C	07/01-09/30	175	23,555	23,215	1,535	4,000	10,000	822
		17	C	07/01-09/30	52						
Sampson	05	200	C	11/16-09/15	2,027	21,785	19,565	3,800	2,000	5,000	602
Tule River RD		758			4,591						
Black Mountain	19	50	C	10/01-09/30	610	8,125	8,015	3,145	2,000	6,500	310
		25	Y	10/01-09/30	304						
Cow Mountain	15	100	C	04/01-09/30	610	5,200	5,200	1,500	3,200	6,000	190
East Bear Creek	14	30	C	03/16-09/15	184	2,490	1,910	1,315	3,200	5,200	30
		2	H	03/16-09/16	12						
Grouse Creek	64	12	C	04/16-09/15	61	3,860	640	290	4,500	6,000	40
Little Kern/	21	225	C	06/06-07/15	533	55,950	55,710	4,015	5,600	10,400	2,175
Lloyd Meadow		225	C	07/16-08/15	225						
Jordan	17	225	C	08/16-09/15	233	24,610	23,830	1,030	4,600	9,200	725
		4	H	08/16-09/15	4						
Middle Tule	18	15	C	02/15-06/15	61	3,835	3,835	2,125	3,600	5,500	50
		16	C	03/01-07/31	82						
North Grouse	13	35	C	05/01-08/15	125	1,150	1,150	160	4,000	5,600	10
Rancheria	12	100	C	04/01-08/31	510	12,305	10,670	2,850	3,000	8,000	225
		50	C	05/01-08/31	205						
South Grouse	16	100	C	03/16-05/31	257	4,740	4,160	1,500	3,600	6,400	140
West Bear Creek	20	125	C	03/16-07/31	575	2,210	2,090	1,700	2,600	4,600	55
Hot Springs RD		1880			8,758						
Capinero	23	214	C	04/16-08/31	984	6,205	5,600	5,300	3,200	6,400	225
Dry Meadow	25	260	C	05/16-08/15	797	13,880	13,000	9,750	4,800	8,000	770
Dunlap	24	220	C	05/01-06/30	447	23,940	23,540	2,290	4,800	7,900	805
		220	C	07/01-09/15	565						
		75	C	05/16-06/30	115						
		72	C	07/01-09/15	185						
		3	C	07/01-09/15	8						
		5	C	05/01-08/31	21						
Powder Magazine	28	40	Y	02/01-10/31	364	280	280	280	3,000	3,400	0
Rube	27	379	C	05/01-08/15	1,352	7,800	7,800	1,500	4,200	6,400	230
		4	C	01/01-12/31	49						
Summit	26	615	C	05/01-06/30	1,251	43,835	43,385	3,100	1,300	3,800	1,430
		465	C	07/01-09/15	1,194						
		100	C	05/16-09/15	410						
		33	C	07/01-09/30	101						
White River	29	150	C	04/01-09/30	915	3,800	3,800	1,860	3,000	4,500	325

8. Rare Plants

There are over 200 plants, species, subspecies, and varieties endemic to the foothills and mountains of Tulare and Fresno Counties. A number of these endemics and other rare plants add to the rich diversity of the Monument. These species are evaluated to determine potential sensitivity to management. Species that may be vulnerable to management activities or are found in limited populations may be designated as Forest Service sensitive species by the Regional Forester. This designation provides additional protection and maintains diversity across the national forest. The sensitive species list for the Sequoia National Forest and Monument was updated in 2003.

Table III-18 identifies species listed as threatened or endangered under the Endangered Species Act and Forest Service sensitive species found within or adjacent to the Sequoia National Forest. Species on this list were evaluated for their potential to occur within the Monument and vulnerability to proposed management. Several species were included for which there are no records, due to close proximity to or availability of suitable habitat in the Monument.

Table III-18: Federally Listed and R5 Sensitive Plants, Sequoia National Forest

Species	Listing Status	Habitat	Potential for Occurrence in Monument	Analysis Included
Astragalus ertterae Walker Pass milk-vetch	FSC/N CNPS 1B	Sandy-loamy, granitic soils, in openings in pinyon pine woodlands in association with canyon live oak	Populations in Kiavah and Owens Peak (BLM) Wildernesses. Not known within Monument	No
Astragalus lentiginosus var. kernensis Kern Plateau milk-vetch	FSC/N CNPS 1B	Dry gravelly or sandy slopes and flats, primarily in and around the large meadows of the upper Kern Plateau	Found eastern Kern Plateau. Not known within or adjacent to Monument	No
Astragalus shevockii Little Kern River milk-vetch	N/N CNPS 1B	Open Jeffrey pine forest with sandy, granitic soils and pine needle duff	Occurrences in Golden Trout Wilderness. Not known within Monument,	No
Botrychium crenulatum Scalloped moonwort	FSC /N CNPS 2	Wet meadows 6,000 - 10,000'	Not known within Sequoia National Forest.	No
Brodiaea insignis Kaweah brodiaea	FSC/SE CNPS 1B	Grassy, west-facing slopes of foothill blue oak woodland, loamy clay soils over granitic substrate	Not known from Sequoia National Forest; historic introduction in TRRD no longer viable.	Yes, not likely to affect
Bruchia bolanderi Bolander's bruchia moss	N/N CNPS 2	Meadow habitats in the mixed conifer zone	Not known within Sequoia National Forest.	Yes, not likely to affect
Calochortus palmeri var. palmeri Palmer's mariposa lily	FSC /N CNPS 1B	Meadows and seeps in chaparral and lower montane coniferous forest	Occurrences in Piute and Breckenridge Mtns. Not known within Monument.	No
Calochortus striatus Alkali mariposa lily	FSC /N CNPS 1B	Alkali seeps, meadows and springs in moist creosote bush scrub.	Kern River Valley and SFWA. Not known within Monument.	No
Calochortus westonii Shirley Meadow star-tulip	FSC /N CNPS 1B	Open, mixed conifer/black oak, associated dry meadow edges, approximately 5,000 - 7,200'	Greenhorn to Balch Park. In Monument near Belknap, Alder Creek, and Balch Park Groves.	Yes, may beneficially affect
Canbya candida Pygmy poppy	N/N CNPS 4	Sandy places in Joshua tree woodland and Mojave desert scrub	Populations near Walker pass. No known populations within Sequoia National Forest.	No
Carlquista muirii Muir's raillardella	N/N CNPS 1B	Granite ledges, cracks, gravelly or sandy flats/ openings in chaparral, ponderosa pine, or mixed conifer forest	Found Tobias Creek and extirpated populations near Baker Point. Not known within Monument.	Yes, not likely to affect
Caulanthus californicus California jewel-flower	FE/SE CNPS 1B	Great Basin shrub, Joshua tree woodland, P-J woodland, upper montane coniferous forest	Occurrences in South Sierra Wilderness. Not known within Monument.	No
Clarkia springvillensis Springville clarkia	FT/SE CNPS 1B	Annual foothill grasslands, blue oak woodlands, and chamise chaparral, between 1,300 - 4,000'	Lower Tule River and Bear Creek drainages. Endemic Giant Sequoia National Monument.	Yes, no effect

Species	Listing Status	Habitat	Potential for Occurrence in Monument	Analysis Included
Cordylanthus eremicus var. kernensis Kern Plateau bird's-beak	N/N CNPS 1B	Great Basin scrub, Joshua tree, pinyon-juniper woodland, upper montane conifer; 5,500-10,000'	Occurrences in the South Sierra and Golden Trout Wilderness. Not known within Monument.	No
Cryptantha incana Tulare cryptantha	N/N CNPS 1B	Lower montane coniferous forest (gravelly or rocky); pinyon woodland 5,500-7,500'	One historic population located on Peppermint Creek within Monument.	Yes, not likely to affect
Delphinium inopinum Unexpected larkspur	N/N CNPS 4	Dry, rock outcrops and open, rocky ridges in pine and red fir forests, at approximately 6000' - 8800'	Known from TRRD and HLRD Slate Mtn., a remote roadless area within Monument.	Yes, not likely to affect
Dicentra nevadensis Tulare County bleeding heart	N/N CNPS 4	Sandy, gravelly crevices and openings in usually dry, granitic soils at approximately 7,500 - 10,000'+	Big Mdw (HLRD), and other locations. Populations within the Monument.	Yes, not likely to affects
Dudleya cymosa ssp. Costafolia Pierpoint Springs liveforever	FSC /N CNPS 1B	Rocky, limestone outcrop in the canyon live oak woodland/mixed chaparral, ~ 4,800 - 5,200'	Steep, remote, inaccessible limestone outcrops near Pierpoint Springs. Endemic to Monument.	Yes. Not likely to affect.
Erigeron aequifolius Hall's daisy	N/N CNPS 1B	Steep, rocky, granitic crevices on dry ridges, approx. 5200'-8000' in mixed conifer forests	Found along Hwy 180 in Kings Cyn within Monument.	Yes, not likely to affect
Erigeron multiceps Kern River daisy	FSC /N CNPS 1B	Dry, open meadows and edges, mixed conifer or aspen, or gravelly creek banks, sandy flats, 5000'-8400'	0ccurs on Kern Plateau and Golden Trout Wilderness. Not known in Monument.	No
Eriogonum breedlovei var. breedlovei Piute buckwheat	FSC /N CNPS 1B	Dry, open meadows and edges, mixed conifer or aspen, or gravelly creek banks and sandy flats. 5000'-8400'	Piute Mtns. Not known within Monument.	No
Eriogonum twisselmannii Twisselmann's buckwheat	FSC /SR CNPS 1B	Dry, granitic outcrops in Jeffrey pine-red fir forests, approximately 8,000 to 9,000'	Along the Needles Road within Monument.	Yes, not likely to affect.
Erythronium pusaterii Kaweah fawn lily	N/N CNPS 1B	Dry, rocky, granitic or metamorphic soils, rock outcrops, ledges, and steep canyon walls of upper montane conifer (fir-pine) forests, approximately 7,300 to 9,100'	Numerous locations in Tule River Drainage, Endemic to Monument and Sequoia/Kings Cyan NP.	Yes, not likely to affect.
Fritillaria striata Greenhorn adobe lily	FSC1/ST CNPS 1B	Small "pockets" or "islands" of heavy, "adobe" clay soils in blue oak woodlands and grasslands 1,000 to 2,000'	No known or suitable soils identified within Sequoia National Forest, found adjacent to Greenhorn Mtns. Not in Monument.	No
Heterotheca monarchensis Sequoia false goldenaster	N/N CNPS 1B	South-facing limestone, cracks and ledges in coarse sandy flats at base of cliffs, 3650 - 6000	Kings Cyn., Monarch Wilderness. Adjacent to Monument.	Yes, not likely to affect.
Heterotheca shevockii Kern Canyon false goldenaster	N/N CNPS 1B	Rock crevices, and shallow, sandy, gravelly soils of a chaparral woodland riparian corridor, 1000-2400'.	Lower kern Cyn. Not known within Monument.	No
Horkelia tularensis Kern Plateau horkelia	FSC /N CNPS 1B	Metamorphic or granitic gravel, rock outcrops, and ridges, upper montane conifer, Jeffrey pine and western juniper 7,500 to 9,450'.	Endemic to Kern. Not known within Monument.	No
Hulsea brevifolia Short-leaved hulsea	N/N CNPS 1B	Granitic or volcanic soils in openings as well as in shade of canopy in Upper Montane Coniferous Forest	NE of Big Mdw (HLRD). Within Monument.	Yes, not likely to affect
Hydrothyria venosa Water fan lichen	N/N	Cold water streams within montane coniferous forest	TRRD in high remote headwater areas or wilderness. Within Monument.	Yes, not likely to affect
Lewisia congdonii Congdon's bitterroot	*N/SR* CNPS 1B	Rock faces, cracks and ledges in rocky talus and scree derived from on granite or metamorphic rock	Kings Cyn, HLRD in Monument.	Yes, not likely to affect.
Lewisia disepala Yosemite bitterroot	N/N CNPS 1B	Pans and shelves of granite gravel found on and next to outcrops surrounded by coniferous forest	Known along lower Freeman Creek and Dome Rock within Monument.	Yes, not likely to affect.
Lupinus lepidus var. culbertsonii Hockett Meadows lupine	N/N CNPS 1B	Rocky slopes from 8,200-9,850'.	Golden Trout Wilderness, TRRD, not known within Monument.	No
Meesia triquetra Three-ranked hump-moss	N/N CNPS 2	Cold, spring fed, acidic meadows with Sphagnum, Drosera, and Vaccinium associates.	Monarch Wilderness. Not known within Monument.	Yes, not likely to affect.
Meesia uliginosa Broad nerved hump-moss	N/N CNPS 2	Primarily spring fed, short-grass, permanently wet meadows	Kings Cyn. NP adjacent to Jennie Lakes Wilderness. Not known in Monument.	Yes, not likely to affect.

Species	Listing Status	Habitat	Potential for Occurrence in Monument	Analysis Included
Mimulus gracilipes Slender-stalked monkeyflower	N/N CNPS 1B	Burned areas in chaparral, foothill woodland, and lower coniferous forest.	Adjacent to GHRD. Not known within Monument.	No
Mimulus shevockii Kelso Creek monkeyflower	FSC2/N CNPS 1B	Coarse, sandy, loam, loose, granitic gravels and sands in Joshua and pinyon-pine woodlands, 2,800 to 4,200'.	Adjacent to GHRD. No known populations within Sequoia National Forest.	No
Monardella linoides ssp. Oblonga Flax-like monardella	FSC /N CNPS 1B	Rock outcrops and decomposed granite soils in yellow pine forest.	Found on Kern Plateau. Not known within or adjacent to Monument.	No
Monardella beneolens Sweet-smelling monardella	N/N CNPS 1B	Metamorphic or granitic scree, in subalpine mixed conifer forest; clumped prostrate mats, growing over boulders	Adjacent to Kern Plateau. No known populations within Sequoia National Forest.	No
Monolopia congdonii San Joaquin wooly-threads	*FE/N* CNPS 1B	Alkali scrub flats in the southern Central Valley from 300 - 1200'	Adjacent to lower Kern/Bakersfield. No known populations within Sequoia National Forest.	No
Navarretia peninsularis Baja navarretia	N/N CNPS 1B	Edges of vernal creeks, meadows, and snowmelt seeps within pinyon-juniper woodland and yellow pine forest.	Not known within Monument.	No
Navarretia setiloba Piute Mountains navarretia	FSC1/N CNPS 1B	Heavy, clay soils, foothill grasslands, blue oak and pinyon-juniper woodlands, ~2,000 to 3,800'	Adjacent to Sequoia National Forest, Piutes to Posey. Endemic to Tulare & Kern Co. Not known within forest.	No
Nemacladus twisselmannii Twisselmann's nemacladus	FSC /SR CNPS 1B	Arid, granitic gravels and sands, ridgetops and rock outcrops in open Jeffrey pine forests, from 7,300 - 7,800'	Endemic to Kern Plateau. Not known in Monument.	No
Optunia basilaris var. treleasei Bakersfield cactus	FT/SE CNPS 1B	Arid aspects within blue oak woodland and chaparral in the southern Central Valley from 300 to 3,000'	Low gradient slops of lower Kern Cyn. Not known in Monument.	No
Oreonana purpurascens Purple mountain-parsley	N/N CNPS 1B	Ridge tops, rock outcrops, and gravelly openings of granitic or metamorphic soils in red fir 7,900 to 9,400'.	TRRD and HLRD Wilderness or remote areas within Monument.	Yes, not likely to affect.
Orthotrichum spjutii Spjut's bristle-moss	N/N CNPS 1B	Protected, shaded granitic rock faces and under hangs in the central and southern Sierra	Occurrences in the Kiawah Wilderness, not known within Monument.	No
Phacelia novenmillensis Nine Mile Canyon phacelia	FSC /N CNPS 1B	Dry, disturbed banks, gravelly or rocky, shallow soils in Jeffrey pine and pinyon-juniper woodland, 5400 – 8300'	Endemic to the Kern Plateau. Not known within Monument.	No
Psuedobahia peirsonii San Joaquin adobe sunburst	FT/SE CNPS 1B	Heavy adobe clay soils in blue oak woodlands and grasslands at 600 to 2,000 feet	Near TRRD, no known populations or suitable habitat within Sequoia National Forest.	No.
Petrophyton caespitosum ssp. Acuminatum Marble rockmat	N/N CNPS 1B	Montane coniferous forest, on carbonate or granitic, rocky substrates or limestone cliffs from 4,000 – 7,500'	Monarch wilderness. Not in Monument.	No.
Sidalcea keckii Keck's checkerbloom	FE/N CNPS 1B	Serpentine soils in blue oak woodlands and grasslands at 600 to 2,000 feet	Near Pine Flat Res. and White River. No known habitat (serpentine) within sequoia National Forest.	No
Streptanthus cordatus var. piutensis Piute Mountains jewel-flower	FSC /N CNPS 1B	Soils from metamorphic rock to fine red clay, road banks, and cliffs in pinyon-juniper woodlands, 3,600 - 5,700 feet	Endemic to Piute Mtns. (GHRD), not within Monument.	No
Streptanthus fenestratus Tehipite Valley jewel-flower	N/N CNPS 1B	Carbonate and granitic outcrops in the middle Kings River Cyn. 2,000 to 5,000'	Monarch Wilderness, HLRD, not known in Monument.	No.
Trifolium dedeckerae DeDeker's clover	N/N CNPS 1B	Granitic soils among rocks and boulders in montane conifer forest of southern Sierra	Endemic to Kern Plateau, not known in Monument.	No
Viola pinetorum ssp. Grisea Grey-leaved violet	N/N CNPS 1B	Slopes and sand flats bordering meadows in sub-alpine red fir and foxtail forest	San Bernardino NF to Sierra NF. Not known within Monument.	Yes, not likely to affect.

Listing Status Key: federal/state

FE	Federally Endangered	N	No fed, or state listing status	CSSC	California Species of Special Concern
FT	Federally Threatened	FSS	USFS Sensitive Species	SP	State Fully Protected
FC	Federal Candidate	SE	State Endangered	CNPS 1B	rare, threatened, or endangered in CA and elsewhere.
		ST	State Threatened	CNPS 2	rare, threatened, or endangered in CA, more common elsewhere.

In the following discussions, plants are grouped by their ecological requirements for soil type, moisture regime, and/or canopy closure as well as vulnerability to management effects. Greater detail on individual species is available from CalFlora (CalFlora, 2000), California Native Plant Electronic Inventory (California Native Plant Society, 1997), the national PLANTS Database (USDA NRCS, 1997), and the biological evaluation for plants for the Monument Management Plan.

a) Species Occurring in Riparian/Aquatic Habitats

These species include *Botrychium crenulatum, Bruchia bolanderi, Hydrotheria venosa, Meesia ulignosa,* and *Meesia triquetra*.

(1) *Botrychium crenulatum,* scalloped moonwort

Botrychium crenulatum is limited to the western United States, scattered from California to Montana. In California, this species is known in Butte, Colusa, Los Angeles, Nevada, Modoc, Mono, Placer, Plumas, Tehama, Tulare, San Bernardino, Shasta and Sierra Counties.

Botrychium crenulatum is often associated with water in California, where it is most often found on the lip of creek banks or on their sides, many times within coniferous forest habitats. Specific limiting factors for this plant species abundance and distribution are not known. All *Botrychium spp*. have strong mycorrhizal requirements that may be a factor.

Soil disturbance can be very detrimental, especially if it is occurring on a regular basis. Soil disturbance includes grazing and trampling by livestock and OHV use, where a little disturbance and compaction is tolerated but heavy disturbance will kill individuals. Changes in the hydrologic regime (from erosion, roads, grazing, etc.) may also threaten occurrences. Hot fires have been shown to be detrimental, especially if the soil conditions are very dry during the burn. Some occurrences are near campgrounds or trails, so visitor impacts could be a potential threat.

(2) *Bruchia bolanderi, Bolander's* bruchia moss

Bruchia bolanderi is endemic to the Sierra Nevada of California in meadow habitats in the mixed conifer zone. It is distributed from Yosemite National Park (type locality) southward to the Sequoia National Forest in Tulare County.

This moss occupies a specialized habitat within Sierran meadows. It seems to prefer the vertical soil banks of small streams that meander through meadows. Trampling of the banks and increased erosion are threats to the species habitat.

Sierran meadows receive a wide range of activities that can have a direct effect on this moss species.

(3) *Hydrotheria venosa,* water lichen

This species is known from only a few occurrences in California. It is found in cold unpolluted streams in mixed conifer forests along the western slope of the Sierra Nevada on the Sequoia, Sierra, and Stanislaus National Forests. The California occurrences are disjunct from other U.S. populations.

According to the occurrences in California documented to date, this species occurs in streams that are fed by cold-water springs. The water is very clear and peak flows are not of the intensity that would lead to scouring. The streamlets have a rich aquatic bryophyte flora. The streams are rarely more than eight inches in depth. Increased sedimentation may impact occurrences. This lichen is a foliose species with a rather delicate thallus. The species cannot tolerate too much physical disruption.

Many recreation activities take place in riparian areas, increasing the likelihood of local impacts. Threats include activities that change the water chemistry, alter the stream channel, or excessively alter riparian vegetation, thereby increasing water temperature or increasing flows that scour the gravels and rocks on which the lichen is attached. The Sequoia National Forest location is outside of grazing allotments.

(4) *Meesia triqueta,* three-ranked hump moss

In California, *Meesia triquetra* is currently restricted to Sierran meadows that are acidic. Occurrences are known in the Sierra and Sequoia National Forests and Sequoia National Park.

This species seems to prefer acidic meadows with *sphagnum, drosera,* and *vaccinium spp*. as associates. Cold springs in the meadow also seem to be essential. This moss requires permanent saturation and will not occur in meadows that dry out.

Primary threats are activities that alter meadow hydrology. Based on recent field observations, grazing has impacted some populations. Status in the Monument is not fully known.

(5) *Meesia ulignosa,* broad-nerved hump moss

The range for this species is disjunct, but occurs from Siskiyou County south to Tulare. Most occurrences are in the southern Sierra Nevada.

Meesia uliginosa prefers saturated meadows generally in the upper level of the mixed conifer through subalpine forests. The meadow must be permanently wet, primarily spring fed. Occurrences do not seem to be as restricted to a particular type of meadow, except that the short-grass variety is a likely place to search. Primary threats are activities that alter meadow hydrology.

b) Plants Associated with Rock Outcrops, Cliffs, and other Special Geologic or Soil Features

These species include *Carlquista (Raillardiopsis) muirii, Cryptantha incana, Delphinium inopinum, Dicentra nevadensis, Dudleya cymosa ssp. Costifolia, Erigeron aequifolius, Eriogonum twisselmanii, Heterotheca monarchensis, Lewisia congdonii, Lewisia disepala, Oreonana purpurascens, Streptanthus fenestratus,* and *Viola pinetorum ssp. grisea*.

(1) *Carlquista murii,* Muir's raillardella

This species occupies roughly a 200-mile range along the length of the southern Sierra Nevada from Fresno to Kern counties, and there is one disjunct population 160 miles to the west in the Ventana Wilderness of the Los Padres National Forest. Elevations range from 4,000 to 8,000 feet. The Monument is within its range and has suitable habitats for this plant, but none of the known populations are within the Monument.

This species occupies granite ledges and cracks, or gravelly or sandy flats within openings in chaparral, ponderosa pine, or mixed conifer forest.

Threats include occurrences next to trails or near lookouts (Baker Point). Foot or stock traffic or trail maintenance could impact populations.

(2) Cryptantha incana, Tulare cryptantha

There are three known locations for this species: 1) at 5800 feet on Ninemile Creek, 2) on the slope above Whitney Portal Road, and 3) along Upper Peppermint Creek on the Kern Plateau. The first two are on the Inyo National Forest and the third is on the Sequoia National Forest within the Monument.

This species inhabits lower montane coniferous forest (gravelly or rocky) and pinyon woodland at 1,700 to 2,250 meters (5800-7440 feet) elevation.

(3) *Delphinium inopinum,* unexpected larkspur

Delphinium inopinum is found in disjunct populations mostly in the Sequoia National Forest (the majority on the Monarch Divide, on Slate Mountain, and in the Piutes), the Sierra National Forest (Monarch Divide), and the Los Padres National Forest (Mt. Pinos). It is also found in Sequoia National Park and on BLM land near Lamont Peak, from Fresno County through Tulare, Inyo, Kern and Ventura Counties.

Delphinium inopinum inhabits dry rock outcrops and open rocky ridges in pine and red fir forests, at approximately 6000 to 8800 feet in elevation. It is often found is association with *Eriogonum twisselmannii, E. breedlovei var. breedlovei,*

and *Oreonana purpurascens*. The more rugged sites along the Monarch Divide are relatively stable, but the saddle along the top of Slate Mountain and the Piute habitats may be vulnerable to disturbances.

Potential threats include the use of mechanical equipment, mining, and recreation.

(4) *Dicentra nevadensis,* Tulare County bleeding heart

Dicentra nevadensis is known from approximately 10 occurrences on the Hume Lake and Tule River Ranger Districts of the Sequoia National Forest and one occurrence on the Sierra National Forest, with the remainder in Sequoia National Park.

The species occupies sandy, gravelly crevices and openings in usually dry, granitic soils from approximately 7,500 to over 10,000 feet elevation.

Threats include trampling, road maintenance, and plant collecting in areas of heavy recreational use (e.g., on the Hume Lake Ranger District and in Sequoia National Park).

(5) *Dudleya cymosa ssp. costifolia,* Pierpoint Springs liveforever

There are two confirmed locations on a formerly private tract of land acquired within the Sequoia National Forest in the Tule River drainage of Tulare County. Potential habitat exists on similar outcrops, but no other occurrences have been found to date.

Rockiness and surrounding vegetation make the site relatively inaccessible to people and livestock. *Dudleya cymosa ssp. costifolia* is found on a rocky, limestone outcrop in the canyon live oak woodland/mixed chaparral vegetation type, at approximately 4,800 to 5,200 feet elevation. Habitat may be sensitive to disturbance but is relatively inaccessible.

(6) *Erigeron aequifolius,* Hall's daisy

Erigeron aequifolius is found primarily from the Needles and the Golden Trout Wilderness of the Kern and Little Kern River drainages of Tulare County to the Kings River drainage of Fresno County. Most recorded occurrences are o the Sequoia National Forest (10), with one each on the Sierra National Forest (found in 1995), the Inyo National Forest, and Kings Canyon National Park. One disjunct population is also known to occur on BLM land in Kern County (Owens Peak). Additional occurrences are likely to exist throughout the range but may never be seen because of the ruggedness and inaccessibility of the habitat.

Erigeron aequifolius is found only in steep, rocky, granitic crevices with little or no competition from other species. It is generally found on dry ridges,

approximately 5200 to 8000 feet in elevation, in mixed conifer forests. Populations are relatively stable due to steep, rugged nature of the habitat, making them inaccessible for timber harvest, grazing and most recreation.

The only potential threat for known *Erigeron aqufolius* populations is from hikers and rock climbers.

(7) *Eriogonum twisselmannii,* Twisselmann's buckwheat

Eriogonum twisselmannii is endemic to the Slate Mountain area (roughly 5 miles by 6 miles) of the Monument in Tulare County.

Eriogonum twisselmannii is found on dry, granitic outcrops in Jeffrey pine/red fir forests, at approximately 8,000 to 9,000 feet elevation. The species is often found in association with *Arctostaphylos nevadensis, Delphinium inopinum,* and *Oreonana purpurascens.*

(8) *Erythronium pusaterii,* Kaweah fawn lily

The species range extends roughly 18 miles (north-south) in Tulare County from the Kaweah River watershed in the Sequoia and Kings Canyon National Parks down through the Tule River watershed in the Sequoia National Forest. Known locations include Hocket Lakes, Moses Mountain, Jordan Peak, Slate Mountain.

Erythronium pusaterii is found in dry, rocky, granitic or metamorphic soils, rock outcrops, ledges, and steep canyon walls of upper montane conifer (fir-pine) forests, at approximately 7,300 to 9,100 feet elevation. Most occurrences are protected by the inaccessibility of the steep, rocky habitat.

(9) *Heterotheca monarchensis,* Sequoia false goldenaster

Heterotheca monarchensis is locally common on limestone formation northeast of Horseshoe Bend on the Kings River near Boyden Cave. To date, it is known only from this area in the Monarch Wilderness on both the Sequoia and Sierra National Forests. This is a remote, rugged area of the wilderness with little to no human impacts.

This species is found scattered on south-facing slopes of limestone in cracks, ledges and flats, with higher densities of plants seen in the coarse sandy flats at the base of cliffs, from 3650 to 6000 feet in elevation. The only discernible threat may be competition from exotic annual grasses.

(10) *Lewisia congdonii,* Congdon's bitterroot

Lewisia congdonii has a disjunct distribution between the Kings River Canyon and the Merced River Canyon 50 miles to the north. All but one population are in the Merced River drainage. Elevation ranges from 1900 to 7000 feet.

On the Sierra National Forest, one population is in the Devil Peak Botanical Area, three are in remote seldom-visited areas, and one extends down from an abandoned barite mine, where it seems to have re-colonized well, to Highway 140. On the Stanislaus National Forest, the only occurrence is at Trumbull Peak, with no visible threats. The only occurrence on the Sequoia National Forest is directly next to Highway 180.

Plants are found on rock faces, cracks, and ledges in rocky areas, on talus and scree, and on spoil piles of the abandoned barium mine. The Kings River population grows on granitics, the other populations are found on metamorphics. Plant communities range from chaparral to coniferous forest.

Most populations face few to no threats. The populations that extend down to the roadside at Highway 180 and Highway 140 are known about by Caltrans and the Forest Service, and protective measures are taken when highway maintenance is proposed. The Highway 140 population is included in a 1994 Memo of Understanding for protection of rare species in the Merced Canyon (signing parties are the Forest Service, the BLM, PG&E, Caltrans, and the California Department of Fish and Game).

(11) *Lewisia disepala,* Yosemite bitterroot

This species is found in Mariposa, Madera, Fresno, Tulare, and Kern Counties, from 4400 to 7800 feet elevation.

This species grows in pans and shelves of granite gravel found on and next to outcrops surrounded by coniferous forest. Plants emerge in the winter and bloom and set fruit very early in the spring, in many cases before access roads are clear of snow. Once seeds are dispersed, the plants are nearly impossible to find. Botanical surveys over the past years have completely missed this plant because it is only identifiable for such a brief period.

Some impacts could result from hiking or camping near outcrops that are accessible to the public. Impacts from mechanical equipment or fuelbreak construction are possible, since the plants are not visible during the normal field season.

(12) *Oreonana purpuracens,* purple mountain parsley

The distribution of *Oreonana purpuracens* stretches along a series of prominent ridges through the northern portion of the Sequoia National Forest (Hume Lake and Tule River Ranger Districts) and the Sequoia and Kings Canyon National Parks in the southern Sierra Nevada Mountains of Tulare County (roughly 50 miles). *Oreonana purpuracens* is found on ridge tops and rock outcrops or gravelly openings of decomposed granitic or metamorphic soils in red fir forests, approximately 7,900 to 9,400 feet elevation.

Both the soils and plants are vulnerable to impact from major activities, such as mechanical equipment or road/trail construction or maintenance.

(13) *Streptanthus fenestratus,* Tehipite valley jewel flower

All occurrences of this species are in Fresno County, mostly in Kings Canyon National Park. One population was recently found on the Monarch Divide between the Sequoia and Sierra National Forests, and a large population was discovered in the Sequoia National Forest near Boyden Cave. The entire worldwide distribution of this rare plant is contained within an area of 100 square miles. The Boyden Cave population is in or near the Monument.

The most vigorous and dense populations are found on carbonate soils, but populations are also found in granitic soils. Most occurrences face no threats, but some are along trails or in areas where groups may be likely to set up camp. Two occurrences in the Monarch Wilderness are far from trails.

(14) *Viola pinetorum ssp. grisea,* grey-leaved violet

Viola pinetorum ssp. grisea occurs in the San Bernardino Mountains and in Fresno, Tulare, and Kern Counties. The Vegetation and Flora of Olancha Peak notes only minor morphological differences between montane (*ssp. xerophyta*) and alpine (*ssp. grisea*) forms on Olancha Peak.

Viola pinetorum ssp. grisea inhabits dry mountain peaks and slopes. The preliminary checklist of the flowering plants of the Kern Plateau describes this species' habitat as slopes and sand flats bordering meadows in the higher red fir forest through the foxtail forest and above timberline.

Threats include development, OHV use in locations outside of the Monument, and potentially cattle grazing.

c) Species in Drier, Upland and Meadow Edge Habitats

These species include *Brodiaea insignis, Calochortus westonii, Clarkia springvillensis,* and *Hulsea brevifolia.* They are often ecologically adapted to fire and, though they may benefit from fire, do not require fire

(1) *Brodea insignis*, Kaweah brodiaea

This species was found historically in the lower Kaweah River drainage and in the lower Tule River drainage, in Tulare County. Some Kaweah occurrences known from the 1980s around Three Rivers, along South Fork Road, and along Grouse Valley Road (primarily on private and some California Department of Fish and Game lands) may have been extirpated. Historical occurrences and a re-introduced site in Tule River Canyon between Lumreau and Coffee Camp

Campgrounds (Sequoia National Forest) did not have plants when last visited by forest staff in 1999.

Brodea insignis is generally found on grassy, mostly west-facing slopes of foothill blue oak woodland habitat, on loamy clay soils over granitic substrate. Elevation ranges from approximately 800 to 1,600 feet.

The species appears to be very sensitive to soil disturbance and habitat changes, making populations vulnerable to impact and possible extirpation from commonly occurring urban activities. Threats include urban development, road maintenance, potentially over-grazing.

(2) *Calochortus westonii,* Shirley Meadow star tulip

There are over 1,200 acres of known habitat. Occurrences may fluctuate, depending on varying habitat conditions. At least 20 to 30 extant occurrences are currently known, most with dozens to thousands of plants each. Known range and abundance have expanded greatly in the past fifteen years. The currently known range is approximately 50 miles (north-south) by 16 miles (east-west) in the Tule, Kaweah, and Kern River drainages of Tulare and Kern Counties. Occurrences may be either small, apparently isolated pockets of plants or large, contiguous colonies scattered from as far north and west as Case Mountain to just below Mountain Home State Forest and the Camp Nelson area, east to Baker Point Road and the Vincent/Dry/Tyler Meadows area, and south to the type locality at Shirley Meadows and Cooks Peak. The Case Mountain population is on BLM land, and a few tracts of private land within the Sequoia National Forest include occurrences. The majority of *Calochortus westonii* populations and habitat, however, exist on national forest system lands (Sequoia National Forest).

After it was collected and tentatively identified in 1927, *Calochortus westonii* was initially thought to be highly localized and endemic to the area around Shirley Peak in the Greenhorn Mountains. In 1984, a species management guide was developed to provide protection, primarily in relation to timber harvest, and ensure long-term conservation of the species. Just before the Stormy Fire burned over 24,000 acres of the area, five more occurrences were discovered in 1990 approximately 10 miles to the north. Approximately 115 acres of additional occurrences were found throughout the burned area during post-fire surveys (1991). These areas were flagged and excluded from salvage timber harvest, according to a 1990 agreement with USFWS. However, many of those occurrences did not persist in post-fire years in burned habitat where ecological conditions were not suitable for the species. Apparently established occurrences have been found in many areas north of the burn since then (1992-1996).

Typical habitat for *Calochortus westonii* is partially open, mixed conifer/black oak and associated dry meadow edges, from approximately 5,000 to 7,200 feet elevation. Soils may be granitic or metamorphic and are moderately loamy and

deep when occurring in or adjacent to meadows and dry out early in the season. They may also be somewhat shallower and rockier on steeper forest slopes (usually less than 40% slope).

Populations appear to be able to tolerate moderate disturbance (the species is a bulbiferous, perennial herb), and have the potential to colonize new sites when habitat conditions are suitable.

Since 1990, the Forest Service has implemented a "flag and avoid" policy for *Calochortus westonii*, according to an agreement with the USFWS. The 1984 Species Management Guide was updated in 1997 (awaiting approval at this time) to incorporate new demographic information and propose similar, additional recommendations for enhancing suitable habitat and protecting and promoting the species. Potential threats may include mechanical equipment use and related activities, trampling, and competition from larger, more aggressive species. Species appears to populate skid trails after disturbance. A study on grazing effects to this species was inconclusive due to low grazing pressure. The highest threat appeared to be herbivory by wildlife.

(3) *Clarkia springvillensis,* Springville clarkia

Clarkia springvillensis is currently known from 35 occurrences. Springville clarkia sites are restricted to the lower Tule River drainage in Tulare County, between the North Fork (originally from Springville to Battle Mountain) and Middle Fork (Tule River Canyon generally from Bureau to Wishon) of the Tule River, and about 25 to 30 square miles on a combination of national forest, BLM, California Department of Fish and Game (CDFG), Tulare County Department of Education, and private lands. Type locality occurrences closest to Springville (on private land) appear to have been extirpated by urban development. This species is listed under the Endangered Species Act and is managed in consultation with the USFWS.

Clarkia springvillensis is found in annual foothill grasslands, blue oak woodlands, and chamise chaparral, between 1,300 and 4,000 feet elevation. The species is generally found in openings on south or west-facing slopes, usually on decomposed granite soils.

Numbers of plants within occurrences tend to be seasonally cyclic with evidence of constant seed bank. Most currently known sites appear to be relatively stable, although some on grazed lands are at risk from over-grazing and some on ungrazed grasslands are at risk of being out-competed by more aggressive, introduced grasses and noxious weeds. Recent findings of populations in chaparral between subwatersheds and after the Coffee Fire suggest more potential occurrences than previously believed.

The CDFG set aside approximately 5 acres as the Springville Clarkia Ecological Reserve in 1987. The area is fenced off and protected from grazing and other

land uses. However, competition from more aggressive, introduced grasses, and noxious weeds, as well as trespass grazing are potential threats. Agencies responsible for the maintenance of roads along which *Clarkia springvillensis* is known to occur (CalTrans, California Department of Forestry, Tulare County Public Works Department) have been educated about the species and implement recommended restrictions of potentially harmful activities in areas of known occurrences. Populations in grazed areas on national forest system lands are excluded from grazing by fencing or exclusion of livestock during the growing season. Southern California Edison implements protective measures for *Clarkia springvillensis* within their project area.

***(4) Hulsea brevifolia,* Short-leaved hulsea**

This species is found in the Sierra Nevada from near Grant Grove where Dorst Creek crosses Generals Highway in Sequoia National Park (Tulare County), northward through Yosemite National Park (Fresno, Madera, Mariposa Counties), to Tuolumne County. Its elevation range is between 5,000 and 9,000 feet.

Hulsea brevifolia is found in granitic or volcanic soils in openings as well as in shade of canopy in Upper Montane Coniferous Forest.

Potential threats include OHV use (new route construction and illegal traffic), timber harvesting, road maintenance, and possibly prescribed burning if done in spring or early summer. Most of these threats are for populations outside of the Monument.

9. Noxious Weeds

Noxious weeds are a growing problem in the Monument, as well as on adjacent lands and statewide. Noxious weeds were one of five major issues for the Sierra Nevada identified in the Framework. The Framework and other sources provide more detail on the extent and process of noxious weed invasions than the summarized version provided here. State or federal law classifies noxious weeds as undesirable, noxious, harmful, injurious, or poisonous. They generally have one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, carrier or host of serious insects or disease, and generally non-native.

Non-native weeds generally lack the competition and natural mechanisms that limit native plant populations, making them difficult to control and often resulting in their out-competing native plants. The results are loss of resource value and diversity. Not all non-native plants are highly invasive or considered noxious. Some noxious weeds are considered so widespread that eradication and most treatments are not practical. These species include cheat grass, black mustard, mullein, and tocaolote. New invasions of these species will be eliminated where possible and existing populations will be managed to avoid spread. Other species such as yellow star thistle are

widespread across the state but are just beginning to spread to the Sequoia National Forest and the Monument where more aggressive action is warranted.

The Sequoia National Forest is actively mapping noxious weed locations in and adjacent to the forest to monitor spread and detect new populations. Ten to 25 acres of noxious weeds are being treated each year. The number of treated acres is expected to expand over the next five years.

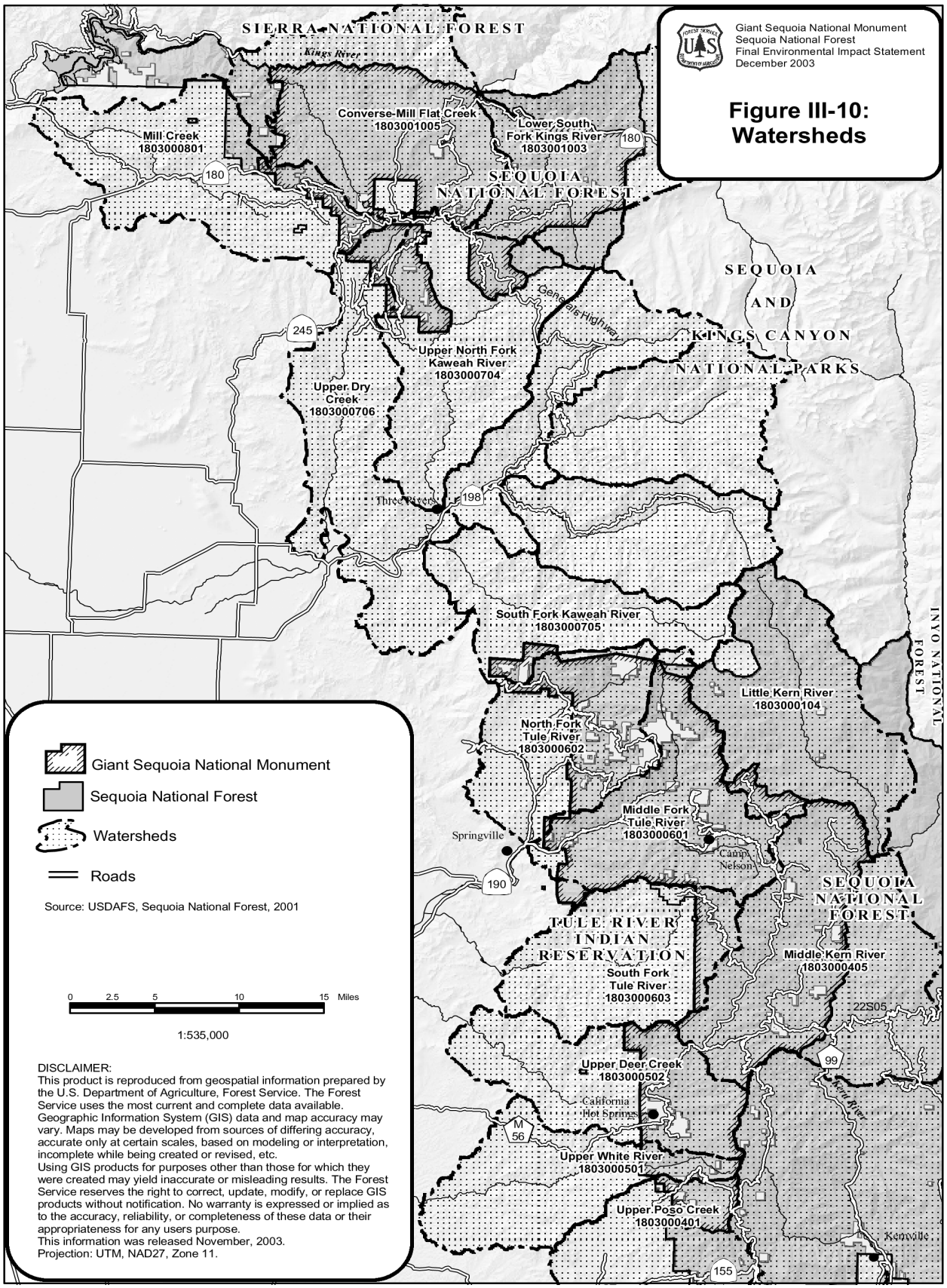
Most ground-disturbing activity can promote weed disturbance and should be carefully monitored. This includes fuelbreak maintenance, OHV travel (limited to designated roads in the Monument), firefighting, mechanical fuels reduction and restoration treatments, road maintenance, and grazing. Appropriate timing, intensity, and frequency of fire use can either suppress noxious weeds or favor them.

10. Watershed

The waters from the watersheds of the Monument all flow into the Tulare Lakebed. The Tulare Lakebed is located in the southern San Joaquin Valley about equidistant from the cities of Fresno and Bakersfield. Historically, the Tulare Lakebed received runoff from the Tule, Kaweah, Kern, and Kings Rivers, as well as other tributaries in these basins. The lakebed was the largest inland body of water west of the Mississippi River. Because the lakebed lacked an outlet to the sea, it acted as a sink in most years. In 1862, the wettest year on record, Tulare Lake encompassed about 486,000 acres to depths of 40 feet. During those wet periods of large-scale flooding, floodwaters reached the outlet to the Sacramento-San Joaquin River Delta. Floodwater flows from the Tulare Lakebed to this outlet last occurred in 1878.

In the late 1800's and early 1900's, reclamation districts were formed to prevent flooding in the lakebed, allowing agricultural production to begin. The lakebed is currently defined as an area that encompasses from 200,000 to 250,000 acres. The lakebed is extensively farmed in crops such as cotton, barley, wheat, safflower, alfalfa seed, as well as others. Flooding is controlled by dams and diversions upstream on the Tule, Kaweah, Kern, and Kings Rivers, and by flood control features such as detention basins, levees, and pumps within the lakebed (U.S. Army Corps of Engineers, 1999).

There are 13 watersheds that are at least partially within the Monument (see Table III-19 and Figure III-10). Two of these watersheds, the Lower South Fork Kings River and the Converse-Mill Flat Creek are shared between the Sequoia and Sierra National Forests. The Converse-Mill Flat Creek, the Upper North Fork Kaweah River, and the Upper Dry Creek are shared with the Sequoia and Kings Canyon National Parks. The South Fork Tule River is shared with the Tule River Indian Reservation. The North Fork Tule River and the Middle Fork Tule River are shared with Mountain Home State Forest. The Middle Fork Tule River is the only watershed that is almost completely located within the Monument. The following table displays the basins and watersheds located within the Monument.


Giant Sequoia National Monument
Sequoia National Forest
Final Environmental Impact Statement
December 2003
Figure III-10: Watersheds
SIERRA NATIONAL FOREST
Kings River
Converse-Mill Flat Creek 1803001005
Lower South Fork Kings River 1803001003
Mill Creek 1803000801
180
SEQUOIA NATIONAL FOREST
SEQUOIA AND KINGS CANYON NATIONAL PARKS
General's Highway
245
Upper North Fork Kaweah River 1803000704
Upper Dry Creek 1803000706
Three Rivers
198
South Fork Kaweah River 1803000705
INYO NATIONAL FOREST
Little Kern River 1803000104
North Fork Tule River 1803000602
Middle Fork Tule River 1803000601
Springville
Camp Nelson
190
SEQUOIA NATIONAL FOREST
TULE RIVER INDIAN RESERVATION
South Fork Tule River 1803000603
Middle Kern River 1803000405
22S05
99
Upper Deer Creek 1803000502
California Hot Springs
M 56
Upper White River 1803000501
Upper Poso Creek 1803000401
Kernville
155
Giant Sequoia National Monument
Sequoia National Forest
Watersheds
Roads
Source: USDAFS, Sequoia National Forest, 2001
0 2.5 5 10 15 Miles
1:535,000
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This information was released November, 2003.
Projection: UTM, NAD27, Zone 11.

Table III-19: River Basins and Watersheds In the Monument

River Basin	Watershed	District	HUC 5#**	Acres within the Monument	Sequoia National Forest Watershed Acres
Upper Kings	**Lower South Fork Kings River**	HL	**1803001003**	**35,470**	**57,890**
	Converse-Mill Flat Creek	HL	**1803001005**	**64,795**	**73,175**
Upper Kaweah	**Upper North Fork Kaweah River**	HL	**1803000704**	**16,175**	19,195
	South Fork Kaweah River*	TR/HS	**1803000705**	**3,115**	**3,115**
	Upper Dry Creek*	HL	**1803000706**	**5,190**	**5,215**
Mill	**Mill Creek**	HL	**1803000801**	**8,015**	**12,160**
Upper Kern	**Middle Kern River**	TR/HS	**1803000105**	**73,395**	**200,895**
	Little Kern River	TR	**1803000104**	**4,500**	**81,245**
Upper Tule	**Middle Fork Tule River**	TR/HS	**1803000601**	**66,255**	**67,120**
	North Fork Tule River	TR/HS	**1803000602**	**30,475**	**30,500**
	South Fork Tule River	TR/HS	**1803000603**	**8,920**	**10,400**
Upper Deer-Upper White	**Upper White River**	TR/HS	**1803000501**	**6,435**	**6,450**
	Upper Deer Creek	TR/HS	**1803000502**	**25,935**	**25,965**
Upper Poso	**Upper Poso**	TR/HS/GH	**1803000401**	**7,935**	**38,130**

*These watersheds are composed of less than 10 percent national forest system lands or are less than 10,000 acres. These watersheds were excluded from analysis under the Framework. Those watersheds less than 20,000 acres may have been included with a larger neighboring watershed for analysis.
**HUC5 = 5th field hydrologic unit code or watershed.

The California State Water Resources Control Board, U.S. Department of Agriculture, U.S. Environmental Protection Agency, and the Natural Resources Conservation Service conducted a unified watershed assessment in accordance with the Federal Clean Water Action Plan (U.S. Environmental Protection Agency, 1998). The purpose of the watershed assessment was to identify those watersheds with the most critical water quality needs and to help guide resources toward correcting the identified problems. The information from this analysis has been incorporated into the watershed analysis for the Monument. The Unified Watershed Assessment was performed at the basin or 4th field hydrologic unit code (HUC) level. Watershed assessments for watersheds in the Monument have been done at the 5th field HUC or watershed level. A watershed is a smaller unit within a basin. Information used to characterize watersheds includes data collected at all levels. This analysis may be found in Volume 4, Appendix I-7, Aquatic and Riparian Information, of the Framework FEIS (USDA Forest Service, Pacific Southwest Region, 2001).

The following table displays the beneficial uses existing within the watersheds of the Monument. Beneficial uses are documented in the State Water Quality Control Tulare Lake Basin Plan and consist of designated uses to be protected, water quality objectives to protect uses, and a program of implementation needed for achieving the objectives (California Water Code, 1975). Beneficial uses, together with water quality

objectives, meet federal regulatory criteria for water quality standards. Therefore, the protection of those past, present, and probable future beneficial uses of water constitutes compliance with state water quality standards. According to the Water Quality Control Plan for the Tulare Lake Basin (California Regional Water Quality Control Board, 1995), all water-related problems can be stated in terms of whether there is water of sufficient quantity and quality to protect or enhance beneficial uses.

Table III-20: Beneficial Uses for Monument Watersheds

Watershed		*Beneficial Uses*												
	HUC 5#	*Mun*	*Agr*	*Pow*	*Rec 1*	*Rec 2*	*Wrm*	*Cold*	*Wild*	*Rare***	*Spwn*	*Grnd*	*Ind*	*Fresh*
Lower South Fork Kings River	1803001003	X			X	X		X	X	X(1)	X		X	X
Converse-Mill Flat Creek	1803001005	X	X		X	X	X	X	X	X(2)	X			X
Upper North Fork Kaweah River	1803000704	X		X	X	X		X	X	X(3)	X			X
South Fork Kaweah River*	1803000705	X		X	X	X		X	X	X(4)	X			X
Upper Dry Creek*	1803000706	X		X	X	X		X	X	X(5)	X			X
Middle Kern River	1803000105	X			X	X		X	X	X(6)	X		X	X
Middle Fork Tule River	1803000601	X	X		X	X	X	X	X	X(7)	X			X
North Fork Tule River	1803000602	X	X	X	X	X	X	X	X	X(8)	X			X
South Fork Tule River	1803000603	X	X		X	X	X	X	X	X(9)	X			X
Upper White River	1803000501	X	X		X	X		X	X	X(10)	X	X		
Upper Deer Creek	1803000502	X	X		X	X		X	X	X(11)	X	X		
Upper Poso	1803000401	X	X		X	X		X	X	X(12)	X	X	X	X

*These watersheds are less than 10 percent national forest system lands or are less than 10,000 acres. These watersheds were excluded from analysis under the Framework. Those watersheds less than 20,000 acres may have been included with a larger neighboring watershed for analysis.
**Rare indicates known occurrences or potential habitat for threatened, endangered, or sensitive species.
(1) Western pond turtle, mountain yellow-legged frogs, and willow flycatcher
(2) Hardhead minnow, western pond turtle, foothill and mountain yellow-legged frogs, California red-legged frogs, western pond turtles, and willow flycatchers
(3) Western pond turtle, foothill and mountain yellow-legged frogs, California red-legged frogs, western pond turtles, and willow flycatchers
(4) Western pond turtle, foothill and mountain yellow-legged frogs, California red-legged frogs, western pond turtles, and willow flycatchers
(5) Western pond turtle, foothill and mountain yellow-legged frogs, California red-legged frogs, western pond turtles, and willow flycatchers
(6) Kern Canyon slender salamander, mountain and foothill yellow-legged frog, western pond turtle, willow flycatcher, and Kern River rainbow trout
(7) Western pond turtle, mountain and foothill yellow-legged frog, relictual slender salamander, and legless lizard
(8) Western Pond Turtle, foothill yellow-legged frog, and relictual slender salamander
(9) Western pond turtle
(10) Western pond turtle, foothill yellow-legged frog, relictual slender salamander
(11) Foothill yellow-legged frog, relictual slender salamander
(12) Western pond turtle, foothill yellow-legged frog, relictual slender salamander

a) Upper Kings River Basin

The Kings River basin is located in the southeastern part of the San Joaquin Valley. It is bounded on the north by the San Joaquin River and on the south by the Kaweah River. The Kings River originates high in the Sierra Nevada and flows in a southwesterly direction as it leaves the foothills and enters the San Joaquin Valley.

Below Pine Flat Dam, it divides into numerous channels, which converge into a single channel, and then separates again into Kings River North and Kings River South. Kings River North flows into the San Joaquin River and Kings River South flows into Tulare Lake.

Pine Flat Dam, completed by the Corps of Engineers in 1954 and situated about 25 miles east of Fresno, impounds Kings River flows for flood control, water conservation, recreation, and hydroelectric power generation. Pine Flat Lake has a capacity of about one million acre-feet at gross pool. Downstream of Pine Flat Dam, the Corps constructed levees, channel improvements, and weirs to control flood flows (Federal Register, April 5, 1996).

The Upper Kings River Basin was rated as a Category II in the Unified Watershed Assessment. A Category II rating describes watersheds with good water quality that, through regular program activities, can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

The Kings River represents the southernmost tributary to the San Joaquin River system that is known to have supported Chinook salmon. In the past, the Kings River emptied into Lake Tulare. The waters of the two streams connected during period when levels of Tulare Lake overflowed into the San Joaquin. Presently, both native and introduced fish species are found in perennial streams within the Upper Kings River watershed. In addition to salmon, historically the Kings River and the lower reaches of some tributaries contained rainbow trout, hardhead minnow, Sacramento sucker, Sacramento pikeminnow, and California roach (Moyle, 2002). Other fish species introduced into the watershed include non-native rainbow trout, brown trout, eastern brook trout, golden trout, smallmouth bass, and spotted bass. Chinook salmon have been stocked in Pine Flat Reservoir and there have been reports of spawning in the river (Mitchell, 2000, personal communication).

Fishing in most of the Upper Kings River within the Monument is managed by the California Department of Fish and Game as a wild trout fishery. Regulations pertaining to this fishery apply to approximately 18 miles of the Kings River. It extends upstream from Pine Flat Reservoir to the confluence of the Middle and South Forks of the river. Wild trout waters are managed principally by protecting, maintaining, and rehabilitating habitat, and adopting appropriate angling regulations.

Lower South Fork Kings River Watershed (1803001003). The Lower South Fork of the Kings River Watershed is located on the western slope of the Sierra Nevada Mountains. This watershed drains one of three main forks of the Kings River, and is fairly typical of the rugged, partially glaciated river basins of the west side Sierra streams. It is approximately 81,520 acres in total, of which about 57,890 acres are in the Sequoia National Forest. Approximately 23,800 acres are within the Monarch Wilderness and 7,000 acres are within the Jennie Lakes Wilderness, and 400 acres surrounded by national forest system lands are under private ownership. Kings Canyon National Park makes up about 23,790 acres of

this watershed. Approximately 35,470 acres of the watershed within the Sequoia National Forest is also within the Monument. This area includes the 9,300-acre Agnew Roadless Area and approximately half of the Monarch Wilderness (estimated 11,900 acres).

Elevation ranges from about 4,000 to 9,000 feet. The watershed is comprised of granite bedrock, which intruded pre-existing ocean floor sediments, which now form roof pendants. These rock types are marble and meta-volcanic and sedimentary rocks. About one quarter of the watershed has been glaciated and the remaining three quarters was formed from stream or fluvial processes. Just east of the confluence of the South Fork Kings River and Grizzly Creek, glacial features terminate. The South Fork of the Kings River flows in a rugged river gorge beyond this point. The drainage is characterized by steep, bedrock boulder-dominated river gorges below Grizzly Creek Falls and the wider, flatter uplands above this confluence. Uplands are steep in sections near the watershed divide and exhibit evidence of glacial polish in the headwaters.

Riparian vegetation consists of stringers of willows and aspen, along creek or meadow edges. Vegetation has good vigor and density and meadow species are flooded for about one month each spring during snowmelt. Steep bedrock and boulder channels cannot grow lush riparian vegetation along their limited flood planes. This type of riparian ecotype makes up of about one-third of the watershed streams.

U.S. Geological Service (USGS) stream gages for the watershed have a 22-year period of record for the Lower South Fork of the Kings River near Hume, California between 1922 and 1957, and a 6-year period of record at Cedar Grove between 1951 and 1956. Measured peak flows from these stations range from 1042 to 2097 cubic feet per second (cfs) and minimum flow from 378 to 409 cfs. Duration of minimum flow is estimated at 22 days and occurs in the month of October. The peak flow in 1952 and minimum flow in 1924 correspond to USGS stream gage readings from other rivers in the vicinity.

The western pond turtle is the only threatened, endangered, or sensitive aquatic/riparian species known to occur within this watershed. However, there is potential habitat for mountain yellow-legged frogs, relictual salamander, and willow flycatchers. The potential habitat for the willow flycatcher is in the Horse Corral and Big Meadows areas.

Both native and introduced fish species are found in perennial streams within this watershed. Historically, this segment of the Kings River, and the lower reaches of some tributaries, contained rainbow trout, hardhead minnow, Sacramento sucker, Sacramento pikeminnow, and California roach (Moyle, 2002). Other fish species introduced into this watershed include rainbow trout, brown trout, eastern brook trout, golden trout, and small mouth bass. Grizzly Lakes, Jennie Ellis Lake, and Weaver Lake are the only large water bodies in this watershed and were stocked with non-native trout species starting in the early 1900s. Due to the conflict between

native amphibians and non-native trout, the California Department of Fish & Game does not currently stock these high mountain lakes. Introduced fish species have become self-sustaining through the majority of the watershed.

Natural disturbances to water quality include wildfires and floods. Man-caused impacts include roads, residences, recreation, grazing, stock use, and vegetation management. Past disturbances have the potential to affect water quality. Watersheds of concern due to past disturbances include Big Meadow Creek and Buck Rock Creek.

Converse-Mill Flat Creek and Mill Creek Watersheds (1803001005, 1803000801). Converse, Mill Flat, and Mill Creeks are the main tributaries to the Kings River on the western slope of the Sierra Nevada Mountains and flow south into the Kings River at or above the Pine Flat Reservoir. Included with this watershed is the portion of the Mill Creek Watershed that falls within the Monument. The uppermost portion of Mill Creek encompasses approximately 4,000 acres that drain approximately 3.5 linear miles of perennial streams west into the Kings River below Pine Flat Reservoir. The Converse–Mill Flat Creek Watershed is divided into seven basins: Upper Tenmile Creek, Lower Tenmile Creek, Cabin Creek, Converse Creek, Verplank Creek, Mill Flat Creek, and Davis Creek. Approximately 1/3 of the Davis Creek basin lies outside the Monument.

The Converse-Mill Flat Creek Watershed consists of approximately 101,480 acres, of which about 73,170 acres are within the Sequoia National Forest. Within the national forest, about 9,360 acres are under private ownership, approximately 64,800 acres are within the Monument, about 22,450 acres are in the Kings River Special Management Area, and approximately 12,400 acres are in the Oat Mountain RARE II Planning Area. Within the Oat Mountain area, about 580 acres are under the jurisdiction of the Army Corps of Engineers and administered by the Sequoia National Forest. Some of these areas overlap with 9,500 acres of giant sequoia groves and the 26,690-acre Mill Flat Creek Critical Aquatic Refuge. Approximately 3,840 acres are within the Kings Canyon National Park and Wilsonia, and 92,970 acres are in the Sierra National Forest.

Elevation ranges from about 900 to 8,000 feet in the drainage and is predominantly granite bedrock, with alluvial fans and basins. Approximately 50 percent of area is steep, bedrock, boulder-dominated river gorges draining into the main stem of the Kings River. Headwater drainages are generally bedrock boulder-dominated streams as well. The wetlands riparian morphology is mainly narrow, steep, boulder/bedrock-dominated channels with little riparian vegetation in the Kings River gorge and along the main tributaries. In the upland basins there are wider riparian areas, generally in the form of meadows or willow clumps along the streams, with substrates ranging from boulder to sand and silt. Several of the meadows have standing water in early spring with high sinuosity, low gradient channels.

Flows from the watershed are extremely variable. It was reported on January 1, 1997, that a low of 6,247 acre-feet per day flowed into the Pine Flat Reservoir, and on January 2, 1997, a maximum of 32,821 acre-feet per day was reported. In the Oat Mountain area, it is estimated that an average of 4,000 acre-feet per day flows into the Pine Flat Reservoir (USDA Forest Service, Sequoia National Forest, 1988, Forest Plan FEIS, Appendix C, page C13).

Riparian vegetation consists of stringers of willows and aspen, usually along creeks or meadow edges. This vegetation generally has good vigor and density. However, the aspen stands along upper Tenmile Creek are over-mature. Meadow forbs and grasses are in standing water approximately one month each spring. There is minimal riparian vegetation in channels with a predominant bedrock/boulder substrate. These drainage types comprise about ¼ of the drainages in the watershed.

These watersheds have potential aquatic/riparian habitat for threatened, endangered, and sensitive species. While western pond turtles are known to occur within these watersheds, there is possible habitat for foothill and mountain yellow-legged frogs, California red-legged frogs, relictual slender salamander, and willow flycatchers. The Mill Flat Creek drainage has been designated a critical aquatic refuge for western pond turtles and native fish associations including hardhead minnows.

Presently, both native and introduced fish species occur within the watershed. Historically, these watersheds represented the upper extent of migration by Chinook salmon (and possibly steelhead trout) in the Kings River system, near the confluence of the North and South Forks. Completion of Friant and Pine Flat Dams, along with natural flow reductions within the San Joaquin River, resulted in the extirpation of native salmon in the upper Kings River system (Yoshiyama, et al, 1996). Other native fish species in this segment of the Kings River and the lower reaches of some tributaries are rainbow trout, hardhead minnow, Sacramento sucker, Sacramento pikeminnow, and California roach (Moyle, 2002). Fish species introduced into the watershed include rainbow trout, brown trout, eastern brook trout, golden trout, and smallmouth bass. Streams and impoundments are stocked annually by the California Department of Fish and Game. Hume, Sequoia, and Pine Flat Lakes are water impoundments with dams.

Natural disturbances to water quality include floods and wildfires. Large scale flooding in January of 1997 damaged facilities at Hume Lake Christian Camps. The areas burned by the Robinson, Converse, McGee (1955), and Highway (2001) fires cover approximately 50% of this watershed. Human-caused impacts include those from roads, recreation residences, private camps and houses, recreation, Hume Lake Dam, grazing, and vegetation management activities. These disturbances currently affect the subwatersheds located in the Sampson Creek, Mill Creek, Upper Abbott Creek, and Mill Flat Creek drainages.

b) Upper Kaweah Basin

The following passage describing the Kaweah Basin was taken from the San Joaquin District, Department of Water Resources, Division of Planning and Local Assistance, Kaweah Ground Water Basin Preliminary Report, and the 1996 Kaweah River Basin Investigation Draft Environmental Impact Statement/Report, U.S. Army Corps of Engineers:

"The Kaweah Basin lies between the Kings Basin on the north, the Tule Basin on the south, the Sierra Nevada foothills on the east, and the Kings River Conservation District on the west. Major rivers and streams in the basin include the Kaweah and St. Johns Rivers. The Kaweah River is the primary source of recharge to the area.

The Kaweah River Basin ranges in elevation from 175 feet in the Tulare Lakebed to 12,600 feet in the Sierra Nevada. Along the western foothill front, granitic and basic intrusive rock outcrops form outliers of low to irregular hills rising from the valley floor. The topography above Terminus Dam is steep, mountainous terrain with deeply incised canyons. Mountain peaks and ridges characterize the area above 10,000 feet. Below the dam the foothills slope gently to the Tulare Lakebed.

The Kaweah River originates from a group of glacial lakes near Triple Divide Peak on the Great Western Divide, a secondary ridge parallel to the main crest of the Sierra Nevada. The Kaweah River is comprised of the North, Middle and Marble Forks above the town of Three Rivers. Below Three Rivers, the South Fork of the Kaweah confluences into the main drainage at the head of Lake Kaweah. These forks have an overall slope of 350 feet per mile and are fed by numerous short, steep streams with slopes ranging from 400 feet per mile to almost 1,000 feet per mile.

More than one-half of the basin tributary to Lake Kaweah lies within the boundaries of Sequoia National Park. The 561 square-mile watershed above Terminus Dam drains to the west and reaches the flattened slopes of the San Joaquin Valley floor about 2 miles below the dam. As the Kaweah River flows toward the valley floor, many distributaries branch from the main river creating the effect of a delta. A few of the Kaweah River's distributaries eventually reach the Tulare Lakebed.

The sediments that comprise the Kaweah Basin aquifers are unconsolidated deposits of Pliocene, Pleistocene, and Recent age. On the east side of the basin, these deposits consist of arkosic material derived from the Sierra Nevada and are divided into three stratigraphic units: continental deposits, older stratigraphic, and younger alluvium. In the western portion of the basin, near the Tulare Lakebed, unconsolidated deposits consisting of flood-basin and lacustrine and marsh deposits interfinger with east side deposits.

The continental deposits of Pliocene and Pleistocene age are divided into oxidized and reduced deposits on the basis of depositional environment. The oxidized

deposits, which crop out along the eastern margin of the valley, consist of deeply weathered, poorly permeable, reddish-brown sandy silt and clay with well-developed soil profiles. The reduced deposits are moderately permeable and consist of micaceous sand, silt, and clay that extend across the trough in the subsurface to the west side of the valley. Older alluvium, which overlies the continental deposits, is moderately to highly permeable and is the major aquifer in the basin.

Younger alluvium consists of arkosic beds, moderately to highly permeable, consisting of sand and silty sand. Generally less than 55 feet thick, it is an important aquifer in the Hanford-Lemoore area.

Flood basin deposits consist of poorly permeable silt, clay, and fine sand. Ground water in the flood-basin deposits is often of poor quality. Lacustrine and marsh deposits consist of blue, green, or gray silty clay and fine sand and underlie the flood-basin deposits. Clay beds of the lacustrine and marsh deposits form aquitards that control the vertical and lateral movement of ground water. The most prominent clay bed is the Corcoran clay, which underlies the western half of the Kaweah Basin at depths ranging from about 200 to 500 feet. In the eastern portion of the basin, ground water occurs under unconfined and semi-confined conditions. In the western half of the basin, where the Corcoran Clay is present, ground water is confined below the clay (San Joaquin District, Department of Water Resources, Division of Planning and Local Assistance, 1995, Kaweah Ground Water Basin Preliminary Report).

The Kaweah Basin was rated as a Category II in the Unified Watershed Assessment. A Category II rating describes watersheds with good water quality that, through regular program activities, can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

Upper North Fork Kaweah River, South Fork Kaweah River, and Upper Dry Creek Watersheds (1803000704, 1803000705, 1803000706). The upper north fork Kaweah River drainage is on the western slope of the Sierra Nevada Mountains. Stony, Woodward and Eshom Creeks flow into the Kaweah River above Kaweah Lake. Dry Creek flows into the Kaweah just below the Reservoir. The north fork of the Kaweah is one of three main forks of the Kaweah River, and is fairly typical of the rugged, partially-glaciated river basins of the west side Sierra streams. Floods rarely occur in the upper portion of the Kaweah on Sequoia National Forest. U.S. Geological Survey stream gauge stations are located on the north fork of the Kaweah River.

These watersheds are approximately 232,240 acres in total, of which approximately 27,530 are within the Sequoia National Forest and 24,480 are in the Monument. Within these boundaries, there are approximately 1,270 acres in private ownership, and approximately 310 acres are in the U.C. Berkeley-owned Whitaker Forest.

Approximately 62,120 acres of the upper Kaweah drainage are within Kings Canyon and Sequoia National Parks; the remaining 22,900 acres are privately owned. Of the portion within the Sequoia National Forest, approximately 1,430 acres are within the Redwood Mountain Grove.

Elevation in the Upper Kaweah drainage ranges from about 4,000 to 8,500 feet. The basin is comprised predominantly of granite bedrock, with alluvial fans and basins. Approximately 30 percent of the area is in steep, bedrock, boulder-dominated river channels draining into the upper Kaweah River. Approximately 35 percent is in basins and other areas of alluvial deposition, with the remaining 35 percent in the steeper headwater drainages leading to the watershed boundaries.

The wetlands and riparian areas are characterized by narrow steep boulder/bedrock-dominated channels, with little riparian vegetation in the Stony and Woodward Creek drainages and in the lower Eshom drainage outside national forest. Dry and Eshom Creeks have more pronounced riparian area at higher elevations where gentler stream gradients favor meadow and willows associated with boulder to sand and silt substrates. Several of the meadows, such as Pierce Meadow, have standing water in early spring with low gradient meandering channels.

Riparian vegetation consists of stringers of willows, along creeks or at meadow edges. Vegetation has good vigor and density. There are small aspen patches in the upper Woodward Creek area.

Western pond turtles are known to occur within these watersheds. There is also possible habitat for foothill and mountain yellow-legged frogs, California red-legged frogs, relictual slender salamander, Sequoia slender salamander, and willow flycatchers. There are no known Forest Service sensitive plant species in the Upper Kaweah River drainage.

Both native and introduced fish species are found in perennial streams within the watersheds. Historically, these segments of the Kaweah River contained hardhead minnow, Sacramento sucker, Sacramento pikeminnow, and California roach (Moyle, 2002). Other fish species introduced into the watershed include rainbow trout, brown trout, eastern brook trout, golden trout, and smallmouth bass. Fish stocking efforts in the early 1900s have resulted in self-sustaining populations. Streams and impoundments are stocked annually by the California Department of Fish and Game. The Montecito Sequoia Resort Lake and Pierce Pond are the only bodies of water other than the stream courses in this watershed, and both are water impoundments with earthen dams.

Natural disturbances to water quality include wildfires and floods. Areas severely burned in historic fires and recent fires (Pierce) cover approximately 10% of the watershed. Human-caused impacts are predominantly associated with roads, grazing, and vegetation management activities.

c) Kern River Basin

The Kern River Basin drains a 2,300 square mile watershed above Bakersfield, California. The North Fork of the Kern River begins at over 10,000 feet in elevation along the Kings-Kern Divide, Junction Peak, and Triple Divide Peak, which separate the south-flowing North Fork of the Kern from the headwaters of the Kings River and the west-flowing Kaweah River. The North Fork Kern tributary system flows over 400 miles from its headwaters to Lake Isabella. The South Fork of the Kern River begins at over 10,000 feet in elevation in alpine meadows on the Kern Plateau. The South Fork and its tributary streams total over 200 miles and flow from near Mount Whitney to Lake Isabella. The Kern Basin is unique because five of California's six major bioregions merge in the valley: the Great Basin Desert, the Mojave Desert, the Coastal Chaparral, the Sierran Forest, and the Great Valley Grassland. This area includes the largest remaining contiguous riparian forest in California.

Glaciers covered most of the high Sierra Nevada mountain range during the Pleistocene Age (10,000 to 2,000,000 years ago). Geologic forces uplifted the mountains of the Kern Plateau, which then experienced the down cutting of the Kern River, erosion, volcanic activity, and glaciation over the past 1.5 million years. This combination of forces left "hanging valleys," or basins with high waterfalls, which are natural barriers to fish migration. These migration barriers isolated rainbow trout in the upper Kern River basin. Over thousands of years, this isolation resulted in the development of the golden trout complex of fish. The golden trout complex consists of the Little Kern golden trout, the California Creek golden trout, and the Kern River rainbow trout. The vividly colored golden trout are prized by anglers throughout the world and the California golden trout has been designated the state fish.

The Kern River flows out of the Sierra Nevada foothills across the Kern River fault. It undergoes a dramatic change in slope as it spreads out from the confines of the Kern River Canyon onto the grasslands of the southern San Joaquin Valley. This water is used for crop irrigation, domestic water, and allowed to seep into the alluvial river bottom to recharge the aquifers in the old Tule Lakebed.

The upper reaches of the North Fork of the Kern River, from its confluence with the Little Kern River upstream to its confluence with Tyndall Creek, was designated a Heritage Trout Stream in 1999. This stream is within the Golden Trout Wilderness in the Sequoia National Forest and Sequoia National Park. The southeastern edge of the Little Kern River Critical Aquatic Refuge overlaps the Monument boundary. Because the Monument affects so little of this watershed, it has been included in the discussion of the Kern River Basin.

Over 151 miles of the North and South Forks of the Kern River above Lake Isabella were made a part of the National Wild and Scenic River system in 1987. The upper reaches of the North Fork are remote and accessed only by hiking and horseback.

The four-mile section of the North Fork upstream of Johnsondale Bridge, which is about 20 miles north of Kernville, is a catch-and-release wild trout fishery managed under special angling regulations. Deep pools and fast runs characterize this part of the river, which has good trail access.

The Upper Kern Basin was rated as a Category II in the Unified Watershed Assessment. A Category II rating describes watersheds with good water quality that, through regular program activities, can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

Middle Kern River Watershed (1803000105) and Little Kern River Watershed (1803000104). This watershed encompasses approximately 204,180 acres. About 200,900 acres are national forest system land, of which approximately 73,400 acres lie within the Monument and about 2,120 acres are private land. Less than two acres lie outside the national forest boundary.

The Middle Kern River watershed is subdivided by the Kern River and borders the southern edge of the Golden Trout Wilderness. The Monument encompasses this entire watershed west of the Kern River. The watershed extends south to the community of Fairview. The morphology of the drainage basin is U-shaped along the Kern River, suggesting glacial influences. Terrain changes to more moderate slopes as elevation decreases towards the Kern River.

Elevations range from approximately 4,000 feet along the Kern River to a high of 8,270 feet at Needles Lookout. Streams exhibit a dendretic drainage pattern. Dominant channel types in the watershed are steep and moderate gradient, confined, boulder and bedrock channels with deep pools. High flows are associated with the Kern River and occur in the spring. Meadow environments occur most frequently at higher elevations.

Approximately 4,500 acres of the Little Kern River Watershed lies within the Monument. It comprises the uppermost sections of Fish Creek, Clicks Creek, and North Fork Creek. It also includes Loggy Meadow, Log Cabin Meadow, Junction Meadow, and White Meadow. These streams and meadows drain in an easterly direction into the Little Kern River that confluences downstream with the Middle Kern River. The Little Kern River Watershed contains the Golden Trout Wilderness and Little Kern golden trout. The Little Kern River comprises their critical habitat and has been designated a critical aquatic refuge for the species. This portion of the watershed is part of the Jordan Grazing Allotment.

The Kern Canyon was formed by numerous episodes of uplift, deformation, deposition, and intrusion of igneous rocks. The canyon has steep rock walls, cluttered with bedrock outcrops and large boulders. Alluvial fans have formed along the base of the canyon walls. Soils consisting of fine, well-sorted sandy loams have developed from the alluvial fans. Coarse sandy loams have developed from the

weathering of the bedrock, boulders, and steep canyon walls. The steep rock walls and bedrock outcroppings are a result of the watershed having rapid runoff rates combined with concentrated flows.

The basins on the western half of the Middle Kern watershed, within the Monument, form both a physical and ecological boundary. This watershed contains ten sub-watersheds including Lloyd Meadow Creek, Nobe Young Creek, Mill Creek, Peppermint Creek, Freeman Creek, Dry Meadow Creek, Needle Rock Creek, Parker Meadow Creek, and sections of the Kern River. These sub-basins have a southern or eastern aspect, drain in a south or southeasterly direction, and feed the Middle Kern River, a wild and scenic river. Drainages outside the Monument within the Middle Kern Watershed have a western aspect and flow in a southwest direction into the Kern River. These sub-basins include Durwood Creek, Brush Creek, and sections of the Kern River.

The mountain yellow-legged frog is known to occur in the Little Kern River Watershed and potential habitat for the species occurs throughout the Middle Kern River Watershed above 5,600 feet in elevation. The foothill yellow-legged frog occurs at several sites on tributaries to the North Fork Kern River and potential habitat for the species occurs throughout the Middle Kern River Watershed below 5,600 feet. Potential habitat for the western pond turtle would be lower-gradient segments of streams within the lower portion of these watersheds. The Middle Kern River Watershed is also known to contain the Kern Canyon slender salamander and willow flycatcher.

Non-native fish species are presently widely distributed among streams in the Middle Kern Watershed. Streams and impoundments are stocked annually by the California Department of Fish and Game. Streams are dominated by rainbow and brown trout. Fisheries habitat condition is generally considered good in the Peppermint, Nobe Young, Freeman Creek, and Little Kern drainages, where canopy cover is generally dense and riparian vegetation is vigorous and diverse. While general conditions are good, there are site-specific sediment increases from off-site locations that negatively affect channel width to depth ratios. High use areas affect habitat conditions. High use is concentrated in the Pyles Camp area, Jerkey Meadow, and Forks of the Kern trailheads. In the South Creek watershed, fisheries habitat has been degraded in approximately 38% of the channel due to large amounts of sediment, high water temperatures, and low complexity cover due to areas of almost non-existent bank vegetation.

The Little Kern River Watershed contains the Golden Trout Wilderness and Little Kern golden trout. The Little Kern golden trout is native only to the Little Kern River Watershed. This species has been negatively affected by the introduction of non-native trout within its range. Rainbow trout and eastern brook trout were introduced in the Little Kern River Watershed in the 1930s and 1940s. By 1977, this trout was reduced to five isolated populations and occupied about 10% of its historic habitat within the watershed. Little Kern golden trout was listed as threatened under the Endangered Species Act due to cross breeding with rainbow trout and competition

with eastern brook trout. The California Department of Fish and Game, Sequoia National Forest, Sequoia and Kings Canyon National Parks, and the U.S. Fish and Wildlife Service are working together to restore pure populations of Little Kern golden trout through its native range. Since 1975, 90 miles of stream and eight lakes have had their non-native trout removed. Eight artificial barriers to upstream trout migration and 32 erosion control structures have been constructed to facilitate the recovery effort. The Little Kern River comprises the trout's critical habitat and has been designated a critical aquatic refuge for the species.

Prior to the July 21, 2002 McNally Fire, the main subwatershed of concern in the Middle Kern Watershed was the Holby Creek drainage. This is predominantly due to the effects of urbanization on water quality in the watershed. The McNally Fire increased the number of subwatersheds of concern in the Monument to include those displayed in Table III-21. These subwatersheds are currently considered for restoration activity to reduce the potential for future affects to water quality resources. These watersheds currently have higher runoff and sedimentation as a result of burn severity. Water quality and beneficial uses in these watersheds has been negatively affected and will require many years to recover.

Table III-21: Monument Subwatersheds Affected by the McNally Fire

Subwatershed	Total Subwatershed Acres	Fire Severity	
		Moderate	High
Lower Peppermint (8C_D)	1,721	957	102
Dry Meadow (8G_G)	2,735	1370	452
Unnamed (8G_I)	781	5742	24
Middle Fork Kern (8G_J)	207	161	2
Lower Dry Meadow (8G_K)	576	363	0
Unnamed (8G_L)	772	552	13
Lower Nobe Young (8H_G)	1,930	914	197
Middle South Creek (8I_L)	1,016	438	131
Unnamed (8I_M)	573	476	96
Lower South Creek (8I_N)	1,218	816	201

d) Upper Tule River Basin

The Tule River Basin is located in Tulare and Kings Counties, in the southeast portion of the San Joaquin Valley, and the Tule River flows from the Sierra Nevada westward toward the Tulare Lakebed. Hydrologically, the basin is a closed system with the river terminating in the lakebed. Lake Success is located on the main branch of the Tule River about 6 miles east of Porterville. It is located within Tulare County, bounded on the north by the Kaweah Basin and on the south by the White River-Deer Creek Basin. Success Dam, with construction completed in 1961 by the U.S. Army Corps of Engineers, provides flood protection and storage for irrigation water. The earthfill dam is 142 feet high, 3,404 feet long, and has a gross pool elevation of 652.5 feet. Currently, the dam and its reservoir provide 82,300 acre-feet of water storage capacity.

The Tule River Basin is a fan-shaped area of about 393 square miles above Success Dam on the western slope of the Sierra Nevada. Three main forks form the Tule River Basin: the North, Middle, and South Forks, which are fed by numerous small tributaries.

Downstream of Lake Success, the Tule River flows through low foothills for three miles until it emerges on the valley floor above the City of Porterville. Downstream of Porterville, it flows through predominantly agricultural land to the Tulare Lakebed. Normally, during the irrigation season irrigation diversions deplete the river west of Porterville, long before it reaches the lakebed.

As the Tule River leaves the foothills, it enters the flat expanse of the San Joaquin Valley. The river passes along the southern edge of the City of Porterville, continues across the valley floor, converges with Elk Bayou (a distributary of the Kaweah River), and continues towards the Tulare Lakebed. A few miles upstream of Porterville is a natural distributary called Porter Slough that is used to convey irrigation water. In addition to Porter Slough, there are numerous irrigation diversions along the river. Water that is not diverted terminates in the Tulare Lakebed.

Elevations range from about 175 feet at the lowest point in the lakebed, to 450 feet in Porterville, to 550 feet at the dam, to a maximum of 10,000 feet in the upper watershed. The higher elevation areas are steep and mountainous, but transition to gentle slopes on the valley floor. Slopes range from 400 to 1,000 feet per mile. Soil cover below 9,000 feet is moderate to deep.

A non-federal hydroelectric plant is located below Lake Success. Two small hydroelectric power plants are located in the upper reaches of the Tule River. One plant is owned by the Pacific Gas and Electric Company and located on the North Fork of the Middle Fork Tule River. The other is owned by Southern California Edison and located on the Middle Fork Tule River. These plants operate on the unregulated flow of the Middle Fork Tule River.

Two types of floods could occur on the Tule River: winter and spring rain and spring/early summer snowmelt. Sharp peaks characterize the winter floods with most of the flood volume occurring within a few days. The spring flood events are usually not as sharp as the winter events. Winter floods generally occur between November and April. Snowmelt floods, on the other hand, have a greater volume, but the runoff occurs over a number of months. The time frame for snowmelt flooding is April through June. To date, peak snowmelt flow releases in the spring have not exceeded the channel capacity below Success Dam. When the reservoir is full and water spills over the spillway at the dam during major storm events, the flows could exceed channel capacity in the reach between the dam and the Tulare Lakebed and cause flood damages. Between water years 1904 and 1997, the average runoff of the Tule River was 145,020 acre-feet (U.S. Army Corps of Engineers. 1999).

Tule River waters can be classified as rich in calcium carbonate. Salinity concentrations are low; electrical conductivity ranges from 112 to 365 micromhos per centimeter. Occasionally, inflow levels of iron, lead, and zinc have exceeded EPA standards for freshwater aquatic life. At the South Fork inflow, total and dissolved iron levels exceeded the federal drinking water standards in the summers of 1995 and 1996. Total iron values also exceeded the drinking water standard at the North Fork inflow in the spring of 1995. Additionally, in the spring of 1995, copper exceeded the aquatic life criteria at the North Fork inflow, and mercury exceeded the standard at the South Fork inflow. Both copper and mercury have exceeded federal standards in past years. However, mineral and nutrient concentrations in the inflow to Lake Success do not pose a threat to water quality within the lake or downstream of the dam.

No detectable levels of pesticides or polychlorinated biphenyls (PCBs) were found in recent sampling years, but in April of 1976 the PCB concentration in the South Fork was over twice the EPA limit.

Downstream of the dam at Lake Success, Tule River water has periodically contained some heavy metals, including cadmium, iron, manganese, and mercury. Cadmium has exceeded the aquatic life criteria and the EPA standard for agricultural irrigation water. Total iron and manganese in the outflow from Lake Success exceeded the federal water quality criteria during the summers of 1995 and 1996. Mercury, which has exceeded federal standards in the past, was below the limit during the 1994 to 1996 period.

PCB concentrations have been below detection limits on all but one occasion. However, the level was well below the 1986 EPA freshwater acute criteria. Nutrient and mineral concentrations below Success Dam do not pose a threat to downstream water quality or beneficial uses. Changes in release schedules at the dam have occasionally caused rapid changes in downstream water temperatures. Although there are no significant fisheries downstream of the dam, such temperature changes can harm downstream native aquatic habitat. Hydropower operations create low concentrations of dissolved oxygen in water releases below the dam for two to five miles downstream. These low dissolved oxygen values could also negatively affect the aquatic habitat (U.S. Army Corps of Engineers, 1999).

Incoming sediment is carried at a rate of 80 acre-feet per year. Presently, approximately 6,500 acre-feet of space remain for sediment in the Lake Success minimum pool. It is estimated this area could be filled by the year 2080.

The Upper Tule River Basin was rated as a Priority Category I in the Unified Watershed Assessment. Category I rating describes watersheds that are candidates for increased restoration activities due to impaired water quality or other impaired natural resource goals (emphasis on aquatic systems). Category I watersheds have flows that have been modified through the existence of dams, channels, canals, ponds, water transfers, and additional criteria listed in the Process for Development of the Final Unified Watershed Assessment (*California Unified

Watershed Assessment Fact Sheet, Index of Indicators). Most of the activities leading to the classification occur in the lower reaches of the watershed. Roads, water diversions and hydroelectric power generation, private residence tracts, recreation, vegetation management, grazing, natural and prescribed fires, slope stability, and floods influence water quality in the watershed.

Both mountain and foothill yellow-legged frogs occurred historically in this basin, although there have been no confirmed identifications of these species here in the last 20 years. Potential habitat for both species exists along both perennial and intermittent streams. The western pond turtle occurs along the Tule River in the lower portion of this basin. Other sensitive species that may be present based on habitat include the relictual slender salamander and the pallid bat.

Rainbow trout, hardhead minnow, Sacramento sucker, Sacramento pikeminnow, and California roach were native to lower portions of this basin. The fishery is now dominated by non-native rainbow trout, brown trout, smallmouth bass, and green sunfish, although roach are still locally abundant. Trout are found in the Tule River upstream from Upper Coffee Camp. Some trout are caught of this site, but generally the stream is occupied by species that prefer warmer temperatures. The Tule River is stocked with trout by the California Department of Fish and Game periodically during the summer.

Middle Fork Tule River Watershed (1803000601). The Middle Fork Tule River is one of three large tributaries that feed the main stem of the Tule River. Its watershed encompasses approximately 66,260 acres within the Monument and drains approximately 99 linear miles of perennial streams. The basin is concave in nature with a drendetic drainage pattern. Headwaters of the watershed are dominated by steep rugged granitic slopes and rock outcrops, which gradually shift to rolling hills at lower elevations. The watershed drains west through Springville into Success Reservoir.

The total acreage within the watershed is 70,480 acres. National forest system lands occupy approximately 67,120 acres. Private property and state lands within the Monument encompass 4,160 acres and 2,450 acres, respectively. Approximately 3,270 acres of private lands occur at lower elevations west of the Forest. The entire watershed lies within the Monument.

Elevation ranges 1,070 feet at Springville to nearly 9,300 feet at Slate Mountain. Dominant channel types include steep and moderately steep bedrock and boulder channels with deep pools. Sedimentation levels tend to increase near channel confluences. Meadow environments occur in headwater areas. Most channels have standing water in the springs within meadow environments.

Western pond turtles are found in lower elevation river segments within this watershed. Other species that may have been present historically based on habitat include the mountain yellow-legged frog, foothill yellow-legged frog, relictual slender salamander, and legless lizard. Rainbow trout were native in the Tule River

Watershed. However, fish stocking by locals and the California Department of Fish and Game has resulted in hybridization with non-native rainbow trout. There are self-sustaining populations of rainbow, brown, and brook trout in various locations throughout the watershed. Stream channels are in medium-good condition with adequate bank protection and abundant aquatic vegetation.

North Fork Tule River Watershed (1803000602). The watershed encompasses approximately 62,360 acres. Of these, about 30,475 acres are national forest system lands that fall within the Monument, approximately 4,370 acres are private land, 2,380 acres are state lands, and 32,120 acres lie outside the Monument. Approximately 6000 acres of the watershed comprise the Mountain Home State Forest.

This watershed drains approximately 39 linear miles of perennial streams. It is separated into two basins, North Fork Tule River and Bear Creek. The streams these two basins are the North Fork Tule River, Bear Creek, Rancheria Creek, Dillon Creek, Pine Creek, South Bear Creek, Backbone Creek, Kramer Creek, an unnamed tributary to Rancheria Creek, and Jenny Creek.

The elevation ranges from approximately 2200 to 9300 feet. Approximately 60 percent of the watershed within the Monument is in steep terrain with high gradient bedrock and boulder channels. The remaining 40 percent of the watershed is composed of moderate gradient boulder and cobble channels.

Surveys were conducted in 2001 on portions of Rancheria Creek, an unnamed tributary to Rancheria Creek, and Bear Creek within the Bear Creek drainage, as well as the North Fork Tule River in the North Fork Tule River drainage. Naturally stable bedrock, boulder, and cobble type channels dominate the watershed. However, areas of naturally unstable landslide-dominated channels and meadow-dominated stable sensitive channels exist in the headwaters of Rancheria Creek and the unnamed tributary to Rancheria Creek.

Forest Service Sensitive species with documented presence in this watershed include the California spotted owl (4 PACS), fisher, marten, goshawk (1 PAC), and western pond turtle. All of these species are associated with the use of riparian environments during various phases of their life cycle. Additional sensitive species that may be present based on habitat include the relictual slender salamander, foothill yellow-legged frog, mountain yellow-legged frog, and pallid bat.

The main subwatershed of concern in the Upper Fork Tule River Watershed is the Bear Creek drainage.

South Fork Tule River Watershed (1803000603). The South Fork Tule River and its tributaries, which include Cedar Creek, Kessing Creek, and Crawford Creek, drain west through the Tule River Indian Reservation into Success Reservoir and eventually into the Tulare Lakebed. The watershed encompasses

approximately 64,440 acres. Of these, about 8,920 acres are national forest system lands within the Monument, approximately 160 acres are private land, and 1,440 are other residential properties.

Elevation ranges from approximately 5,000 at the Monument boundary to 9,000 feet at Slate Mountain. Most of this watershed lies within the Tule River Indian Reservation.

The main subwatershed of concern in the South Fork Tule River Watershed is the unnamed drainage tributary to Windy Creek.

e) Upper Deer-Upper White River Basin

Most of the Upper Deer-Upper White River Basin is located off of national forest system lands. Headwaters for this basin begin along the Greenhorn Summit, which separates these two east-flowing watersheds from the south-flowing North Fork of the Kern River. Tobias and Bull Run Peaks are high points along this divide. Deer Creek Basin is roughly 90 square miles and terminates 10 miles east of Terra Bella. The White River Basin is roughly 100 square miles and ends about 20 miles east of Delano on the Tulare/Kern County line. Both Deer Creek and White River become intermittent drainages once they hit the valley floor. Historically, both of these drainages flowed directly into the old Tulare Lakebed. Both of these drainages have had years of no flow for several months in most years; however, high flows have reached 2,720 cubic feet per second and 5,330 cubic feet per second for White River and Deer Creek, respectively.

These basins were both rated as Category II in the Unified Watershed Assessment. A Category II rating describes watersheds with good water quality that, through regular program activities, can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems. Roads, private residence tracts, recreation, vegetation management, grazing, natural and prescribed fires, slope stability, and floods influence water quality in the watershed.

Rainbow trout are native to this watershed. However, fish stocking by locals and the California Department of Fish and Game have resulted in hybridized rainbow trout. Fisheries habitat is in satisfactory condition in Starvation, Tyler, and Deer Creeks. Fish abundance is considered good in these creeks, but is limited by the quality of the habitat. Overall, a lack of cover complexity and high sediment loads appear to be the limiting factors. White River and Capinero Creek are associated with rainbow trout fisheries in degraded condition. High sedimentation, width-to-depth ratios, low cover complexity, and water temperatures affect fisheries habitat. Gordon, Rube, and Alder Creeks are Class IV streams with no known fisheries.

Upper White River Watershed (1803000501). The White River and its tributaries are located on the west slope of the Sierra Nevada Mountains and drain in a westerly direction into the Central Valley south of Ducor.

The morphology of the drainage basin ranges from deep V-shaped canyons with steep rugged terrain to moderate slopes at lower elevations. The White River Basin comprises the entire Upper White River Watershed that lies within the Monument boundary.

The watershed encompasses approximately 57,490 acres. Of these, approximately 6,440 acres are national forest system lands that fall within the Monument, about 350 acres are private land, and 51,030 acres lie outside the Monument. Elevations range from 4,000 feet at Twin Springs to 8,025 feet at Bull Run Peak. Dominant channel types include moderate to steep bedrock/ boulder/ cobble channels and there are several minor springs and seeps that occur within the watershed. No giant sequoia groves are located in this watershed and there are no known dams within the Monument in this watershed.

Forest Service Sensitive species that may have been present historically based on habitat include the western pond turtle, foothill yellow-legged frog, mountain yellow-legged frog, relictual slender salamander, and pallid bat.

Wildfires have burned approximately 31,503 acres within the watershed since 1910. The main subwatersheds of concern in the Upper White River Watershed are the Upper and Middle White Rivers. This is predominantly due to the effects that urbanization has had on the water quality in the watershed.

Upper Deer Creek Watershed (1803000502). Deer Creek and its tributaries are located on the western slope of the Sierra Nevada Mountains and drain west into the Central Valley between Terra Bella and Porterville. The morphology of the drainage basin ranges from deep V-shaped canyons with steep rugged terrain to moderate slopes at lower elevations. The watershed encompasses approximately 65,340 acres. Of these, about 25,935 acres are national forest system lands that fall within the Monument, approximately 4,160 acres are private land, and 39,310 acres lie outside the Monument boundary.

Elevations range from approximately 3,600 to 8,285 feet at Tobias Peak. Dominant channel types include high gradient bedrock boulder or landslide-dominated channels in steeper terrain within the watershed, and moderate gradient cobble channels in the more moderate terrain. Several meadows occur in the upper portions of the watershed. They include Parker Meadow, Pack Saddle Meadow, Pup Meadow, and Dead Horse Meadow. The Upper Deer Creek Watershed is comprised of four sub-watersheds: Gordon Creek, Rube Creek, Tyler Creek, and Deer Creek. There are several minor springs and seeps that occur within the watershed.

Forest Service Sensitive species that may have been present historically based on habitat include the foothill yellow-legged frog, mountain yellow-legged frog, relictual slender salamander, and pallid bat

Roads, private residence tracts, recreation, vegetation management, grazing, natural and prescribed fires, slope stability, and floods influence water quality in this watershed. This type of past disturbance has the potential to affect water quality. Watersheds of concern resulting from past disturbances include the tributaries to Rube Creek, Merry Creek, Alder Creek, the Headwaters of Deer Creek, and Capinero Creek.

f) Upper Poso River Basin

Rivers forming the headwaters of the Upper Poso River Basin drain southwest into the Central Valley near Famoso in Kern County and then run north toward the old Tulare Lakebed. The basin covers more than 250,000 acres. Precipitation on this watershed ranges from six to 30 inches. The morphology of the drainage basin ranges from deep v-shaped canyons with steep rugged terrain to moderate slopes at lower elevations. Poso Creek drains into the Kern National Wildlife Refuge. Poso Creek is an intermittent stream, which spills floodwaters onto the Kern National Wildlife Refuge only during wet years. Kern National Wildlife Refuge is found just south of the historic Tulare Lake in the San Joaquin Valley. The region was a vast wetland prior to the 1900s. Starting in the 1850s and ending in the early 1950s, most of the wetlands were drained and reclaimed for agriculture.

The Poso Creek Basin was rated as a Category II in the Unified Watershed Assessment. A Category II rating describes watersheds with good water quality that, through regular program activities, can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals and standards and support healthy aquatic ecosystems.

Upper Poso Creek Watershed (1803000401). The Poso Creek watershed encompasses approximately 136,090 acres. Of these, approximately 7,940 acres are national forest land within the Monument, about 2,390 acres are private land, and 96,820 acres lie outside the Monument boundary.

Elevations range from about 4,000 feet at Poso Cabin to 8,295 feet at Sunday Peak. Tributaries include Von Hellum Creek, Peel Mill Creek, and Spear Creek. Dominant channel types include steep to moderate gradient cobble/boulder/bedrock channels. Meadow habitats are limited and restricted to the upper portions of the watershed (Marshall Meadow).

Upper Poso Creek Watershed contains the sub-watersheds of Poso Creek, Fulton Creek, Cedar Creek, Lumreau Creek, and Little Poso Creek. Only a portion of the Poso Creek drainage is within the Monument.

Forest Service Sensitive species that may have been present historically, or may be present based on habitat include the western pond turtle, foothill yellow-legged frog, mountain yellow-legged frog, relictual slender salamander, and pallid bat.

Fisheries habitat in the Upper Poso Creek Watershed is degraded by large width-to-depth ratios and sedimentation. Stream banks are unstable and provide poor cover and water quality; cover complexity is moderate. Fish are not present in Von Hellum and Peel Mill Creeks.

11. Wildlife

The Framework serves as a background document that discusses analysis methods, risk assessment, assumptions, uncertainty, modeling and detailed species accounts. Framework discussions are summarized in this document with added local detail. Wildlife is addressed by special habitats and species at risk.

a) Habitats of Special Interest and Management Indicator Species

The National Forest Management Act directs the Forest Service to select and track species that are of special interest and/or indicative of management trends. These species are designated management indicator species. Forest Plan management indicator species are displayed in the following table.

Table III-22: Management Indicator Species for the Sequoia National Forest

MIS Species:	Forest Plan Defined Habitat:	General Natural History Information for Project Level Analysis:
Early Successional Stages:		
Mule Deer	Early seral stages of all habitats	Resident and migratory browsing and grazing species with a widespread distribution. Occurs in early to intermediate successional stages of most forest, woodland and brush habitats. Prefers a mosaic of various-aged vegetation that provides woody cover, meadow and shrubby openings.
Hardwood Species Association:		
Western gray squirrel	Mature hardwood and mixed hardwood-conifer	Common locally, dependent on mature oak and mixed conifer, require large trees, mast and snags. Home range size in Sierra Nevada foothills varied from 1.2 to 2.5 acres (males).
River/Stream Species Association:		
Rainbow trout	Rivers/streams Habitat addressed under watershed and aquatics section	Common in cool, clear, fast-flowing permanent streams and rivers. Rare to abundant in accessible low gradient streams where suitable habitat is present. Flows necessary to provide dissolved oxygen (typically close to saturation); cool water temperatures (optimum 15-18 degrees C); and diverse and abundant invertebrate life are required. Coarse (1-13 cm diameter) gravels in riffles or pools are used for spawning and cobble and boulders for cover. Ample and complex cover from riparian vegetation, coarse woody debris, boulders, deep pools, or undercut banks reduces exposure to predators, high flows, and excessive energy expenditure.
Snag Species Association:		
Pileated woodpecker	Snags in Late-successional coniferous forests	Uncommon, yearlong resident of mature, montane conifer habitats with permanent water. Occupies dense (preferably >40% canopy), mature forest with large numbers of snags, stumps and logs. Frequents WF and RF more than other conifers. Nest tree selection at least 20” DBH. Estimates of high quality habitat range from .14 snags/ac >20” to
Mature Forest		
California spotted owl	Mature forests addressed under Sensitive Species	Uncommon permanent resident oak riparian and conifer habitats from 900 to ~8,000’. May shift elevation seasonally. Uses dense, multiple layered canopy closure with large trees, down logs and snags.
Northern goshawk	Mature forests addressed under sensitive species	Scarce to uncommon yearlong resident in middle to higher elevation mature and dense conifer forest with meadows or other openings and nearby water required.
Listed Species		
California condor	Individual species. Addressed under species at risk	Potential nesting habitat in large cavities within giant sequoia or on suitable cliffs. Open chaparral and blue oak woodland provide foraging and some roosting habitat.
Bald eagle	Individual species. Addressed in BA, not likely to affect	Associated with large bodies of water. No suitable breeding habitat and low potential for more than incidental winter use within Monument
Peregrine Falcon	Individual species, no longer federally listed. Low potential for effect, addressed in BE	Two known eyries within or adjacent to Monument 4 superior nest sites identified
Little Kern golden trout	Individual species. Addressed under species at risk.	Habitat similar to rainbow trout. Limited to 4,500 acres of critical habitat within Monument.

(1) Aquatic and Riparian

There are approximately 640 miles of perennial and 395 miles of intermittent streams within the Monument. Stream conditions, water quality, and habitat conditions for aquatic species are addressed in the watershed section.

Rainbow trout are the management indicator species for riparian habitats in the Forest Plan. Other aquatic or riparian species of interest addressed under species at risk include foothill yellow-legged frogs, mountain yellow-legged frogs, and Little Kern golden trout.

(2) Early Seral

Open grassland, meadow, and recent burns or other disturbances serve as early seral habitat within the Monument. Most early seral habitats in the Monument are minor inclusions within mature forest. Exceptions are recent wildfires and a few hundred acres of prescribed underburns. The management indicator species associated with early seral stage habitats is mule deer.

Mule Deer – MIS. There are portions of four deer herds within the Monument: the Hume, Kaweah, Tule River, and Greenhorn. The deer herds have been reorganized into deer assessment units (DAU). DAU 7, the South Sierra Nevada unit comprises about 8,800 square miles on the west side of the Sierra Nevada from Yosemite National Park south to the Kern River drainage area, then across the Tehachapis to Interstate 5 (including the Monument).

Habitat is typified by mixed conifer forest summer ranges. Common species and habitats important to deer in the forest community are aspen, riparian-wetland areas, willow, ceanothus, and manzanita. Winter ranges are composed largely of oak woodland, annual grass and oak woodland, chaparral, and agricultural fields or pasture.

The deer population has been fairly stable at 30,000-40,000 animals in the past several years within the DAU. Longhurst et al. (1952) estimated about 95,000 deer in this DAU, illustrating how far we have declined since the late 1940s. They attributed deer range problems to livestock on winter ranges and to overuse by deer. Currently, studies indicate fawn mortality is high on summer ranges, while adult mortality primarily occurs on winter ranges. Causative factors on summer range are not well documented. Resident deer were considered to be responding positively to wildfires, while migratory deer populations were not.

California Department of Fish and Game biologists believe that long-term declines in habitat condition, starting in the 1930s and continuing today, are most responsible for the decline. Lack of habitat disturbance, especially from fire, has decreased habitat value for deer and other wildlife in much of the state's forested areas. Deer and numerous other wildlife thrive on early successional (seral) vegetation that grows back in the first few years after fire. Without periodic fire, the habitat becomes old, or "decadent," and is unable to support wildlife populations of the past. Indirect consequences, such as increasing competition with livestock and overuse of ranges by deer themselves, are typical (http://www.dfg.ca.gov/hunting/deer/d_grph1.html).

(3) Late Seral

Late seral, old growth (LSOG) forest conditions are important to a number of species (see Appendix C, Advisory XII). Management indicator species for late seral, old forest include the California spotted owl and northern goshawk. Spotted owl and goshawk are addressed under species at risk. Pileated woodpeckers are the selected indicator species for a subset of old forest species related to snags.

The habitat requirements for each mature forest MIS species are slightly different but they appear to have common ties to nest/den requirements or prey that prefer one or more of the following habitat elements: large trees, moderate to high canopy closure (40% or greater for moderate closure and 60% or greater for high canopy closure), proportion of landscape with moderate or higher canopy closure, high volume of down logs (greater than 132 cubic feet per acre, or 5 tons per acre), and large snags. These elements are used as measures or indicators of environmental effects. LSOG species appear to be able to use a wide range of habitats if these elements are available on a watershed or landscape scale.

LSOG rankings from the Sierra Nevada Ecosystem Project (Sierra Nevada Ecosystem Project, 1996) are also used as an indicator for habitat availability and quality for these species on a landscape scale. LSOG rankings are based on landscape assessments using subjective estimates of snags, large trees, down logs, and stands with higher canopy closure. The rankings reflect lower ratings based on fragmentation from natural rock outcrops, wildfire, poor soils, or past management activity. Rankings range from 0 (little or no habitat for closed canopy, mature forest species) to 5 (high canopy closure, high numbers of large trees (>30 inches in diameter), high decadence large down woody debris and snags)). LSOG rankings are relative to idealized habitat for LSOG species, not potential natural conditions, and they are not reflective of the full range of habitat conditions used by these species. LSOG values are useful for comparing one point in time to another for estimating or modeling trends in habitat availability and are used as such in this analysis.

Pileated woodpecker – MIS. Optimum nesting habitat for pileated woodpeckers includes multiple-layered stands with crown closure of approximately 70% in overstory and understory combined. Full habitat capability is met with approximately .15 snags over 20 inches in diameter per 100 acres. The primary food is carpenter ants, which are usually found in trees and logs with heart rot. Pileated woodpeckers rarely forage outside of forested stands (> 40% canopy closure).

(4) Lower Westside Hardwoods

Hardwoods, primarily oaks, were identified as an ecosystem of particular concern in the Framework. Reasons for concern include development and loss of hardwoods on private lands adjacent to national forests, lack of regeneration, and ecosystem changes in the absence of natural fire regimes. Management indicator species associated with these habitats include gray squirrel and deer. There are approximately 124,000 acres of hardwoods including shrub forms of oaks, blue oak woodlands, black oak woodlands, and mixed oak/conifer forests.

All alternatives follow Framework standards for maintaining or enhancing oak woodlands. Fuels management prescriptions under all alternatives preferentially thin to retain oaks and provide openings to protect and enhance reproduction of oaks where possible. In general black and blue oaks provide canopy cover will relatively low flammability, as such they are preferentially retained in fuels management. Depending on density and location scrub, live and canyon oaks may require some thinning or reduction of understory fuels. Acres of treatment of the more flammable oaks are low and will encourage a range of age classes. Since effects on this habitat are expected to be low, this element is not carried forward into the environmental consequence section nor is the management indicator species addressed in detail.

b) Special Status and Species at Risk

Special status species include species listed by the Fish and Wildlife Service under the direction of the Endangered Species Act, as well as Forest Service Sensitive species listed by the Regional Forester due to sensitivity to management, limited distribution, or other concerns.

The Forest Service requests a species list from the U.S. Fish and Wildlife Service (USFWS) on a quarterly basis. The list includes all federally listed, proposed for listing, and candidate species found within or near the Sequoia National Forest. All species likely to be found within the Monument are addressed in the biological evaluation (BE) for sensitive species or biological assessment (BA) for threatened, endangered, or proposed for listing species prepared for this FEIS. Information on species at risk from proposed management activities or on those species where there is controversy regarding management are addressed here. Species accounts are provided in detail in the Framework FEIS and are summarized here with added local detail. Sensitive plants are addressed in the Rare Plants section of this chapter.

Table III-23: Threatened, Endangered, Proposed Species, Sequoia National Forest

Common Name *(Scientific Name)*	Listing Status	Habitat Requirements	Potential for Occurrence in Monument	Addressed in Plan (Monument)
Tipton kangaroo rat *(Dipodomys nitratoides)*	FE	Alkali sinks and valley floor habitat	Unlikely, no suitable habitat	No, outside known range.
California bighorn sheep *(Ovis canadensis californiana)*	FE	Rugged mountain areas, mostly eastern Sierra with small historic range on western edge of Kern Drainage	Unlikely. No historic range in Monument.	No, outside known historic range.
San Joaquin kit fox *(Vulpes macrotis mutica)*	FE	Valley floor annual grassland, alkali washes generally below 1,000'	Unlikely, no historic records. Forest above known range	No, outside known range.
SW Willow flycatcher *(Empidonax trailii extimus)*	FE	Riparian forest and meadow with dense willow habitat and standing water.	Habitat at Lake Isabella. Monument may be within range.	No, no change to suitable habitat, grazing addressed under Framework
California condor *(Gymnogyps californianus)*	FE	Mountain and foothill rangeland and forest habitats; nests on cliffs and in large trees.	Designated roost areas, critical habitat, nest area and potential nest trees identified in Monument.	Yes
Bald eagle *(Haliaeetus leucocephalus)*	FT	Lakes and open water; nests on large trees.	Winter resident along Kings River. Occasional visitor, Tule and White River areas.	Yes in BA, not in FEIS
Least Bell's vireo *(Vireo bellii pusillus)*	FE	Riparian forest	Unlikely, historic to Kern Valley, recent incidental detections limited to South Fork Wildlife Area.	No, no current or historic detections,
Blunt-nosed leopard lizard *(Gambelia silius)*	FE	Open grassland, valley floor below 1,000'.	Unlikely. No populations in near proximity. All occupied valley floor habitat transferred to USFWS.	No, outside known range
Giant garter snake *(Thamnophis gigas)*	FT	Valley floor aquatic habitats	Unlikely, outside known range	No, outside known range
California red-legged frog *(Rana aurora draytoni)*	FT	Low gradient streams and ponds with emergent vegetation	Unlikely. One unverified historic occurrence 1926 adjacent to Monument, no detections since. Most streams high gradient, high spring flow	Yes in BA not in FEIS.
Delta smelt *(Hypomesus transpacificus)*	FT	Limited to San Joaquin/Sacramento delta	None. No outlet from Sequoia NF to Delta.	No, no potential effect on species.
Little Kern golden trout *(Oncorhynchus mykiss whitei)*	FT, CH	Native to cold water streams in Little Kern Drainage	Approximately 4,500 acres of CH in Monument.	Yes in BA.

Common Name (Scientific Name)	Listing Status	Habitat Requirements	Potential for Occurrence in Monument	Addressed in Plan (Monument)
Sacramento split-tail (Pogonichthys macrolepidotus)	FT	Limited to San Joaquin/Sacramento delta	None. No outlet from Sequoia NF to Delta.	No, no potential effect.
Vernal pool fairy shrimp (Branhinecta lynchi	FT	Valley floor annual grassland, alkali washes generally below 1,000'	Unlikely, Forest outside known range. Potential for disturbance low	No, outside known range.
Valley elderberry longhorn beetle (Desmocerus californicus dimorphus)	FT	Elderberry plants with base > 1" diameter in chaparral and riparian habitats below 2,900'	Likely, suitable habitat exists. Known exit holes on Hume Lake Ranger District outside of Monument.	Yes
Kern primrose sphinx moth (Euproserpinus euterpe)	FT	Valley foothill, oak woodland and chaparral associated with evening primrose. Range limited to Walker Basin area	Unlikely. Some potential habitat on forest. No known records from forest and species believed extinct.	No, outside known range, believed extinct.
California jewel flower (Caulanthus californicus)	FE	Level areas or gentle slopes in subalkaline sandy loam soils up to 1350'in the western Sierra	Unlikely, outside known range, no known suitable habitat.	No, low potential for occurrence, low potential for effects.
FE = Federally Endangered; FT = Federally Threatened; PT = Proposed for Federal listing; CH = Designated Critical Habitat				

Table III-24: Sensitive Wildlife Species, Sequoia National Forest

Common Name (Scientific Name)	Listing Status	Habitat Requirements	Potential for Occurrence in Monument	Addressed in Plan (Monument)
Pallid bat (Antrozous pallidus)	FSS, CSSC	Forages mostly over open habitats. Requires rocky crevices, tree cavities, mines, caves, or buildings for maternity roosts. Deep crevices and other are important for day roosts	Present. Presumably forages on suitable habitat throughout the forest. No maternity roosts documented	Yes in BE not in FEIS
Northern goshawk (Accipiter gentiles)	FS, FSC, CSSC, MIS	Dense mixed conifer forest to open eastside pine. Generally > 40% canopy cover	Present. Suitable habitat and nesting occur within both OHV and OSV program areas.	Yes covered with old forest species
California legless lizard (Anniella pulchra)	FS	Loose, moist soil in chaparral and valley foothill woodland.	Present generally below 4,000'	Yes in BE, not in FEIS
Inyo Mtn. slender salamander (Batrachoceps campi)	FS, CSSC	Down logs and moist areas	Low, known range limited to Inyo Mtns.	No, outside known range.
Relictual slender salamander (Batrachoceps relictus)	FS, FSC, CSSC	Down logs and moist areas, generally in mixed conifer zone	Likely to be present, suitable habitat present	Yes in BE, not in FEIS

Common Name *(Scientific Name)*	Listing Status	Habitat Requirements	Potential for Occurrence in Monument	Addressed in Plan (Monument)
Kern Cyn. slender salamander *(Batrachoceps simatus)*	FS, FSC, ST	Down logs and moist areas, below 3,500'	Known from limited area in Kern Canyon	No, outside range.
Tehachapi slender salamander *(Batrachoceps stebbensii)*	FS, ST	Down logs and moist areas, below 3,500'	Low, range is canyon and desert areas Tehachapi to Caliente. Known range adjacent to Forest	No. Outside known range.
Kern Plateau slender salamander *(Batrachoceps sp.)*	FS, CSSC	Down logs and moist areas, `~7,000-8,000'	Present on Kern Plateau	No. Outside known range.
Breckenridge slender salamander *(Batrachoceps sp.)*	FS, FSC	Down logs and moist areas in the Breckenridge area. Known only from one location	Low, believed extinct	No, outside known range.
Southwestern pond turtle *(Clemmys marmorata pallida)*	FS, FSC	Low gradient ponds and streams with basking sites. Can be found up to 1 mile from perennial water	Present	Yes in BE. Habitat quality addressed in watershed section FEIS
Western yellow billed cuckoo *(Cocczyus americanus occidentalis)*	FS, FSC, SE	Dense riparian forest, foothill and valley floor.	Only known from South Fork Wildlife Area at Lake Isabella, no suitable habitat in Monument.	No suitable habitat
Townsend's (Pacific W.) big eared bat *(Corynorhinus townsendii townsendii)*	FS, FSC, CSSC	Nocturnal, roosts in caves, uses wide variety of habitats although usually mesic areas for foraging	Present in area	Yes in BE not in FEIS.
Little Willow flycatcher *(Empidonax trailii brewsterii)*	FS, FSC, SE	Large meadow (15acre +) complexes with dense willow and standing water	Present in area	Yes in BE not in FEIS
Yellow blotched salamander (ensatina) *(Ensatina escholtzii croceator)*	FS, FSC, CSSC	Valley foothill/hardwood habitats and conifer in the Breckenridge Mtns. Moist habitats and down logs	Present in area	Yes in BE not in FEIS.
American Peregrine Falcon *(Falco peregrinus anatum)*	FS, D/FSC, CSSC	Cliff dwelling raptor associated with open habitats	Present in area	Yes in BE, not in FEIS.
California wolverine *(Gulo gulo luteus)*	FSS, FSC, ST	Remote habitats, sensitive to human presence. 4000' to 13,000' mixed habitats	Low in Monument, likely present on forest in wilderness.	No, no detections since 1988, addressed in BE and Framework.
Western red bat *(Lasiurus blossevillii)*	FS, CSSC	Associated with riparian habitat, roosts in trees and forages over open woodlands and grasslands	Present in area	Yes in BE not in FEIS

Common Name (Scientific Name)	Listing Status	Habitat Requirements	Potential for Occurrence in Monument	Addressed in Plan (Monument)
American marten (*Martes americana*)	FSS, FSC, CSSC	High quality habitat has >70% cc; moderate habitat 41-70% cc. Habitat should also have a high number of or large snags and down logs, close proximity to dense riparian corridors for movement, and an interspersion of small (<1 acre) openings with good ground cover for foraging. Potential occupied elevation 4,000-13,000 ft.	Present. Suitable habitat for marten, and recent surveys indicate marten occur throughout Monument.	Yes in FEIS with old forest habitat
Pacific fisher *(Martes pennanti pacifica)*	FSS, FSC, CSSC	High quality habitat has >70% cc; moderate habitat 41-70% cc. Habitat should also have a high number of or large snags and down logs, close proximity to dense riparian corridors for movement, and an interspersion of small (<1 acre) openings with good ground cover for foraging. Potential occupied elevation 3,500-8,000 ft.	Present. Suitable habitat and recent surveys indicate occurrence in black oak woodland and mixed conifer over most of the Monument area. Generally found below deep snow zone	Yes in FEIS with old forest habitat
Hardhead *(Mylopharodon conocephalus)*	FSS, CSSC	Warm water rivers at low elevation	Present	No. Not likely to affect. Covered under watershed section
Volcano Creek (California) golden trout *(Oncorhynchus mykiss aguabonita)*	FSS, FSC, CSSC	Kern Plateau, cold water streams	May be present as introduced species. Native population limited to SF Kern Drainage	No outside range.
Foothill yellow-legged frog *(Rana boylii)*	FSS, FSC, CSSC	Low gradient streams and ponds generally below 6,000'	No current known populations, within historic habitat.	Yes in BE, habitat quality covered in watershed section.
Mountain yellow-legged frog *(Rana muscosa)*	FSS, FSC, CSSC	4,500-12,000' aquatic habitats	Present in wilderness and historic occurrence over most of the Forest	Yes in BE, habitat quality covered in watershed section.
California spotted owl (*Strix occidentalis occidentalis*)	FSS, CSSC	Nesting habitat contains >70% canopy closure; foraging habitat >40% cc. In general, preference is shown for stands with ≥2 layers, but open enough to allow for observations and flying space to attack prey. Substantial amounts of dead woody debris are desirable.	Present.	Yes, addressed in BE and FEIS

Common Name (Scientific Name)	Listing Status	Habitat Requirements	Potential for Occurrence in Monument	Addressed in Plan (Monument)
Great gray owl (*Strix nebulosa*)	FSS, FSC, SE	Large meadows & openings 2,500 – 9,000'. Dense forest and large snags for nest area	Present at several locations. No breeding status known.	Yes, addressed in BE low potential for effects.
Sierra Nevada red fox (*Vulpes vulpes necator*)	FSS, FSC, ST	Appears to prefer red fir and lodgepole forests in sub alpine and alpine zone. Forages in meadows & riparian zones. Mostly above 7,000'	Low, no confirmed historical reports in area. Suitable habitat exists	No, habitat addressed as part of old forest.
Sierra night lizard (*Xantusia vigilis sierrae*)	FS	Annual grasslands near Granite Station	Low. Not known outside of limited range near Granite station several miles from Forest boundary	No outside known range.

c) Threatened, Endangered, and Proposed for Listing Species

(1) California Condor (USFWS Endangered)

The California condor's historic range included foraging and reproduction with the Sequoia National Forest (USFWS, 1996b). At present, breeding in the wild population is limited to a few individuals. Breeding on the Sequoia National Forest is not anticipated for several years. Close monitoring by the Fish and Wildlife Service is used to evaluate this potential on a yearly basis.

The California condor was listed by the USFWS as a federal endangered species in 1967. Specific causes contributing to the decline of the condor over the last several decades have included incidental shootings, lead poisoning, egg collecting, collisions with power lines or other obstacles, and various forms of poisoning (DDT, cyanide, strychnine, compound 1080, antifreeze from car radiators). A recovery plan was developed for the condor in 1984 and last revised in April 1996.

Both designated critical habitat and habitat identified as essential to recovery occur on the Sequoia National Forest (USFWS, 1984a). The Sequoia National Forest also identified approximately 1,000 acres in the Starvation Grove Condor Nest Management Plan, and nineteen potential giant sequoia nest trees. These areas all receive special management consideration for the protection of current and potential condor use. These designations are retained where they occur within the Monument.

Critical habitat designated for the condor by the U.S. Fish and Wildlife Service includes the area from Blue Ridge south to Springville and the Kern County foothills west of the national forest boundary near Glennville. The Blue Ridge

critical habitat includes approximately 120 acres within the national forest at Lumreau Mountain. Essential habitat has no legal status but is managed under the 1984 Condor Recovery Plan as if listed critical habitat. Essential habitat includes roost areas near Basket Pass, Breckenridge, and Lyon Ridge (mostly outside of the Monument). The 1996 Recovery Plan does not address essential habitat (USFWS, 1996b) however the Forest has designated these areas for special management compatible with condor recovery objectives under the 1988 Forest Plan.

In 1987, all known wild condors were taken into captivity to facilitate breeding. In 1992, the first two re-introductions occurred on the Los Padres National Forest. In recent years, condors have frequented the rangelands west of the Sequoia National Forest and roosted at night on the forest.

Critical periods for this species are associated with nesting activities. Nest selection, egg laying, and rearing young can start as early as January with the fledgin in October or November (USDA, 1986). Roosting may also take place at the nest site even when there is no nesting activity (USFWS, 1984). Although roosting birds are less susceptible to disturbance, activities that may disturb roosting sites may be restricted within ½-mile or more, depending on the type of activity (USFWS, 1996b).

Factors influencing the choice of nest sites by condors are poorly understood. The appearance of many nest sites suggests that they have been in long use, perhaps for centuries, whereas other apparently suitable sites in undisturbed areas show no signs of condor use. Condors have nested in giant sequoias near or within the Sequoia National Forest in two documented cases.

If condors nest or are actively searching for nest sites in the vicinity of the Starvation Grove Nest Management Area, or any other area on the Sequoia National Forest, there will be a seasonal suspension of travel on Roads 23S29, 23S03C, and 23S68, as well as any other roads that travel in the vicinity of nest sites where nesting attempts are made (USDA, 1986). A permanent suspension of public vehicle traffic on Road 23S64 will be maintained by Forest Supervisor Order. Permits and contracts within the nest management area contain clauses that provide for immediate cessation of all activities when condors are using the nest management area. Forest Supervisor Order will implement area closures. The area closure includes all of the nest management area except that portion west of County Road H-50 to the watershed divide (USDA Forest Service, 1984). The limited operating period for this species for all activities within ½-mile of the nest site is January 1 to June 30 (USDA Forest Service, 1990).

(2) Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle was federally listed as threatened on August 8, 1980 (Federal Register, 45:52807; USFWS, 1991). Critical habitat has been designated, but is not located on national forest system lands. Threats to

this species include urbanization, insecticides, herbicides, and fluctuations in stream water levels (Steinhart, 1990). Streamside woodlands have been largely developed or converted to agricultural uses, eliminating most of the elderberry (Sambucus spp.) necessary for the beetles' survival. Headwater disturbances that result in downstream flooding or mudslides could result in the destruction of elderberry plants (USFS, 1993d). Grazing on Sambucus by domestic or wild herbivores as well as human pruning or burning of the plants may be a concern (Barr, 1991).

The species range in California consists of patchy distribution from as high as 3,000 feet from Redding south to Bakersfield, and the western Sierra Nevada foothills to the eastern Coast Range foothills. Surveys on the Sequoia National Forest have been limited. Possible exit holes for this beetle have been found in the Kern Canyon, in the Tule River drainage, and at Pine Flat Reservoir on the Kings River. No presence has been confirmed for this species.

Habitat consists of elderberry shrubs and trees in a variety of habitats and plant communities, but most often in elderberry-dominated riparian areas or moist valley oak woodlands. Elderberry shoots generally must be at least one inch in diameter at the base to support the beetle. Suitable habitat and elderberries are widely distributed across the Monument. Although elderberries are found at higher elevations, the valley elderberry longhorn beetle appears to be limited to the chaparral belt below 3,000 feet in elevation.

(3) Little Kern Golden Trout

Approximately 4,500 acres of Little Kern golden trout critical habitat are found within the Monument. The potential for programmatic effect on the species or critical habitat is low and this species is not addressed under environmental consequences. Individual projects such as road closure and obliteration, light underburning, or thinning might have a beneficial effect but are not specifically proposed in this FEIS. Analysis of effects is deferred to site-specific project analyses.

d) Forest Service Sensitive

The following summarizes the biological evaluation prepared for the programmatic effects of the Monument management plan. Species with a high potential for conflict or public controversy are addressed here. Where there was low potential for effect and low public controversy regarding management, species were addressed in the biological evaluation but not carried forward into the FEIS.

(1) California Spotted Owl (Forest Service Sensitive, USFWS Species of Concern)

There are 72 spotted owl territories located on the three ranger districts that encompass the Monument. Surveys for the California spotted owl have been conducted by Sequoia National Forest personnel and consulting biologists in accordance with Forest Service Region 5 protocol over most of the Monument from 1974 through 2002.

Nesting activities commence in March, depending on elevation. Egg laying and incubation occur in May and June. Young are usually fledged in late July and early August (USDA, 1993).

Nesting habitat is characterized by dense canopy closure (greater than 70 percent) with medium to large trees, and usually at least two canopy layers are present. In addition, nest stands have large snags and an accumulation of logs and limbs on the ground (USDA, 1993). Foraging habitat includes all medium to large tree stands with 50 percent or greater canopy closure. Proportion of the watershed or landscape in suitable habitat (greater than 50% canopy closure) appears to be important to northern spotted owl and is presumed to be important to California spotted owl as well. Northern spotted owl show declines when less than 80% of the landscape is suitable and appear to reach a critical threshold between 30% and 50% suitable habitat in the landscape (Bart, 1995). Hunsaker et al. 2002 reported sites that consistently produced young had a median proportion of 60 percent of their analysis area (1000-acre circles around the nest) in 50 percent canopy cover or greater (moderate to high density canopy cover). Neither study indicates an absolute threshold. In the Hunsaker study, half the consistently reproducing owls had less than 60% of the analysis area in 50% or greater canopy cover. However, it may be used as a potential indicator of habitat quality.

The California Spotted owl Technical Report (Verner et al, 1992) gave tentative estimates for suitable spotted owl nesting and foraging habitat in Sierran mixed conifer forests that include canopy cover of 70 to 95%, tree live basal area of 185 to 350 square feet per acre, snag basal area of 30 to 55 square feet per acre, and down woody debris (> 12”) at 10 to 15 tons per acre for nesting habitat and 50 to 90% cover, 180 to 220 square feet per acre, 15 to 30 square feet per acre, and 10 to 15 tons per acre, respectively, for foraging habitat.

Stand-replacing or catastrophic wildfire has been identified as one of the major threats to the spotted owl and its habitat. Approximately 23 spotted owl territories on the Sequoia National Forest have suffered substantial loss of habitat due to wildfire since 1980. Substantial unsurveyed but likely suitable habitat was also lost during large, stand-replacing fires on the Sequoia National Forest between 1970 and 1980. Most of these territories and habitats, including

one other territory affected by drought-related mortality of trees, do not support viable breeding territories.

Demographic studies (5) within the range of the California Spotted Owl have been ongoing for a number of years. One of the primary objectives of these studies is to monitor fluctuations or rate of change (lambda) in owl populations. There has been considerable debate over the most appropriate measure of the finite rate of population change in spotted owl populations and actual census or direct population measurement does not support the modeled rates of decline.

There are varying differences in lambda between study areas and between analysis methods. In general, past analysis has indicated a declining trend in populations. Franklin, et al. 2003 conducted a meta-analysis of data (including the most recent information) collected under the demographic studies noted above. The analysis uses different analytical methodologies that may eliminate some potential bias associated with earlier studies. The new analysis does not show the statistically significant decline in owl populations in the study areas that previous research indicated. It shows evidence of one apparently stable population (Sequoia and Kings Canyon National Parks), and the rest with an estimated finite rate of population change (lambda) of less than 1 (potential decline) but also includes a lambda value of 1 (stable population) within a 95 percent confidence interval. The analysis shows adult survivorship rates still indicate concern for population stability.

The Fish and Wildlife Service was petitioned to list the California spotted owl under the Endangered Species Act. The Fish and Wildlife Service reviewed the available science and commercial information available and found the petitioned action was not warranted. The finding statement acknowledged the Framework ROD and associated California spotted owl strategy as management direction being implemented across the Sierra Nevada in determining that there were adequate regulatory mechanisms to protect the owl. The findings did recognize two factors that may affect the determination. The first is a management review of the Framework; the second is implementation of an administrative study on the Lassen and Plumas National Forests to evaluate the effects of extensive fuels treatment on the California spotted owl (67 FR 72136). The Fish and Wildlife Service will monitor development of management direction, offer scientific assistance, and review effects at a later date, if necessary (USFWS, 68 FR 7604).

(2) Northern Goshawk (Forest Service Sensitive, USFWS Species of Concern)

There are 12 goshawk territories identified within the Monument. Biologists have conducted intermittent surveys for nesting goshawks in relation to projects or based on reported sightings for at least two decades in portions of the Monument. The location of the exact nests each year is unknown, as goshawks

use alternate nest sites. Protected activity centers have been established for these territories.

Preferred habitat consists of older-age coniferous, mixed, and deciduous forest habitat. Habitat also consists of large trees for nesting, a closed canopy for protection and thermal cover, and open spaces allowing maneuverability below the canopy (Hargis, et al, 1991). Snags, downed logs, and high canopy cover are critical habitat features. The former two are also an important component used by numerous prey species. Many of the species that provide the prey base for goshawks are associated with open stands of trees or natural openings containing an understory of native shrubs and grass (Fowler, 1988).

Northern goshawk nesting habitat is characterized by dense canopy closure (50 to 90 percent) with mature timber. Nest trees for this species are commonly located on benches or basins surrounded by much steeper slopes (Hargis, et al, 1991). Mature trees serve as nest and perch sites, while plucking posts are frequently located in denser portions of the secondary canopy. The same nest may be used for several seasons, but alternate nests are common within a single territory. The chronology of nesting activity varies annually and by elevation. In general, nesting activities are initiated in February. Nest construction, egg laying, and incubation occur through May and June. Young birds hatch and begin fledging in late June and early July. They are independent by mid-September (USDA, 1992c).

(3) Great Gray Owl (Forest Service Sensitive, California State Endangered)

The CDFG's California Natural Diversity Database records several gray owl detections within the Monument. Many large meadows contain suitable habitat for great gray owls. Protocol surveys in 2001 and 2002 did not detect presence and no nest stands have been found to date. Informal surveys through 2002 and anecdotal information indicate great gray owls are still present at several locations within the Monument.

Preferred habitat consists of mixed coniferous and hardwood forests, usually bordering small openings or meadows (USDA, 2001b). Optimal habitat consists of semi-open areas near dense coniferous forests, which the owls use for roosting and nesting. Breeding great gray owls are typically found between 4,000 and 8,000 feet elevation, but breeding has been documented as low as 2,500 feet in the Sierra Nevada. Courtship and nest site selection occur during late winter. Most nests are in broken-top snags, generally greater than 21 inches diameter and 20 feet tall (Winter, 1986). Nests are also found in debris platforms from dwarf mistletoe or in old stick nests of other raptors. Nests are generally located within 1,000 feet of the edges of wet meadows that range in size from 15 to 250 acres. Preferred canopy closure is greater than 70 percent, although owls use habitat with canopy closure as low as 40 percent (Zeiner et al, 1990).

The owls prey primarily on voles and pocket gophers throughout the year (Zeiner et al, 1990). High prey density, perch availability, and relatively open forest canopies have been identified as important factors in foraging habitats (Greene, 1995. In winter, the owls hunt in early morning and from late afternoon to dusk. During the breeding season, they hunt throughout the day and night. Great gray owls hunt by perching 2 to 20 feet high at the edges of meadows or grasslands and listening for prey in grass runways or underground burrows. The owls fly low over the ground and drop on their prey (Winter, 1981).

(4) California Wolverine (Forest Service Sensitive)

The wolverine occupies a variety of habitats, including mixed conifer, red fir, lodgepole pine, wet meadow, and montane riparian habitats, as well as alpine dwarf-shrub, montane chaparral, and Jeffrey pine. Wolverines prefer areas with low human disturbance (Zeiner et al, 1990).

In summer, wolverines are typically opportunistic omnivores. Small mammals, such as marmots and ground squirrels, are the principal prey items. Carrion is an important component of the wolverine's diet. In winter, wolverines are primarily scavengers, often feeding on large animal carrion such as deer, but will also prey on snowbound live prey (Ruggiero, et al, 1994).

Wolverines are primarily nocturnal but diurnal movements have been recorded. During the summer, long distance movements occur at night when temperatures are cooler (Hornocker and Hash, 1976). Studies indicate that wolverines have large home ranges, anywhere from 38 to 347 square miles; males have larger territories than females. Because of these factors, wolverines are rarely seen. Wolverines may move great distances on a daily basis; 15 to 30 miles a day is common for males, and some individuals have moved 60 to 70 miles in a single day (Ruggiero, et al, 1994).

The historic range of wolverines in California included much of the Sierra Nevada (Schempf and White, 1977). However, as a result of increased human activities, wolverines are believed to have become isolated within the Sierra Nevada ecoprovince of California. The known distribution is from Del Norte and Trinity Counties east through Siskiyou and Shasta Counties, and south through the Sierra Nevada to Tulare County. Most observations have been recorded between 4,300 and 7,300 feet in the northern Sierra Nevada, while in the southern Sierra Nevada sightings have been recorded between 3,900 and 10,800 feet (Zeiner et al, 1990).

The California wolverine has historically occupied the Sierra Nevada at low population densities and the current distribution is poorly known (Zeiner et al, 1990). Remote-camera surveys conducted in 1993 throughout much of the Sierra Nevada did not detect any wolverines. Fifteen historical sightings of wolverines have been reported on the Sequoia National Forest dating from 1909

to 1988. These sightings were all in the Monument or in the adjacent national park.

(5) Marten (Forest Service Sensitive)

At a regional level, martens are affected by climate, land use patterns, and metapopulation dynamics (Zielinski et al, 1997). On a landscape scale, patches of preferred habitat and the distribution of open areas with respect to these patches may be critical to the distribution and abundance of martens (Buskirk and Powell, 1994). Marten use diminishes in landscapes with greater than 25 percent of the area in openings (less than 30% canopy cover), even where suitable habitat connectivity exists (Chapin et al, 1998; Hargis et al, 1999; Potvin et al, 2000). Although some researchers have found marten in habitats with up to 50% openings (Steventon, 1982), it is suggested that such conditions are anomalies. Martens prefer coniferous forest habitat with large diameter trees and snags, large down logs, moderate-to-high canopy closure, and interspersed riparian areas and meadows. Important habitat attributes are: vegetative diversity, with predominately mature forest; snags; dispersal cover; and large woody debris (Allen, 1987). Martens selected stands with 40 to 60 percent canopy closure for both resting and foraging and use stands with less than 30 percent canopy closure less than expected (Spencer et al, 1983).

Various studies in the Sierra indicate that martens have a strong preference for forest meadow edges, and riparian forests appear to be important foraging habitats (Spencer et al, 1983; Martin, 1987). It appears that the key to forest carnivore habitat quality is the structural diversity of forest vegetation (Allen, 1987). Small open areas and regenerating stands (or plantations) are used by marten as foraging habitat, but these openings are of optimum value when they occupy a small percent of the landscape and occur adjacent to mature forest stands meeting requirements for denning or resting habitat. It is suggested that small dispersed tree harvest units within a forested matrix should have less impact on marten populations than large contiguous clearcuts and, in some instances, may prove beneficial (Thompson and Harestad, 1994). Self and Kerns (2001) found that although marten rest sites were consistently associated with relatively high canopy closure, a substantial number of rest sites were surrounded by relatively open stands. This indicated that marten in the study area are using relatively open forest stands where canopy closure, down woody material, and snags were clumpy in nature rather than homogenous over the stand.

Marten natal dens are typically found in cavities in large trees, snags, stumps, logs, burrows, caves, rocks, or crevices in rocky areas. The dens are lined with vegetation and occur in structurally complex, late successional forests (Buskirk and Ruggiero, 1994). Canopy cover and the number of large old trees in these patches exceed levels available in the surrounding suitable habitat. The availability of habitat suitable for natal dens may limit reproductive success and

population recruitment; this has direct repercussions on future population size (Buskirk and Ruggiero, 1994).

The Framework FEIS suggests that establishment of a buffer, equivalent to approximately 10% of an average marten home range (100 acres), at verified marten den sites provides protection for important habitat used by reproductive females. None of the known marten den sites in the Monument have been reused, but it is assumed that new dens have been selected within the general area (Zielinski et al, 1977) and maintenance of a buffer would provide protection. Mean female territory is 178 acres and mean male home range is 544 acres for the Sequoia National Forest study (Zielinski et al, 1997); however, these territory sizes are smaller than reported in other locations.

Marten diet in the Sierra Nevada changes seasonally but is predominately microtine rodents, tree squirrels, snowshoe hares, and – especially in the summer – ground squirrels (Zielinski et al, 1983; Martin, 1987). If one item were to be singled out as critical to the diet of martens in the Sierra, it would be voles, which contribute to the diet to varying degrees during all seasons of the year (Zielinski et al, 1983). The Douglas squirrel is very important prey in the winter, whereas ground-dwelling sciurids occur exclusively in the diet during the snow-free period of the year.

The marten occurs from the southern Rockies in New Mexico northward to the tree line in Canada and Alaska, and from the southern Sierra Nevada eastward to Newfoundland in Canada. In Canada and Alaska, martens have a vast and continuous distribution. In the contiguous western United States, martens are limited to mountain ranges within a narrow band of coniferous forest habitats (Buskirk and Ruggiero, 1994). In California, the marten was historically distributed throughout the Sierra Nevada, California Cascades, and the Coast ranges, from the Oregon border southward to Sonoma County. Martens are currently distributed throughout the Sierra Nevada and Cascades (Buskirk and Zielinski, 1997). The species' core elevation range is from 5,500 to 10,000 feet, and they are most often found in the Sierra Nevada above 7,200 feet. The bulk of the marten's Sierra Nevada and southern Cascade (in California) distribution occurs on national forest lands. Verified marten detections (either by track or photo) exist for all Sierra Nevada national forests, although negative survey results occurred at numerous locations in central Plumas and southern Tulare Counties (Kucera et al, 1995).

In most western States and Canadian Provinces where it occurs, the marten is managed as a furbearer (Buskirk and Ruggiero, 1994). Although the marten is classified as a furbearer in California, there has been no open trapping season for marten in California since 1954. Cessation of trapping coincided with a period when timber harvest and human population in California were dramatically increasing (Zielinski et al, 1997). Marten distribution in North America has undergone regional contractions and expansions (Buskirk and Ruggiero, 1994). Recent studies and sightings indicate that martens are relatively well distributed

in a pattern similar to their historical distribution in the Sierra Nevada (Kucera et al, 1995). The decline in marten population size and range during the early part of the twentieth century has been attributed to habitat modifications, with trapping and predator control as contributing factors (Bennett and Samson, 1984). Three factors make martens vulnerable to local extirpation and extinction: (1) low reproductive potential; (2) an affinity for overhead cover and avoidance of extensive open areas, especially in winter; and (3) very large home ranges. Although marten are wide-ranging carnivores and likely occur in suitable habitats across the Sierra Nevada, martens are considered rare compared to many other species of mid-sized carnivores. Empirical population estimates are not available for marten in California.

Risks to marten habitat under Forest Service control include those activities that cause the removal of overhead cover, removal of large diameter trees and coarse woody debris, and the conversion of mesic to xeric sites with associated changes in prey communities (Campbell, 1979). Although overhead cover is regenerated via successional processes in the ecosystem, the removal of coarse woody debris can only be ameliorated by artificial additions to the system or by the growth and decadence of new large diameter trees (Buskirk and Ruggiero, 1994).

(6) Fisher (Forest Service Sensitive)

Zielinski et al (in prep) found fisher home ranges selected for higher canopy closure than the surrounding area, averaging 66% in canopy closure greater than 60% (ranging from 53 to 84% total, 40 to 71% for males, and 61 to 81% for females), but percent of the landscape in 60% canopy closure at the watershed scale was less. Analysis for the Monument indicates that 51% of watersheds with fisher habitat meets the 60% canopy closure guideline. Mazzoni et al (2002) noted fisher home ranges in the Kings River Demonstration Project averaged 43% of the area with 60% canopy cover and 47% of the area when hardwoods were added to the calculation of cover class. Self & Kerns (2002) indicated that fisher in northwest California selected areas with canopy closure greater than 60% for rest sites over 60% of the time but that the study area had only 50% of the area in canopy closure greater than 40%. Self and Kerns (2002) noted that rest sites were selected for high canopy closure (generally over 60%) but they were often 0.1 to 2-acre clumps within a stands with 25 to 40% canopy closure.

Truex (2002) noted that models based on canopy closure, large trees, and other habitat elements accurately described use of habitat by the Tule River subpopulation. Habitat use by fisher on the Sierra National Forest was significantly below predicted levels based on habitat modeling. Since initial survey efforts in the early 1990s met with little success while more current survey efforts have shown greater success, there is some speculation that the Sequoia National Forest population is a source for northward dispersion. This is somewhat supported by lower success or detection rates despite suitable habitat along a northward gradient through the Sierra National Forest. Habitat modeling

on the Kern Plateau underestimated population density in an area with drier, more open habitat. Self and Kerns also showed greater habitat use than would be predicted in open habitats where legacy elements and patches of dense habitat provided suitable rest sites.

Both Zielinski et al (in prep) and Self and Kerns (2002) noted a high use of stands in the intermediate size class (CWHR 4) but, in each study, the trees actually used were among the largest available and often had higher density of vegetation than the surrounding area.

Preferred habitat for fisher includes extensive, continuous canopies, such as dense lowland forests, or mature to old-growth spruce-fir forests with high canopy closure. Fishers use greater percentages of mid to early seral stages for foraging in summer months, but still appear to need and use mature or old growth stands for denning, especially in areas with high snowfall.

Suitable fisher habitat is thought to occur at elevations ranging from 4,000 to 8,000 feet. Recent studies of fisher and marten support past assumptions that fishers are found at lower elevations than martens (Zielinski, et al, 1997). Fisher appear to be restricted by soft thick snow cover and seek out areas with relatively low snow accumulation, and sightings of fisher at high elevations appear to be confined to east slopes where the snow is less deep (Krohn et al, 1997; Ruggiero et al, 1994; Raine, 1981).

Sequoia National Forest wildlife biologists have conducted extensive fisher and marten surveys as part of a research project, and many occurrences of fisher have been documented in the project area since 1991 using track plates and camera stations. Since marten and fishers have been located with these camera stations and all suitable habitat that has been surveyed is occupied by marten or fisher, it must be assumed that all unsurveyed suitable habitat in the Monument will be occupied by marten or fisher (Anderson, 2001, personal communication).

Zielinski et al 1997 and Self and Kerns 2002 indicate that shrub and small tree cover may be very important to fisher in use of a wide variety of habitats.

The fisher is among the most habitat-specific mammals in North America and changes in the quality, quantity, and distribution of available habitat can affect their range in California (Buskirk and Powell, 1994). Forest type is probably not as important to fishers as the vegetative and structural aspects that lead to abundant prey populations and reduce fisher vulnerability to predation (Powell, 1993). In general, fishers use forest or woodland landscape mosaics that include conifer-dominated stands, and avoid entering open areas that have no overstory or shrub cover (Buskirk and Powell, 1994). They select forests that have low and closed canopies. Late-successional coniferous or mixed forests provide the most suitable fisher habitat because they provide abundant potential den sites and preferred prey species (Allen, 1987). Fishers use large areas of primarily coniferous forests with fairly dense canopies and large trees, snags, and down

logs. A vegetated understory and large woody debris appear important for their prey species. The following California Wildlife Habitat Relationships (CWHR) types are important to fishers: generally structure classes 4M, 4D, 5M, 5D and 6 (stands with trees 11 inches in diameter or greater and with greater than 40% cover) in ponderosa pine, montane hardwood-conifer, mixed conifer, montane riparian, aspen, red fir, Jeffrey pine, lodgepole pine, subalpine conifer, and eastside pine (Timossi, 1990).

At a landscape scale, patches of preferred habitat and the location of open areas with respect to these patches may be critical to the distribution and abundance of fishers in an area (Buskirk and Powell, 1994). Fishers will probably use patches of preferred habitat that are interconnected by other forest types, whereas they will not likely use patches of habitat that are separated by sufficiently large open areas (Buskirk and Powell, 1994). Riparian corridors (Heinemeyer and Jones, 1994) and forested saddles between major drainages (Buck, 1983) may provide important dispersal habitat or landscape linkages for the species. Riparian areas are important to fishers because they provide important rest site elements, such as broken tops, snags, and coarse woody debris (Seglund, 1995). Powell and Zielinski (1994) suggested that habitat suitable for resting and denning sites may be more limiting and that these habitats should be given more weight than foraging habitats when planning habitat management.

Rest site structures used by fishers include hollow logs, tree cavities, rocks, snags, ground burrows, fallen trees, canopies of live trees (commonly in witches brooms), and slash and brush piles (Heinemeyer and Jones, 1994). In California, trees are the most commonly used rest sites. Buck (1983) reported that rest site trees were greater than 25 feet tall, with diameters of 19 to 67 inches. In the southern Sierra Nevada, oak and white fir were the tree species most frequently used for resting (Truex et al, 1998). Down logs greater than 30-inch maximum diameter accounted for approximately 85 percent of all logs used as rest sites (Truex et al, 1998), indicating the importance of large woody debris in the forest habitat.

Kits are born most commonly in tree cavities at heights of greater than 20 feet, while maternal dens, where kits are raised, may be in cavities closer to the ground so active kits can avoid injury in the event of a fall from the den (Lewis and Stinson 1998). Most natal and maternal dens are in large conifers (white fir in southern Sierra, Douglas fir in Eastern Klamath) or oaks (black oak in southern Sierra), which may be live or in snag form (Truex et al, 1998).

Only eight fisher natal and maternal dens are known in the Sierra Nevada, representing four female territories. None of the den sites have been reused. The Framework suggests that protection of these reproductive sites is essential to prevent degradation of habitats used by reproductive females and to minimize disturbance of females during the reproductive period. Since research that resulted in the detection of the dens was limited to areas with relatively easy

access, all of the den sites are in close proximity to wildland urban interface. There is concern that this approach focuses protection efforts on structures that are not reused, in areas of high potential conflict where fisher are most exposed to human disturbance and potential for diseases from domesticated pets. Attention on known den sites may distract from management or protection in more remote and potentially higher value habitats for fisher.

It was decided to carry the den protection through to Monument management since they do afford a measure of protection to the few known reproductive areas. In the absence of empirical data on female microhabitat use, an area equivalent to approximately 10% of the average home range or 700 acres was estimated to be adequate to protect these important areas. This corresponds to the mean male home range of 6,808 acres. The mean female home range is 1,245 acres (Zielinski et al, 1997).

While protection of den sites is essential, it is important to note that location of den sites is difficult and time-consuming. Surveys for site-specific projects are unlikely to locate new den sites. Radio-collared females monitored as part of demographic studies would yield the best information on the location of natal and maternal dens and microhabitat use. In lieu of demographic studies, larger, home range sized areas could be established around detection locations. Detection locations likely represent a location used by the individual within the home range so, by protecting a large area around the detection, one is likely to protect habitat used by fishers.

The presence of large conifers and hardwoods is a highly significant predictor of fisher occurrence (Carroll et al, 1999). There are two possible reasons for the importance of large hardwoods to fishers: (1) cavities, which are frequently used as resting and denning sites, are more common in hardwoods than in conifers; and (2) large hardwoods produce mast (acorns), which may in turn stimulate higher prey densities (Powell and Zielinski, 1994). Density of overhead cover is another predictor of fisher occurrence (Carroll et al, 1999). Landscapes with high levels of overhead cover may protect fishers from predation, reduce the amount of energy fishers expend when traveling between foraging sites, provide more favorable microclimates, and increase prey numbers or prey vulnerability (Buskirk and Powell, 1994; Powell and Zielinski, 1994). Fishers also use habitat where shrubs contribute to overhead canopy (Buck et al, 1994; Dark, 1997; Seglund, 1995). Roads may affect fisher distribution; areas with more roads may have increased fisher mortality due to road kill (Heinemeyer and Jones, 1994). In addition, roads are associated with habitat alteration and fragmentation, and roads provide access for trappers who target other species, but might incidentally trap a fisher (Carroll et al, 1999).

Fishers in the Sierra Nevada currently appear to occupy less than half of their historic range (Zielinski et al, 1997). Recent surveys indicate that fisher are absent from their former range for a distance of almost 240 miles in the central and northern Sierra, from Yosemite National Park northward (Zielinski et al,

1995). This gap in distribution may be effectively isolating the existing southern Sierra Nevada population in the Sequoia National Forest and a portion of the Sierra National Forest, from the remainder of the fisher's range in California, Oregon, and Washington.

Fisher populations are presently at low numbers, or absent throughout most of their historic range in Montana, Idaho, Washington, Oregon, and California (Heinemeyer and Jones, 1994). In recent decades, a scarcity of sightings in Washington, Oregon, and the northern Sierra Nevada may indicate fisher extirpation from much of this area (Aubry and Raley, 1999, Carroll et al, 1999; Zielinski et al, 1996). The Sierra Nevada and northwestern California populations may be the only naturally-occurring, known breeding populations of fishers in the Pacific region from southern British Columbia to California (Zielinski et al, 1997). Moreover, mortality rates of adult female fishers in the southern Sierra population appear to be high (Truex et al, 1998). No empirical population estimates are available for California, but fishers are considered rare. Because fishers occur at lower elevations than martens, they are more likely to be directly affected by human activities The Fish and Wildlife Service was petitioned to list the fisher under the Endangered Species Act in 1990 and 1994. In both cases, the Fish and Wildlife Service reported that there was insufficient information to make a determination. A third petition was submitted to the Fish and Wildlife Service on November 27, 2000. A preliminary finding indicated that listing of the fisher may be warranted and the Fish and Wildlife Service has begun a 12-month fact finding period to determine whether to list fisher.

(7) Foothill yellow-legged frog (Forest Service Sensitive)

The foothill yellow-legged frog has drastically declined. Two populations are known within the southern Sierra Nevada. There is one population on the Kern Plateau east of the Monument and one known on the Sierra National Forest 20 to 30 miles north of the Monument.

The foothill yellow-legged frog has been found primarily within shallow channels with riffles that have at least cobble-sized substrate. Streams and rivers with this species include those with both permanent and intermittent flows, low gradient and high gradient greater than four percent, alluvial and bedrock channels. The species is also occasionally found in other riparian habitats including moderately vegetated backwaters, isolated pools and slow moving rivers with mud substrates.

The ability to withstand and recover from disturbance is crucial for any organism living in the highly variable environment of a river. The life history strategy of the foothill yellow-legged frog has been shaped by the wet winters and dry summers typical of the Mediterranean climate in the Sierra Nevada. To avoid disturbance of its most vulnerable life stages (eggs and larvae), breeding is timed late enough in the spring to avoid extreme discharge fluctuation. However breeding must occur early enough to allow tadpoles sufficient time to metamorphose and

juveniles time to grow, before the onset of the next wet season. Breeding sites are not continuously distributed along the streams and rivers occupied by this species as the frogs select channels with particular morphological traits. Understanding that the frogs are concentrated in both time and space during breeding is critical to their conservation. The potential loss of adults and recruits due to any number of risk factors (dam releases, all terrain vehicles, mining, grazing, etc.) during breeding would be much worse than losses caused by the same activities at times of the year when frogs and tadpoles are more widely dispersed.

Previous literature reports breeding to occur from late March through May, with egg deposition for any single population being concentrated to a two-week period. More recent reports indicate that breeding activity can be spread over several weeks in the Coast Range and up to 31 days in the Sierra Nevada. Duration of the breeding season appears to be determined by weather. In cold rainy springs, the breeding season is longer than in dry warm springs.

Egg masses usually contain about 900 eggs, but the number of eggs can range from 100 to over 1,000 per mass. For survival to hatching, eggs must remain inundated and attached to substrates despite falling and/or rising water levels. In wide shallow channels, stage height and near bank velocities are less sensitive to changes in discharge than in deeper more confined channels. Breeding sites with greater than average success to hatching have significantly greater width to depth ratios than channels where hatching success is low.

In the Coast Range, adults are frequently seen when congregated at breeding sites in April, May, and June. Later in the summer adults are scarcely observed along the main stems of larger rivers (the Trinity and Eel Rivers). This may indicate movement into the vegetation, movement into tributaries, or reduced diurnal activity.

The foothill yellow-legged frog is listed as a sensitive species on the Region 5 Regional Forester's Sensitive Species List. In addition, the frog is a California Species of Special Concern. Jennings and Hayes recommend endangered status in southern and central California south of the Salinas River, Monterey County, and threatened status in the "west slope drainages of the Sierra Nevada and southern Cascade Mountains east of the Sacramento-San Joaquin River axis." In the Coast Range north of the Salinas River, the foothill yellow-legged frog stills occurs in significant numbers in some coastal drainages but is also at risk due to anthropogenic and environmental threats.

This species is highly aquatic and is rarely found away from the immediate riparian area. As such the risk as a result of programmatic direction in this document is limited.

(8) Mountain yellow-legged frog (Forest Service Sensitive and California Species of Special Concern)

This information was compiled and summarized from the Draft Conservation Assessment and Strategy for the Mountain Yellow-Legged Frog (*Rana muscosa*).

In the 12-month finding for a petition to list the mountain yellow-legged frog (USDI, 2003), the U.S. Fish and Wildlife Service concluded that the Sierra Nevada population of the mountain yellow-legged frog is discrete from the southern California population, on the basis of their geographic separation, differences in vocalization, differences between their habitats, and apparent genetic differences. They also concluded that the Sierra Nevada population of the mountain yellow-legged frog is significant because the loss of the species from the Sierra Nevada would result in a significant reduction in the species' range and population numbers. This would constitute loss of a genetically discrete population that differs markedly from the southern California population of mountain yellow-legged frogs. The Fish and Wildlife Service consider the Sierra Nevada mountain yellow-legged frog to be a distinct population segment. Listing was warranted but precluded by other listings with a higher priority.

Mountain yellow-legged frogs were found historically over much of the Sequoia National Forest. They are limited to a few known and isolated populations in the Golden Trout Wilderness, Kern Plateau, and the Sequoia and Kings Canyon National Parks.

Mountain yellow-legged frogs in the Sierra Nevada live in high mountain lakes, ponds, tarns, and streams - largely in areas that were glaciated as recently as 10,000 years ago. This species is usually associated with montane riparian habitats in lodgepole pine, yellow pine, sugar pine, white fir, whitebark pine, and wet meadow vegetation types.

Alpine lakes used by mountain yellow-legged frogs usually have margins that are grassy or muddy, but they are not limited to this habitat. Mountain yellow-legged frogs extensively utilize deep-water ponds (greater than 2.5 meters or 8.2 feet) that have open shorelines and lack introduced fishes. Adults are typically found sitting on rocks along the shoreline, usually where there is little or no vegetation. Both larvae and adults prefer open shorelines that gently slope up to shallow waters of 5 to 8 centimeters (2 to 3 inches) deep. Shallow water likely provides a refuge from predation if fish occur in adjacent deeper water. Mountain yellow-legged frogs also use stream habitats, especially in the northern part of their range.

Some of the highest observed densities of frogs have been found both at creek junctions with irregular banks and a variety of water depths, and in open areas

on the edges of glaciated lakes. Mountain yellow-legged frog populations seem to be most successful where predatory fish are absent.

In the Sierra Nevada, adult frogs apparently hibernate during the coldest winter months, probably because they can tolerate only limited dehydration. Larvae and adults generally overwinter under ice. Both adults and larvae have been found to overwinter (up to 9 months) in the bottoms of lakes (at least 1.7 meters or 5.6 feet deep, and preferably at least 2.5 meters or 8.2 feet deep), or in rocky streams. In some instances, frogs have been found to overwinter in bedrock crevices that allow them to survive in shallower water bodies that freeze to the bottom in winter. This activity may also be in response to the presence of introduced fishes that cannot survive in ponds that completely freeze.

Mountain yellow-legged frogs emerge from overwintering sites immediately following snowmelt. Adults sometimes travel over snow to reach preferred breeding sites early in the season. Breeding activity begins early in the spring and can range from April at lower elevations to June and July in higher elevations. The timing of the onset of breeding depends on the amount of snowfall and subsequent ice-out dates of ponds, lakes, and streams. In years with particularly cold winters, high elevation frog populations may only be active for approximately 90 days during the warmest part of the summer.

Life history characteristics, such as overwintering under frozen lakes and multi-year larval development, make the mountain yellow-legged frog susceptible to large-scale die-offs. In lakes less than four meters or 13 feet deep, overwintering frogs may die apparently due to oxygen depletion, while larvae are able to survive. Conversely, in dry years larvae are lost to desiccation in the late summer or fall.

The mountain yellow-legged frog was once extremely abundant in aquatic ecosystems of the Sierra Nevada. It was distributed nearly continuously in high elevation water bodies in the Sierra Nevada Mountains of California and Nevada, from southern Plumas County to southern Tulare County at elevations mostly above 1,820 meters (6,000 feet).

Since about 1970, mountain yellow-legged frog numbers and populations have undergone a precipitous decline throughout the Sierra Nevada. Further declines continue to be documented. Mountain yellow-legged frogs have disappeared from between 70 and 90 percent of their historic localities. Remaining populations are widely scattered and consist of few breeding adults.

Numerous factors, separately and in combination, have contributed to the species' decline. Introduction of non-native fish, pesticides, ultraviolet radiation, pathogens, acidification from atmospheric deposition, nitrate deposition, livestock grazing, recreational activities, and drought have all been identified as potential factors impacting this species and its habitat. Because many of the remaining populations of Sierra Nevada mountain yellow-legged frog are small

isolated remnants, they are vulnerable to random natural events that could quickly extirpate them. It is widely recognized that, in general, small populations are more vulnerable to extinction than large ones.

The distribution of the Sierra Nevada mountain yellow-legged frog is restricted primarily to publicly managed lands at high elevations, including streams, lakes, ponds, and meadow wetlands located on national forests, including wilderness and non-wilderness on the forests, and national parks. Approximately 210 known mountain yellow-legged frog populations (or populations within metapopulations) exist on the national forests within the Sierra Nevada, though not all of these populations may be reproducing successfully.

In 1999, a team of agency managers and researchers agreed that a mountain yellow-legged frog conservation assessment and strategy was needed to provide for protection and conservation of this species. The Forest Service Pacific Southwest Region Ecosystem Conservation Director and the State Director of the California Department of Fish and Game approved preparation of a mountain yellow-legged frog conservation assessment and strategy. In 2000, a working group of biologists from the Forest Service, National Park Service, U.S. Fish and Wildlife Service, and California Department of Fish and Game, as well as research scientists, was established to complete this effort.

On February 8, 2000, the Center for Biological Diversity and the Pacific Rivers Council petitioned the Fish and Wildlife Service to list the Sierra Nevada population of mountain yellow-legged frog as an endangered species. The Fish and Wildlife Service published a 90-day finding warranting the listing under the Endangered Species Act. On October 12, 2000, the Fish and Wildlife Service announced a 90-day finding on the petition to list the mountain yellow-legged frog as endangered (Federal Register, Vol. 65, No. 198). The Fish and Wildlife Service found that the petition presents substantial information indicating that listing the species may be warranted. The Fish and Wildlife Service twelve-month petition finding was completed on January 16, 2003. It concluded that the petitioned action is warranted, but precluded by higher priority actions to amend the lists of endangered and threatened wildlife and plants. Upon publication of this 12-month petition finding, this species will be added to the Fish and Wildlife Service candidate species list. A 2081 permit is required to handle or possess the mountain yellow-legged frog at any time.

The mountain yellow-legged frog is listed as Sensitive on the Region Five Regional Forester's Sensitive Species List. It is a State Species of Special Concern and Fish and Wildlife Service candidate for listing.

(9) Neotropical Migratory Birds.

Neotropical migratory birds breed in North America and migrate south of the continental U.S. during non-breeding seasons. These species are protected under the Migratory Bird Treaty Act based on their international importance. The

list of neotropical migratory birds within the California region is large and includes a broad number of habitat associations (USDA, 1994). The overall effect of management activities on neoptropical migrant species populations has not been specifically studied, unless a species falls within the category of Threatened, Endangered, Forest Service Sensitive (TES), or MIS. The Forest Service has a legal mandate to provide habitat for viable populations of neotropical migratory birds. Species with viability concerns are included as Forest Service Sensitive species.

B. Human Use

1. Heritage Resources

Heritage resources are in many instances tangible cultural resources. They may be structures, remains of structures, accumulated or deposited trash, physical evidence of mining, logging, livestock grazing, or agriculture. Physical resources are carefully recorded, explored, and excavated or preserved in place.

Another category of heritage resources is the intangible historic aspects of the environment. Within this category falls the general and particular history of the project area as expressed in social life, economic adaptations, and folk life. This information can contribute to the development of historic research and, like tangible resources, are subject to loss through modification of the environment.

Heritage resource surveys have been conducted on approximately 40 percent of the Monument. To date, over 1,200 prehistoric and historic sites have been located and recorded.

a) Ethnographic Groups Within the Study Area

Kings River Drainage. Five groups inhabited the Monument portion of the Kings River drainage: the Choinimne ("Yokuts"), Michahai, Entimbits, Wobonuch, and Tuhukwaj ("Mono"). The major Choinimne settlements were on the south side of the Kings River in the vicinity of Mill Creek and on Mill Creek.

The Entimbits held a territory to the east of the Choinimne, which extended to the north side of Mill Creek east and southeast to Sampson Flat and Dunlap. Two important villages, *Kudsowabi* and *Wojidu*, were located in the Dunlap area. The Michahai ranged between Squaw Valley and the Drum Valley/ Badger area in the Kaweah River drainage.

The Wobunuch held the south Fork of the Kings River, east from its confluence with the North Fork of the Kings River. Eighteen hamlets have been identified in this area, including the major villages of *Yumsanyu, Ko'onikwe,* and *Kadawinao* along Mill Flat Creek.

Population figures for this area exist only as rough estimates since no village count or population census was taken. The Mono groups on the Upper Kings River are estimated at between 1,700 to 2,340 persons.

Kaweah River Drainage. Three groups in the Kaweah River drainage are important for the Monument: the Wukchumni, a "Yokuts" group, and the Waksachi and Patwisha, two "Mono" groups. The three main Wukchumni villages were located in nearby Sequoia and Kings Canyon National Parks.

The core range of the Wukchumni extended to Antelope Valley to the north, Rivers (a modern town) up the Kaweah River to the east, Yokol to the south, and as far west as Woodlake. The Waksachi were centered in Eshom Valley, where the main village was *Chitatu*, with about 25 houses. They ranged southwest to Gaines Flat, where their summer camp was called *Atitrao*. They also ranged southeast as far as Cactus Mountain and northeast to old Baldy Ridge (Gayton, 1948, pages 213-214). The Patwisha are a little known group whose range began just below the confluence of the North and Middle Forks of the Kaweah River, where their main village of the same name, *Patwisha*, was located. They also shared a village, *Botnunyu*, just downstream from the former, with the Wukchumni, but their range basically included the upper drainages of the Kaweah (Gayton, 1948, pages 55-59). Again, population figures for these groups are only rough estimates, as Gayton could not develop an adequate census during her 1925 fieldwork (Gayton, 1948, page 56). Nevertheless, Kunkel has some figures derived from a variety of sources. From the early (1819) account of Estudillo, the figure of 1,250 is given, which may refer either to the single, major Wukchumni village or to the whole tribelet. Kunkel takes this as a possible minimum figure. Kunkel derives a density range of 7.35 to 10.0 persons per square mile from these population estimates (Kunkel, 1962, page 139). Clearly, Wukchumni villages were large (300-400), even if the minimum population estimate represents the whole group. The Waksachi and Patwisha population estimates range from 150-300 per tribelet. Kunkel derives a maximum density of 1.41 persons per square mile, although he acknowledges that this figure may be misleading (Kunkel, 1962, page 141).

Tule River, Deer Creek, White River, Poso Creek, And Lower Kern Drainages. Together these drainages held five "Yokuts" groups and one Tubatulabal or related group. The Yaudanchi residential core was focused on the North Middle Forks of the Tule River at the main winter village of *Shawahtau (*Springville). The Bokninuwad resided on the southern forks of the Tule and on Deer Creek. Their main settlements were *Keyau* towards the valley and *Hoin Tinliu* (California Hot Springs) in the foothills (Kroeber, 1925, pages 479-480).

The Bankalachi or Toloim (Uto-Aztecan speakers or mixed Yokuts/ Tubatulabal group) lived above the Bokninuwad on Deer Creek at *Sototio* on White River (Gayton, 1948, page 50; Kunkel, 1962, page 145). The group occupied the headwaters of Poso Creek at White River, with their main village of *Hoschiu* on the White River (Kroeber, 1925, page 479). They lived along Poso Cre*ek, principally at*

Altau just south of the creek, also at Bekiu and Shikidapau at Poso Flat and *Holmiu* in Linn's Valley (Kroeber, Y925, page 479). These three ethnologically linguistic groups are not well documented ethnographically. The sixth group was the Yaulemani, who were basically a valley "Yokuts" group but who held the lower reaches of the Kern River. Their major settlement was *Woilo* at Bakersfield. Kroeber describes their range as extensive, reaching south to Tejon (Kroeber, 1925, page 482).

Population estimates for these groups are weak at best. Kunkel figures 400 minimum and 800 maximum for Yaudanchi, with a density of 1.6-3.2 persons per square mile, and a single figure for theYaudanchi of 200, with a density of 1.14 (Kunkel, 1962, page 144). He gives a combined for the remains of four tribelets (Bankalachi, Kumachisi, Paleuyami, Yauelmani) as 1,200 minimum and 2,700 maximum, resulting in densities to 3.38 (Kunkel, 1962, page 148).

b) Expected Areas of Archaeological Sensitivity

Prehistoric Resources (Entire Monument). Prehistoric archaeological sensitivity was determined primarily by consideration of research done in the Monument. In the adjacent Yosemite Valley Region, Bennyhoff (1956) was able to show that the frequency of sites occurred at various elevations. Large and small village sites were always found below 8,000 feet, while most of the large and small camps existed above this elevation. In his sample, 2% of the sites occurred in the Upper Sonoran Life Zone, 36% in the Transition Zone, and 61% in the Boreal Zone. Factors important to site location include availability of water and meadow edges, accessibility to boulders within the oak belt, sunny exposures, and relatively dry and well drained soil (Bennyhoff, 1956, page 14).

High Sensitivity Zones are those in which archaeological sites are most likely to be found and are characterized by the following:

- Debris slopes, stream terraces, flat, or benches.
- The foothill woodland community.
- Perennial or intermittent streams.
- Distance from water of 0 to 100 meters.
- Open areas or a southern direction of exposure.
- Slopes of 0 to 15%.

Moderately sensitive areas reflect a smaller degree of aboriginal use and are characterized by the following:

- Slope crests.
- Yellow pine forest community.
- Springs and seeps.
- Distance to water of 101 to 300 meters.
- Western direction of exposure.

- Slopes of 16 to 30%.
- Elevations between 1,601 to 2,400 meters.

Zones of low sensitivity are those places where the occurrence of archaeological sites is least likely and are characterized by the following:

- Escarpments and stream channels.
- Valley grassland, red fir forest, lodge pole forest and sub-alpine forest.
- Ephemeral streams, lakes and ponds.
- Distance to water greater than 300 meters.
- Northern and eastern directions of exposure.
- Slopes greater than 31%.
- Elevations between 401 to 1600 meters and above 2400 meters.

(1) Historic Resources

Chronological Historic Site Typology. In historic times, a variety of mineral resources attracted miners, and meadows and forest resources brought ranchers and loggers. These and the major rivers continue today to be the focus of activities designed to extract and use the values of the area. In simplistic terms, the hydrology, flora, and fauna of the southern Sierra Nevada provided and continue to provide a number of natural resources of interest to human users. However, the interaction between culture and natural environment is complex; simple lists of available resources do not convey this complexity. Any discussion must artificially separate out some of the multiple interacting factors of the natural environment, which affected human use of the study area. For example, it is clear that the factors of elevation, latitude, climate, and biotic communities are all interrelated in the distribution of natural resources. But it is possible to isolate a single variable, such as elevation, to be used as an indicator for the associated factors. The elevation range of the area includes a number of biotic communities, which are either known or expected to have been used by human groups. At varying elevations, with the correspondingly varying climatic conditions and biotic communities, different types of cultural resources have been recorded and can be expected to be found. Likewise, variations in the patterns of site occurrence can be anticipated for settings at different elevations.

As early as 1776, the Spaniards, and later the Mexicans and Americans, explored areas in and adjacent to the study area. Connected with this was the struggle for land ownership between various countries and individuals. This often led to expeditions, battles, military patrols, and documented events. Although material manifestations of many of these do exist, it is difficult to locate them in the field. However, some features of these sites may still be observable. Roads and trails used by these people may sometimes be recorded on the ground. Other physical characteristics of this type of land use may include graves, carved or blazed trees, and trail markers. Forts, outlaw hideouts, battlefields, and campsites of soldiers and explorers are more difficult to discern.

Some campsites received annual or extended use. It is possible that cans, bottles, flattened earthen pads, rock alignments, and perhaps bullet cartridges or other military occupational items might be visible on the ground. Most explorers were just passing through and left no material objects to mark their passage.

The documentary record discusses the location of a few of these sites, chiefly forts, trails, battlefields, and campsites. Other types of sites, such as hideouts, bootleggers' stills, trash pits or scatters, and graves, remain undocumented. Too few of such sites have been recorded in the Monument to allow us to generalize, based on associated environmental variables, the expected locations of these sites. The only guide is that buildings, regardless of associated activity, tend to be located near water, on gently sloping land, and near a transportation route.

Governmental Regulation. The government began to directly regulate the use of the Sierra Nevada by the 1860s. However, not until the 1890s, with the establishment of army camps, did governmental regulation create physical remains. Most recordable sites relate to U.S. Forest Service administration. It was not until the turn of the 20th century that funds were available to hire forest rangers and work began in national forests. Rangers and assistant rangers began constructing trails, buildings, bridges, camps, and other structures. Permanent winter stations were built at lower elevations or in valleys, and summer headquarters were constructed in the mountains, usually near meadows. Seasonal stations consisted of log or shake one-room cabins with pitched, shake-covered roofs or tents constructed on a leveled and cleared area. These stations often had a developed spring and/or corral or fenced-in pasture, associated with the cabin.

More often than not, a forest ranger simply rolled up in his blanket and slept out in the woods. Bundles containing camping gear were often left at strategic places, eliminating the need for the ranger to carry supplies on his saddle. These temporary camps often consisted of a fire circle by a spring and were not used on a regular basis.

Along with the national forest came fire management. The government hired men to live in the mountains and look for smoke during fire season. First, heliographs (mirrors) were used to communicate from lookout to station, or from any high spot in the forest to any lookout. Later, telegraph and telephone lines were strung and dry-battery crank telephones were hung at campgrounds, lookouts, and stations for easier and quicker communication.

Lookouts were constructed in trees, on peaks, and on mountaintops, any place with good 360-degree visibility over a large area. Early lookouts were towers, small cabins, or one-room tree houses. These were equipped with beds, stoves, and fire sighting and fighting equipment. Caches of tools were also placed in meadows and along trails for emergency use by rangers, recreation users, cattlemen, and sheepherders.

Today, many of the original stations are gone or have been replaced by modern buildings. Scattered boards, square or round nails, developed water troughs, corral poles, trash pits, and perhaps a privy might be found in some combination at the sites of these first stations. The camps used by rangers may be more difficult to detect and identify. Fire hearths or rock circles and trash scatters may remain at camp locations. Larger camps may have telephone lines and insulators still present in trees, about 15 or more feet above the ground.

Fire management activities were incorporated as part of the job. Tool caches may occasionally be located in remote areas of the southern Sierra Nevada. These may contain shovels, picks, axes, and canned goods. Most of the fire structures are no longer standing, but some remnants (trash pits, telephone lines and insulators, boards, nails, water sources) may be in the immediate vicinity. Historic trails (usually indicated by blazed trees), bridges, and developed campsites might also be recorded.

The Civilian Conservation Corps (CCC) constructed many of the roads and foot trails currently in use throughout the study area in the early 1930s. The CCC also strung telephone lines in the mountains, cleared brush, cut trees, and constructed permanent bridges. In addition, from 1931 to 1938, the CCC constructed many of the currently used Forest Service administrative structures. They usually had permanent camps and spike camps. The permanent camps housed large numbers of men and may be marked by concrete foundations, boards, nails, equipment, bunkhouse remnants, and assorted historic debris. The spike camps were temporary in nature and consisted of tents with small groups of men. These may be identified in the field by earthen tent platforms, portable privies, trash pits or scatters, and abandoned equipment. These temporary CCC camps occurred throughout the mountains and can still be found today. The documentary record gives the locations of many Forest Service cabins.

Settlers. In the late nineteenth century, it was possible to homestead and/or receive government land under a variety of patents. Homesteaders were usually awarded up to 160 acres of land. Pre-emption claims were also awarded. Both of these types of patents were usually associated with the settler. However, not all settlers received title to their lands, and many sites called “homesteads” predate the official claim entry by many decades, or were never patented at all.

Basic improvements had to be made on the homestead. The settler probably fenced in all, or a portion of, his land to keep his stock protected. Perhaps a log or shake cabin was constructed, or an earthen platform was built. Later, this crude structure may have been replaced with a more permanent home. A few acres were usually cleared for growing grains, vegetables, and other crops. Some settlers planted orchards in addition to crops. Out- buildings, barns, corrals, sheds, and other structures were often added as time progressed. Most homesteaders also built trails and/or roads leading to and from their property.

Today, it is still possible to identify the physical remains of homesteads. Depending on the length of occupation and the level of improvements made, a variety of features may be observable. These can aid in establishing the historic use of the site. One of the more noticeable features in the field might be the remnant of a fireplace, chimney, or stone hearth. Surrounding this rock pile, boards, nails, historic debris (glass, cans, household goods), a stone or concrete house foundation, and a basement or cellar hole are likely to be scattered. Privies, barns, sheds, and other outbuildings might be identified by flattened earthen pads, board and nail scatters, foundations, abandoned equipment, and trash pits. A pole corral might be situated away from the main complex or attached to the barn. The main area was often enclosed with a fence. Fallen or standing hand-hewn square posts with attached barbed wire can sometimes be located in the main complex area and/or within the 160-acre allotment. Ax-cut stumps, indicative of building and other settler activities, may also be present in the general vicinity.

Vegetation changes can indicate settler activity. Once thriving orchards, especially apple orchards, may still have a few isolated fruit trees growing within their confines. Locust, black walnut, and other decorative trees were often planted around the house and may still be alive. Trees native to the area may be blazed, testifying to a path or trail that marked the way to the homestead. Relatively few settler-related sites exist which can be recorded during field survey. The documentary record indicates far more settler-related sites exist in surveyed areas than are recorded, and the best sources for locating these sites are government land office survey plats and public land records. Many of the settler-related sites that are not located in the documentary record belonged to squatters. These, like documented settler-related sites, are most likely to be found in meadows or on broad flats.

Seasonal Grazing. Many of the large ranchers in the valleys, as well as smaller landowners, grazed their sheep and cattle in the mountains from May to October. The herders and cowboys who accompanied the stock usually established temporary camps. The camps were often established in high elevation mountain meadows with permanent springs or water sources. The meadows provided plenty of feed for horses and pack animals, and forage for stock.

A cabin, constructed of either logs and/or shakes, was often built on the edge of a meadow or in a clearing by a creek. The springs were sometimes developed and/or fenced to keep the stock out of the water supply. Other streams and springs were dammed to fill stock ponds. Log troughs were devices used to water the stock and saltboxes were placed in the mountains. After Forest Service oversight began, ranchers were assigned specific territories and required to build drift fences to keep their stock from wandering into another rancher's range.

Numerous features mark the passage of ranchers and sheepherders through the Monument. Foremost is the stockman's cabin, a one-room building made of shakes or logs with a pitched shake roof, usually located at the edge of a meadow near a water source. A small barn, a lean-to, or perhaps a privy may be associated with the cabin. Flattened and scattered boards and nails might be all that remains of this structure. It is possible that an associated trash scatter or pit, or debris, might be found near the cabin. Developed springs, dammed creeks, pole corrals, and log troughs or saltboxes might be virtually anywhere in the mountains. Sheep and cattle “driveways” are also associated with grazing, as are roads and blazed trails.

After the turn of the 20th century, permanent “cow camps” were established in the mountains. Cattlemen began transporting their entire families up to the cow camps for the entire season, or for one or two months. More permanent and larger cabins were built to accommodate wives, children, and visitors. A small garden may have been planted next to the cabin. Boards, nails, a developed water source, cleared land, corrals, privies, foundations, and chimney hearths might still be visible. The cattlemen worked out of these camps, but sometimes spent the night in the woods. These temporary stock camps may contain nothing more than a fire circle of rocks and a trash scatter, or may not even be noticeable. Most features relating to seasonal grazing which can be recorded in the field date from the twentieth century, by which time improvements were strictly regulated.

Nineteenth century features evidently have not survived to be recorded, with minor exceptions, such as Basque sheep carvings. Should others exist, they would probably be located with respect to water, slope and transportation as are twentieth century features. Government land office survey plats frequently show the routes of historic trails. It is logical that since these trails were used principally for livestock drives by seasonal grazers, most nineteenth century grazing-related sites will be located in close proximity. However, not enough nineteenth-century grazing-related sites have been recorded to test this hypothesis.

Logging. Some areas in the Monument were sites of logging activities from the mid-nineteenth century to the present. Early logging operations relied on skidways, oxen teams, and steam donkeys to transport lumber to the mill in the 1880s. The narrow gauge railroads (1889), steam engines, and rate flume systems came into use as a means of transporting lumber to the mill and marketplace.

The first mills were portable and were skidded from one location to next following the harvest. Later mills were often permanent and established in lower elevations or valleys. These later mills were elaborate with workshops, millponds and dams, workers housing, storage areas for cut and unprocessed lumber, and saws.

Early lumbering operations were usually very small and run by one or two men. Trees were usually cut three or more feet from the ground by using bucksaws and springboards. The tree stumps are one indication of historically logged regions (modern methods cut trees less than 18 inches from the ground). Portable mill sites are hard to detect in the field, but sawdust piles, abandoned equipment, flattened earthen pads, boards, and nails may remain in the area. Flumes, developed water sources, and a small cabin or camp might be found in the vicinity of the mill. If so, square or round nails, boards, and historic debris would be evidence of man and mill.

Large-scale operators owned later mills. In the northern area, the activities of the Sanger Lumber Company in Converse Basin (ca. 1897 to 1905) and the Hume Bennett operations at Hume Lake (ca. 1909 to 1918) are well documented. The remains of these activities include mill locations, hoist machinery locations, work and living camps, and linear features such as chutes, hoist tramways, and railroad grades.

Brown and Elling (1981) proposed a classification system of historic resources based on functional complexity and temporal duration of the activity. The classes are isolated artifacts, locations, linear features, sites, and landscapes. Individual objects, which may be related to the activity area (e.g. sites or locations) but have no direct spatial association, would fall in the isolated artifact class. Broken saw blades, bottles, tin cans, or machinery parts are examples. Locations are areas “where specific logging tasks of short duration took place”. The distinction of a location is that it would be designed for a single purpose activity that lasted “a few hours, days, a week or perhaps a month” (Brown and Elling, 1981, page 91). Linear features connect locations or activity areas (sites more or less represent an extension of the activity). Skid trails, pole chutes, tramways, or railroad grades are the most common examples of linear features. Sites are places where several interrelated activities occurred over a long period of time. The mill area or permanent hoist locations are examples. Landscapes are the collective physical remnants of logging. Stump Meadow or the Boole Tree area are examples.

Associated with these large operations were narrow gauge railroads, trestles, hoists, steam engines, and flumes. The railroads were a boon to large companies, making possible fast transport from harvest sites to mills for processing, and then to the market place. Tracks could be removed and transferred from one location to the next, reducing overall cost. Oxen teams were sometimes used to transport from the stump to the track, but more often a combination of steam donkeys and cables performed this task

The greatest impact on the land came from the actual logging (mill sites and harvest areas). Companies logged giant sequoias, as well as smaller pines and firs. Most large giant sequoia trees were cut 5 to 25 feet above the ground and are good indicators of early 1900 logging activity. Abandoned equipment and trash scatters, privies, and small camps may be found in logged-over areas. Mill

sites can be identified by structural remains (usually more than one cabin or building), stone foundations, sawdust piles, platforms, and a wide assortment of metal, glass, ceramic, and wooden objects. Cables (used to transport logs) may be found anywhere

The large-scale operators left scars on the physical landscape. Although narrow gauge rails were usually removed, some isolated railroad debris may remain. The tracks were usually laid out on cleared and leveled paths. Many of these old railroad grades now serve as Forest Service roads and are still visible. Abandoned railroad carts, cars, or flatbeds remain in the Monument. Flumes, trestles, and bridges may be in a dilapidated condition. Boards, nails, and abandoned equipment are indicators of these features.

Analysis of logging-related sites has shown that locations of certain types of sites can be anticipated in the documentary record. Maps give the locations of railroads, mills, towns, major lumber camps, and hoists. Isolated cabins, equipment pieces, trash deposits, and piles, along with stumps, are frequently recorded.

Recreation. After the mid-1880s, people began going to the mountains for summer recreation and to escape the valley heat. Some hot springs were developed in the southern Sierra Nevada, while other camping spots higher in the mountains became favorite retreats. Hunting, fishing, and hiking were common activities, especially in the summer and fall. Later, people obtained special use permits from the government for a nominal fee and moved their entire family into the mountains to the “cabin” (recreation residence) for vacation.

Many of the more developed resort sites are still in existence. Others are characterized by glass and can scatters or trash pits, stone or cement foundations, boards, nails, fencing remnants, telephone wire and ceramic insulators, and in some cases, bath house remains and developed hot springs. Earth tent platforms and/or fences, pastures, blazed trails, footpaths, roads, and log or shake one-room cabins may also be present.

Hunter camps and other camping sites are more difficult to discern and to differentiate from forest, lumber, and temporary mining camps. The recreational user camps may consist of a fire hearth or rock circle, spent bullet cartridges, developed springs, and trash scatters or pits. Some hunter camps were used on an annual basis and may be more developed. In this case, it is possible that log benches, wood tables, tent platforms, privies, hunting blinds, and shelves or cupboards may be located in clearings or on the edges of meadows. A hunter camp will usually be characterized by a deer rack (pole) hanging between two trees.

Summer cabins, even when receiving minimal use, were often more elaborate and developed than other recreation sites. Usually a small house or cabin was built of logs or boards in a forest clearing or on the edge of a meadow or creek.

The cabin housed a family and often had two or more rooms. These sites may be identified by structural remains (boards, nails), chimney or fire hearths, trash pits, privies, and associated pole corrals or fenced-in pasture areas. Blazed trails and/or wagon roads led to these summer homes. Tree stumps and developed water sources are good indicators of this type of camp, as are kitchen items and stove or oven fragments.

Resort sites are documented in the record. Since few other recreation-related sites have been either anticipated or recorded for the Monument, no generalization can be offered as to locations.

Hydroelectricity. The need for water to generate power for southern California, and for use in mining and lumbering operations, became overwhelming around the turn of the 20th century. Around 1900, several companies began to harness the energy from water flowing out of the southern Sierra Nevada. Dams, flumes, and powerhouses were constructed along major rivers and streams, all designed to get the most power out of the rushing water. Many of these dams, original flumes, and powerhouses are still in operation. However, some flumes have been abandoned and may be found in the field. These were usually constructed of wood or concrete. Associated worker camps, both temporary and permanent, may be recordable. Permanent camps may be identified by stone or cement foundations, abandoned equipment, roads, boards, and trash pits. Fire rings, privies, abandoned equipment, and trash scatters or pits may mark temporary camps, and developed water sources.

2. Recreation

The Sequoia National Forest and Giant Sequoia National Monument are unique in their juxtaposition to Los Angeles, San Bernardino, San Francisco, and San Diego, and the metropolitan areas of Fresno, Sacramento, Bakersfield, and Las Vegas, Nevada. Over 28 million people live within a half-day's drive of the national forest and the Monument. The San Francisco Bay Area, Sacramento, San Diego, and Las Vegas are all located within a half-day's drive. Approximately 60% of the visitors to the Sequoia National Forest are estimated to come from the Los Angeles Basin, which is within a three-hour drive. More than two million people live within an hour's drive from the forest. While all of these people are potential visitors to the Monument, numerous other recreation opportunities in these areas may also attract this population base.

Recreation use in the Monument was last estimated for the period of October 1996 through September 1997. The northern portion of the Monument was estimated to have 3.7 million visits and the southern portion had 2.4 million visits.

Group and family campground occupancy rates (percent of sites occupied) average 75 to 85% on peak weekends and about 25 to 30% on summer weekdays. For day use sites, percentages range from about 30% to 85%. For the northern portion of the

Monument, most facilities have 100% occupancy on peak use days, which is partially a reflection of their proximity to Sequoia and Kings Canyon National Parks.

Once occupancy reaches 60%, campers are likely to find that adjacent campsites are occupied, and some people will begin to feel crowded. Crowding can affect how and when people visit an area. Some people do not mind crowds and, in fact, crowds can positively influence their recreation experiences. Many others, however, find that crowding adversely affects their experiences. Consequently, they may avoid visiting areas when they perceive the areas will be more crowded and shift their visits to other areas, other times of the week, or seasons of the year. If people perceive that areas are always crowded, they may simply avoid visiting them altogether.

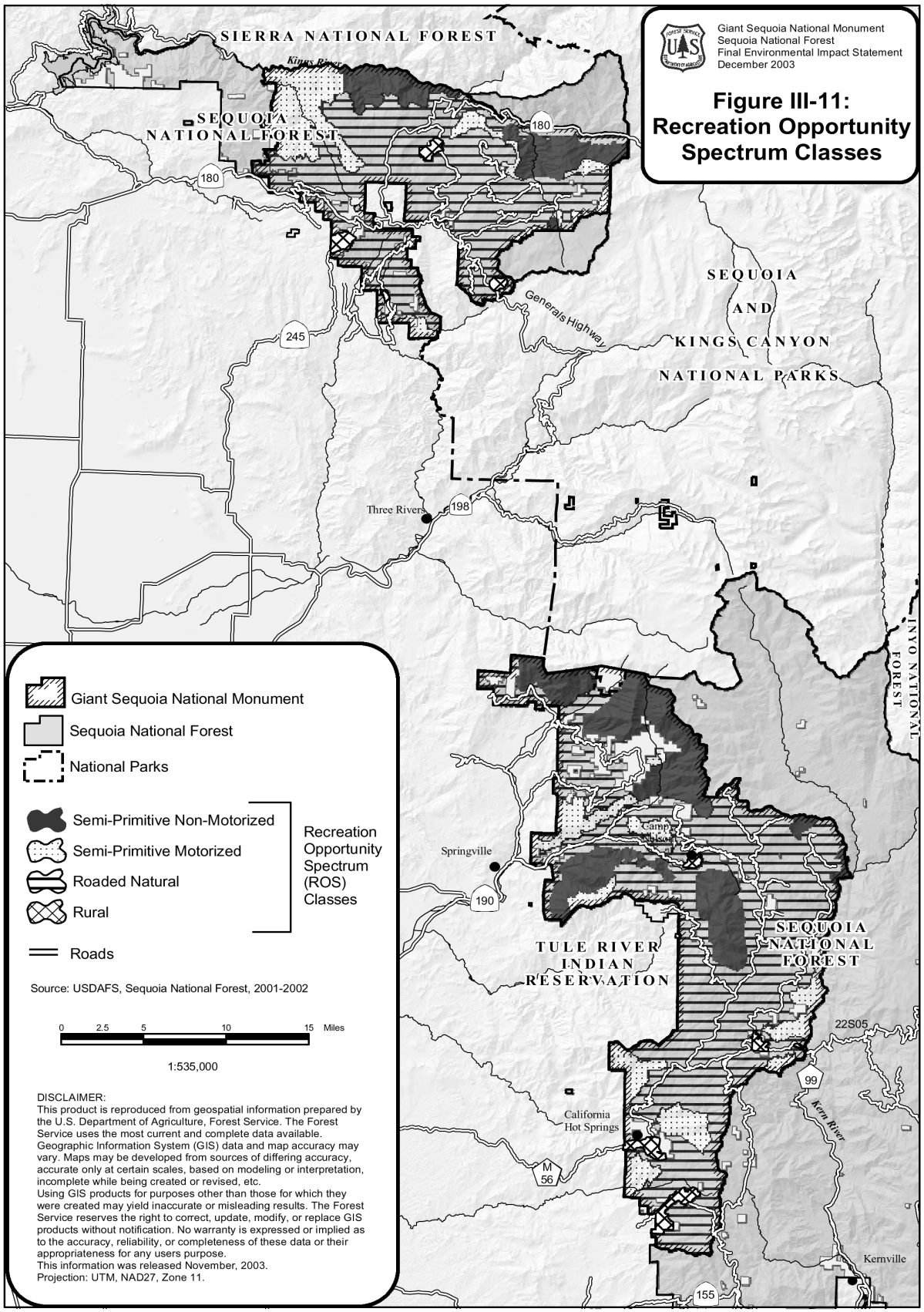
Typically, the recreation facilities within the Monument were built 40 to 50 years ago. Many are outdated and are not equipped to handle today's visitors. Although an effort is being made to upgrade them, only a small portion can be reconstructed each year. The result is that many facilities cannot accommodate today's larger vehicles or larger family groups, nor can they meet the growing demands for universal accessibility to accommodate people of all abilities.

The Monument offers a rich and varied range of recreation, interpretation, and education opportunities that existed prior to its designation. Changes in some uses, most notably the exclusion of off-highway vehicles on trails, occurred as a result of the Proclamation that established the Monument.

The Forest Plan assigned recreation opportunity spectrum (ROS) classes to all lands within the Sequoia National Forest (see glossary in Chapter VII for definitions of the ROS classes and Figure III-11). Approximately 10% (32,600 acres) of the Monument is in the Semi-Primitive Non-Motorized class, 12% (39,200 acres) is in the Semi-Primitive Motorized class, 77% (251,300 acres) is in the Roaded Natural class, and 1% (3,300 acres) is in the Rural class. There are no areas in the Primitive or Urban classes in the Monument.

Developed recreation facilities in the Monument encompass about 222 acres and provide a variety of opportunities for the recreating public. There are 21 family campgrounds with 502 campsites and seven group campgrounds. The total capacity (also called persons at one time, or PAOT) of the family sites is 2,510, while the group sites have a PAOT of 450. Six picnic areas have 53 sites. There are 12 developed trailheads that offer parking, information, and rest rooms, as well as 10 other trailheads with only parking for trail users. Outside of wilderness, there are approximately 160 miles of system trails, including 12 miles of the Summit National Recreation Trail. Two pack stations provide outfitter guide services.

A number of recreation facilities are located within the current administrative boundaries of giant sequoia groves. These include four family campgrounds (Belknap,


Giant Sequoia National Monument
Sequoia National Forest
Final Environmental Impact Statement
December 2003
Figure III-11:
Recreation Opportunity
Spectrum Classes
SIERRA NATIONAL FOREST
Kings River
SEQUOIA NATIONAL FOREST
180
245
Generals Highway
SEQUOIA AND KINGS CANYON NATIONAL PARKS
Three Rivers
198
INYO NATIONAL FOREST
Springville
190
Camp Nelson
TULE RIVER INDIAN RESERVATION
SEQUOIA NATIONAL FOREST
22S05
99
Kern River
California Hot Springs
M 56
Kernville
155
Giant Sequoia National Monument
Sequoia National Forest
National Parks
Semi-Primitive Non-Motorized
Semi-Primitive Motorized
Roaded Natural
Rural
Recreation Opportunity Spectrum (ROS) Classes
Roads
Source: USDAFS, Sequoia National Forest, 2001-2002
0 2.5 5 10 15 Miles
1:535,000
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This information was released November, 2003.
Projection: UTM, NAD27, Zone 11.

Redwood Meadow, Eshom, and Princess) with 144 campsites, one interpretive trail (Trail of 100 Giants) with 5 picnic sites and 15 parking spaces, and about 23 miles of trail. Also located in groves are five trailheads (Chicago Stump, Boole Tree, Cherry Gap, Freeman Creek, and Needles), two recreation residence tracts (McIntyre and Soda Springs), one organization camp (Quaker Meadow Church Camp), and one recreation rental cabin (Mountain Home). One administrative site, the Sequoia Guard Station, is located within the Redwood Mountain Grove.

Concentrated use areas are scattered throughout the Monument. These are areas of various sizes, with little or no development, that visitors primarily use to recreate in a forest environment, often near streams, without the amenities of a campground. There are 43 concentrated use areas in the northern portion of the Monument, with an estimated 8,900 use days. The southern portion has 80 concentrated use areas, with about 17,700 use days.

In the northern part of the Monument, the greatest amount of water-oriented recreation occurs at Hume Lake. Non-motorized boating, fishing, and swimming are the primary uses. Recreation developments around the lake include campgrounds, a lakeside trail accessible to persons with disabilities, two beach areas, a picnic area, a boat launch, and two fishing piers. Hume Lake, which permits only non-motorized boats, is the only lake within the Monument that can be accessed by vehicle.

A number of campgrounds in the northern portion of the Monument are located near streams and provide opportunities for water-oriented recreation. These include Tenmile, Landslide, and Logger Flat Campgrounds along Tenmile Creek; Eshom Campground along Eshom Creek; Upper and Lower Stony Creek Campgrounds along Stony Creek; and Big Meadow Campground along Big Meadow Creek. Recreation facilities along the Main Fork and South Fork of the Kings River are Boyden Cavern with guided tours, Grizzly Falls Picnic Area with an interpretive trail, Mill Flat and Convict Flat Campgrounds, and several vista points. The Cedarbrook Picnic Area is along Mill Creek near Pinehurst.

In the southern part of the Monument, many campgrounds and picnic sites are located near streams and rivers that provide opportunities for water-oriented recreation. They include Upper and Lower Coffee Camp picnic areas along the Tule River, Wishon Campground along the North Fork of the Tule River, Belknap Campground at the confluence of Belknap Creek and the Middle Fork of the Tule River, Redwood Meadow and Long Meadow Campgrounds along Long Meadow Creek, Leavis Flat Campground along Deer Creek, White River Campground along White River, and Peppermint and Lower Peppermint Campgrounds along Peppermint Creek.

Boating, primarily whitewater rafting and/or kayaking, occurs mostly on the Kern and Kings Rivers. Skilled kayakers also float Dry Meadow Creek. The Kings and Kern Rivers are also popular fisheries.

Several congressionally-designated areas are found entirely or partially within the Monument: the Monarch Wilderness, the Golden Trout Wilderness, the Kings Wild and

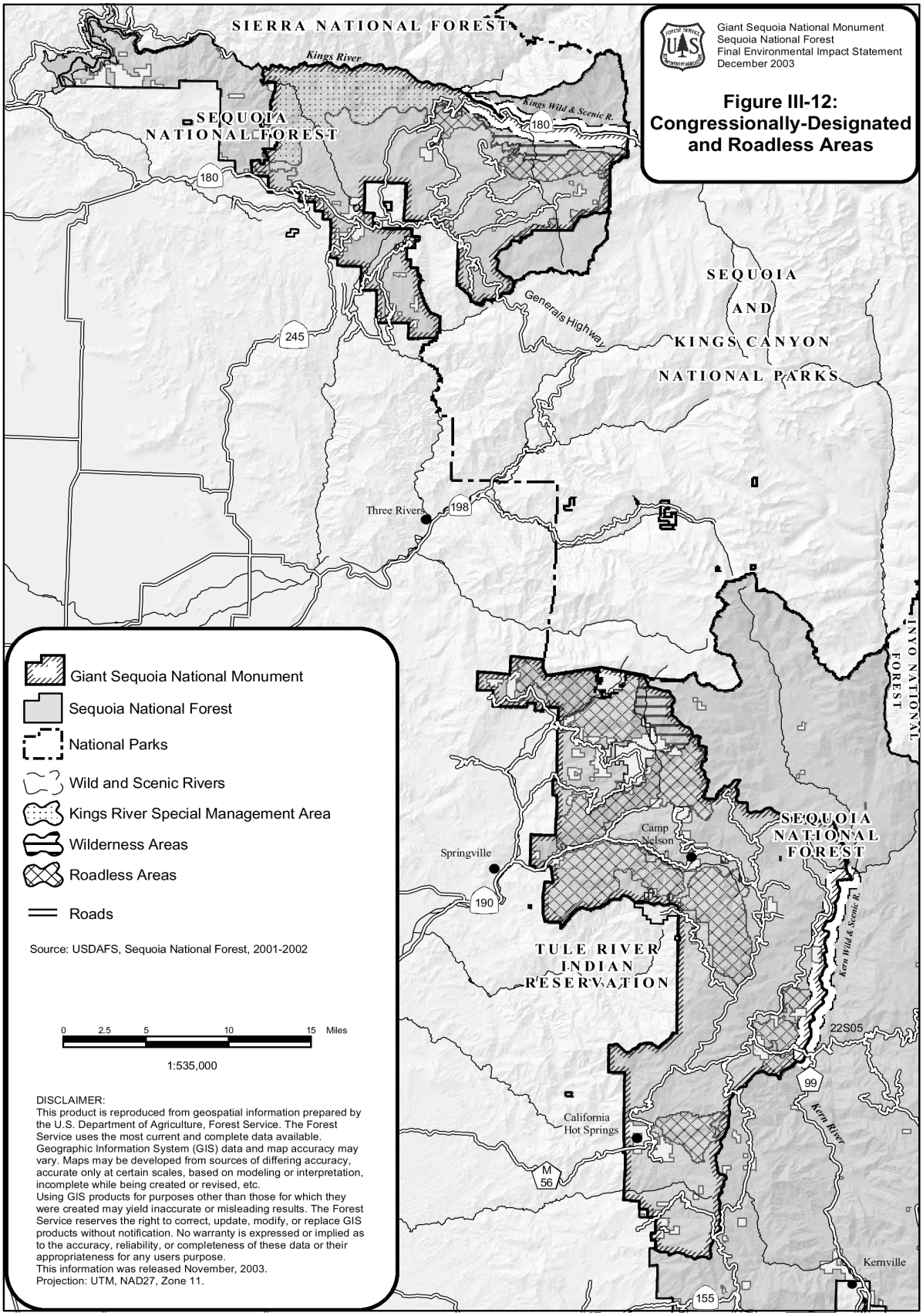
Scenic River, the South Fork Kings Wild and Scenic River, the North Fork Kern Wild and Scenic River, and the Kings River Special Management Area (see Figure III-12). Part or all of three giant sequoia groves are in the Monarch Wilderness: Agnew, Monarch, and Evans Complex. The Golden Trout Wilderness contains part or all of three other groves: Maggie Mountain, Upper Tule, and Middle Tule. A botanical area exists at Slate Mountain. The Sequoia National Forest Land Management Plan Mediated Settlement Agreement proposed the Freeman Grove as another; however, no formal nomination has occurred to date.

About 24,000 acres of the Kings River Special Management Area are located within the northern portion of the Monument, adjacent to the Kings River. This special management area was created by Public Law 100-150 in 1987 to provide for public outdoor recreation use and enjoyment; for protection of the natural, archeological, and scenic resources; and for fish and wildlife management. This public law permits off-highway vehicle (OHV) use on trails to the same extent and in the same location as was permitted before enactment. This statute takes precedence over the Presidential Proclamation that created the Monument and prohibits OHVs from driving off of designated roads. Therefore, within that portion of the special management area located within the Monument, OHV use may still occur on about 20 miles of trails.

Trails within the Kings River Special Management Area and designated roads in the rest of the Monument offer OHV riding experiences. A total of approximately 150 miles of road are designated for OHV use in the northern portion of the Monument, including about 20 miles of motorcycle routes, 25 miles of challenging 4-wheel drive road that is also available for motorcycles and all-terrain vehicles, and an additional 100 or more miles of high-clearance dirt road. The southern portion has OHV recreation opportunities that offer approximately 300 miles of unpaved, designated roads.

The National Scenic Byway Program showcases outstanding national forest scenery and increases public awareness and understanding of all national forest activities. The Kings Canyon Scenic Byway, which is 50 miles long, is the only national forest scenic byway in the Monument and the Sequoia National Forest and is an eligible state scenic highway. The Scenic Byway Nomination Report states that this is an internationally significant travel corridor with two extraordinary features: towering giant sequoia trees and Kings Canyon (USDA Forest Service, 1990).

Winter recreation activities are primarily snowmobiling, cross-country skiing, snow play, and some snowshoeing. In the northern portion of the Monument, there are 39 miles of marked over-snow vehicle routes, 21 of which are groomed, and an additional 50 miles of unmarked roadbeds that are open to snowmobiles. These offer opportunities for all levels of riding experience, from easy, groomed routes to very difficult, deep-powder routes. Existing facilities include four winter trailheads with parking; two have restrooms. Snow conditions in the Big Meadows area make this the center for winter use, with Quail Flat and Woodward as popular take-off points for both snowmobile users and skiers. In better snow years, the Cherry Gap site provides opportunities for


Giant Sequoia National Monument
Sequoia National Forest
Final Environmental Impact Statement
December 2003
Figure III-12:
Congressionally-Designated and Roadless Areas
SIERRA NATIONAL FOREST
Kings River
Kings Wild & Scenic R.
SEQUOIA NATIONAL FOREST
180
245
Generals Highway
SEQUOIA AND KINGS CANYON NATIONAL PARKS
Three Rivers
198
INYO NATIONAL FOREST
Giant Sequoia National Monument
Sequoia National Forest
National Parks
Wild and Scenic Rivers
Kings River Special Management Area
Wilderness Areas
Roadless Areas
Roads
Source: USDAFS, Sequoia National Forest, 2001-2002
0 2.5 5 10 15 Miles
1:535,000
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This information was released November, 2003.
Projection: UTM, NAD27, Zone 11.
Camp Nelson
Springville
190
SEQUOIA NATIONAL FOREST
Kern Wild & Scenic R.
TULE RIVER INDIAN RESERVATION
22S05
99
Kern River
California Hot Springs
M 56
Kernville
155

both snowmobilers and skiers. A local resort offers 31 miles of groomed trails used exclusively by skiers. Snow play typically occurs near winter trailheads and road turnouts opened by plows. In the southern portion of the Monument, there are approximately 114 miles of primary groomed and marked roads, 68 miles of secondary groomed and marked roads, a warming hut located north of the junction of SH190 and the Western Divide Highway, and three trailheads. Cross-country skiing commonly occurs along the groomed snowmobile routes with some adventure trail breaking occurring off-road. Volunteers commonly mark approximately 4 miles of ungroomed ski trails in the Quaking Aspen-Ponderosa area and the Parker Pass area. Snow play typically occurs wherever there are winter trailheads and road turnouts opened by plows.

Three resorts and nine organization camps, operated under special use permits, offer additional opportunities for forest visitors. One hundred eighty-nine recreation residences are authorized in the Monument under special use permit. Numerous temporary permits authorize recreation events such as hiking and climbing programs, snowmobile festivals, horseback riding and rodeo events, youth camping, running events, and American Indian gatherings. Three recreation rental cabins, owned by the Forest Service, are available for use by the public. The Sequoia and Kings Canyon National Parks border the northern portion of the Monument and visitors to these parks often use Monument facilities. Located on private land surrounded by the Monument, the Hume Lake Christian Camp is the largest Christian camp in the United States.

a) Education and Interpretation

The Hume Lake Ranger District in the northern part of the Monument has been actively involved in both indirect and direct face-to-face interpretation and education for the past decade. Delivery of these services follows the National Strategy for Interpretive Services and the National Conservation and Education Strategic Action Plan.

Interpretive and conservation education activities are based on an overall strategy for the district, with two general focuses: 1) create self-guided opportunities along the Kings Canyon Scenic Byway; around Hume Lake; in the historically significant areas at Millwood, Converse, and Indian Basin; and around Big Meadows; and 2) create interpreter-based opportunities through guided hikes, campfire programs, and educational activities both on and off-forest.

Indirect interpretation and education is accomplished through a variety of recreation opportunity guides and signs at points of interest. Three recreation opportunity guides focus on items of interest in easily accessible giant sequoia groves and several others address a variety of commonly asked questions.

Interpretive signs are added as funding allows. Existing signs are located along three trails and the Kings Canyon Scenic Byway. A trail around Hume Lake, which is fully accessible for persons with disabilities and has four interpretive signs, was

recently completed. Additional signs are proposed in the Scenic Byway Interpretive Plan. Four major wilderness trailheads have wilderness ethic signs and six other areas have interpretive signs. Three overlooks on Highway 180 and one on the Generals Highway have interpretive signs. The Forest Service maintains two signs at the Grant Grove Visitor Center in the Sequoia and Kings Canyon National Parks.

Direct interpretation and education take several forms. Through a partnership with the National Park Service, Forest Service employees work at the Grant Grove Visitor Center each summer. Boyden Cavern, operated under special use permit, offers guided tours through the cave. Montecito Sequoia Resort, which is also operated under permit, has naturalists on staff during the summer season and focuses many activities on education and respect for the natural environment. These recreation service partners, as well as others, serve over 40,000 visitors each year.

Interpreters are trained each summer to provide traditional campfire interpretive programs as well as guided hikes, children's activities, and living histories. The venue for these programs varies between one of the three amphitheaters, Buck Rock Lookout, along streams, in organization camps, or along trails. Forest Service programs directly reach an average of 7,000 visitors each year. Forest Service personnel also offer programs to schools and service organizations at local schools, fairs, and other gatherings in surrounding communities.

For the past three summers, the Forest Service has hosted the Celebrate Sequoias Festival. This event offers a variety of interpretive hikes through several giant sequoia groves, along with entertainment, children's activities, and vendors.

In the southern part of the Monument, ongoing education and interpretation are available on trails at Wishon Campground and the Trail of 100 Giants, wilderness ethics displays at Quaking Aspen Campground, and three developed wilderness trailheads. Quaking Aspen Campground has an amphitheater available for environmental education.

All Forest Service offices offer written guides to the public at no cost, covering a wide range of topics, including hiking and camping opportunities, safety messages, ecological education, outdoor ethics, visiting giant sequoia groves, hunting and fishing rules, and fire safety.

b) Projections of Demand

Recreation use of the Sequoia National Forest has been estimated at 10 to 13 million visits a year, which is more than Sequoia, Kings Canyon, and Yosemite National Parks combined. Use within the Monument portion of the Sequoia National Forest was over 6 million visits based on the latest estimate in 1997, and is estimated to have been over 6 million in 2002. Activities with the greatest

participation were automobile travel, camping, and a combination of viewing scenery, interpretive sites, wildlife, and works of humankind.

The National Visitor Use Monitoring methodology is being employed on the forest in 2003, which should yield more accurate visitation figures. This methodology is being implemented by the Forest Service nationwide and is designed to provide consistent, statistically valid visitation estimates and data regarding visitor preferences, and future demand for recreation opportunities.

A number of recreation surveys have been conducted over the past several years, all of which project increases in participation for most activities, at varying rates. Participation is expected to increase, at varying rates, across all demographic strata, for all ages and abilities, including persons with disabilities. All surveys seem to indicate a growing interest in viewing and learning activities (see Appendix I).

Several factors, relating to societal, lifestyle, and demographic trends, can affect recreation participation. The aging of the baby boomer generation, income changes, time constraints, changes in family structure, and immigration are examples.

The diversity of recreationists will continue to increase, as the American population becomes more diverse, and international visitors will increase.

The variety of activities is expected to continue to grow. Some will be determined to be suitable uses for national forest land, and some will not. As more recreation uses occur, they must compete with existing uses for a limited land base.

Participation in many activities that currently occur in the Monument is expected to grow in the future, so that the need will exist to create additional opportunities for them. Whatever additional opportunities are provided, they must be provided in such a way that lifestyle and demographic trends are taken into account, in facility design and recreation management, in order to truly serve the needs of the recreating public.

3. Scenic Environment

With the creation of the Giant Sequoia National Monument, recognition of the quality of its natural beauty was suddenly thrust into greater national and international significance. Language used in the Presidential Proclamation of April 15, 2000 described the “rich and varied landscapes” of the Monument. The Proclamation affirmed, “Groves of towering giant sequoias, the world’s largest trees, are interspersed within a great belt of coniferous forest, jeweled with mountain meadows. Bold granite domes, spires, and plunging gorges texture the landscape (Appendix B).” This language describes the magnificent beauty that is experienced best by visiting these lands and viewing them firsthand.

Scenery is a critical resource within the Monument. The Scenic Management System (SMS) is an approach to determine the relative value and importance of scenery in the Monument (USDA, 1995). The three primary elements identified in this approach are landscape character (scenic attractiveness), landscape visibility, and scenic integrity. Landscape character is the physical appearance of a landscape that gives it an identity and "sense of place" and measures the scenic importance of the land. Landscape visibility is a measure of people's concern for aesthetics based on the context of the landscape being viewed, perceptual factors of people viewing those landscapes, and different visual characteristics of a landscape. Scenic integrity reflects the amount of human-caused deviation from the character valued by constituents for its aesthetic appeal.

a) Landscape Character and Scenic Attractiveness

The Monument offers a wide range of scenic features that include western Sierra Nevada foothills and mid to high-elevation landscapes. Elevations vary from 1,240 feet to over 12,400 feet above sea level, an indication of the area's scenic diversity. Previous American Indian inhabitation and historic logging add cultural and educational value to the area. Vegetation, water and rock form, and cultural features combine to create a landscape unique to the southern Sierra Nevada.

Of special note is the renowned beauty of the giant sequoia, considered by many to be the nation's crown jewels. Generations of Americans, as well as people from all over the world, have been awed and inspired by giant sequoias. These trees are the largest trees on the planet and are among the oldest, sometimes living for 3,200 years or more. They often occur in stately groups that some people have likened to living cathedrals. Few organisms on the planet, plant or animal, have inspired as much human admiration (Stephenson, 1996).

The intangible value of the giant sequoia groves was highlighted in 1992 when President George Bush offered his Presidential Proclamation entitled "Giant Sequoia in National Forests." It states, "For centuries, groves of the Giant Sequoia have stimulated the interests and wonder of those who behold them. The Giant Sequoia is a tree that inspires emotion like no other and has mystically entered the hearts of humanity everywhere. "

Volume II of the Sierra Nevada Ecosystem Project (Science Review Team, 1998, Final Report to Congress, pages 839-853) discusses and maps significant natural areas. These areas contain outstanding features of unusual rarity, diversity, and representativeness on national forest system lands. The result is the recognition of more distinctive landscapes (Class A) than those identified in the old visual management system.

Examples of highly distinctive landscapes include the giant sequoia groves mentioned above, old-growth conifer forest, meadows with aspen groves alongside, and recognized botanical areas. Geologic features such as the Needles, Dome

Rock, Tobias Peak, Mule Peak, Moses Peak, Maggie Peak, Buck Rock, Mitchell Peak, and the Kern and Kings River Canyons provide high scenic value. Water features include the Kern, Tule, and Kings Rivers and their tributaries.

b) Landscape Visibility

With the creation of the Monument, expectations for a high quality landscape have increased, and the sensitivity of seen areas has risen. Travelways that access giant sequoia groves will take on added sensitivity.

Using the old visual management system, all roads and trails were assigned a sensitivity level. The highest level, Level 1, was assigned to Highway 190, Highway 180, and the Generals Highway. Short trail segments going into the Golden Trout Wilderness and Jennie Lake Wilderness were also considered Level 1. This high sensitivity along travel corridors resulted in the retention visual quality objective of landscapes seen in the foreground. Low-use roads and trails were assigned Level 3, the lowest level of sensitivity, while others received a moderate sensitivity (Level 2).

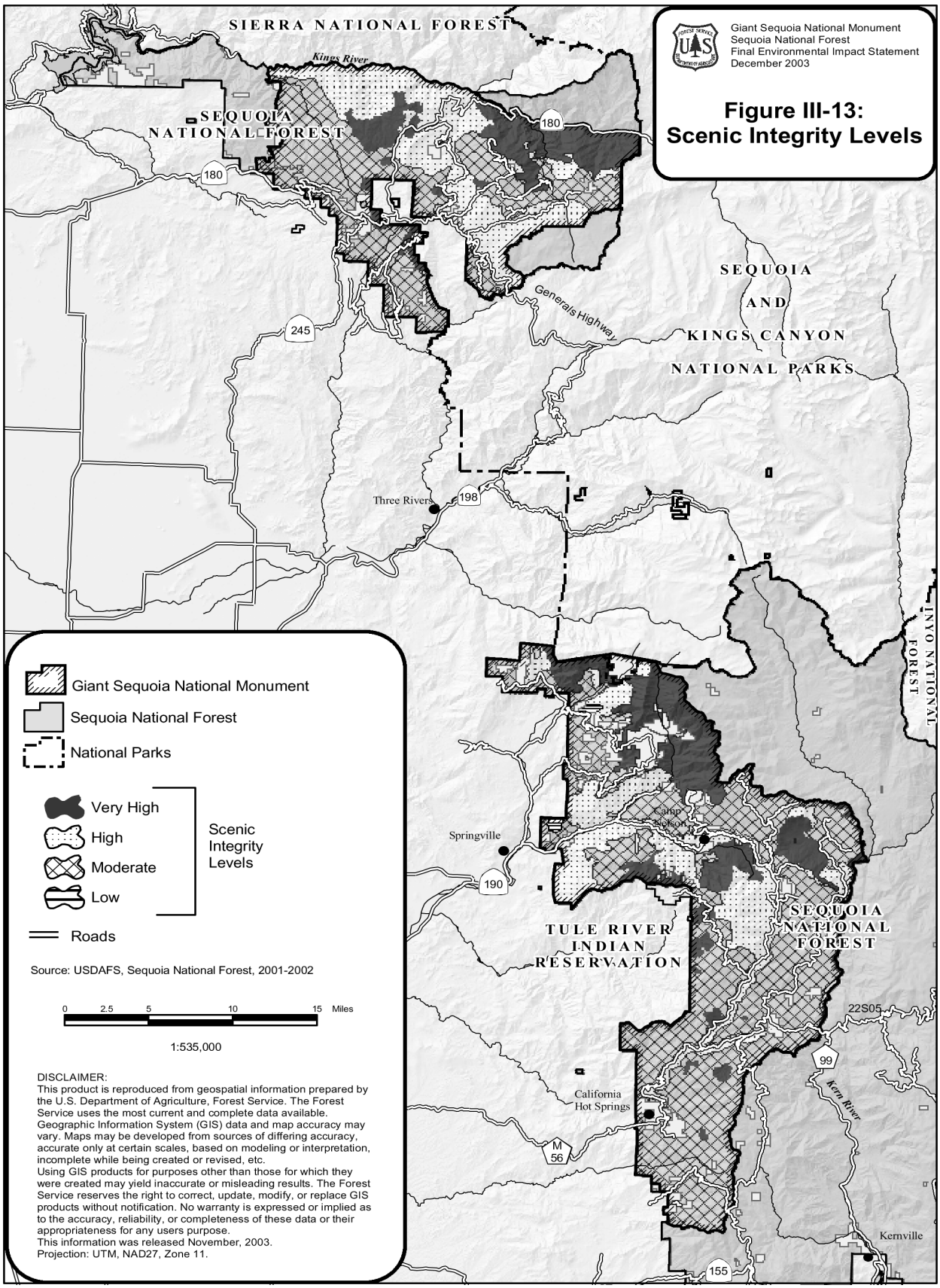
c) Scenic Classes

All national forest landscapes have value as scenery, some more than others. The concept of scenic classes was developed to measure the relative importance, or value, of discrete landscape areas having similar characteristics of scenic attractiveness and landscape visibility. The lower the number of the scenic class, the more important it is to maintain the highest scenic value.

Scenic classes were mapped for the Monument by combining the three classes of scenic attractiveness with the distance zones and concern levels of landscape visibility. There are approximately 108,100 acres of Class 1 (the highest class); 127,500 acres of Class 2; 52,400 acres of Class 3; 2,400 acres of Class 4; and 36,000 acres of Class 5 (the lowest class).

d) Scenic Integrity Levels

Levels of scenic integrity range from very high to very low (USDA Forest Service, Pacific Southwest Region, 2001, Chapter 3, pages 501-503). These levels were mapped for the Monument based on a combination of landscape character, roadless status, slope, and past management practices. The giant sequoia groves and other distinctive landscapes were mapped as having a very high scenic integrity level. No areas in the Monument were found to have a very low scenic integrity level. There are approximately 800 acres of Low, 174,200 acres of Moderate, 91,200 acres of High, and 60,200 acres of Very High (see Figure III-13). Scenic integrity levels are roughly equivalent to the old visual management system's visual quality objectives: maximum modification = very low, modification = low, partial retention = moderate, retention = high, and preservation = very high. The visual


Giant Sequoia National Monument
Sequoia National Forest
Final Environmental Impact Statement
December 2003
Figure III-13:
Scenic Integrity Levels
SIERRA NATIONAL FOREST
Kings River
SEQUOIA NATIONAL FOREST
180
245
Generals Highway
SEQUOIA AND KINGS CANYON NATIONAL PARKS
Three Rivers
198
INYO NATIONAL FOREST
Springville
190
Camp Nelson
TULE RIVER INDIAN RESERVATION
SEQUOIA NATIONAL FOREST
22S05
99
Kern River
California Hot Springs
M 56
Kernville
155
Giant Sequoia National Monument
Sequoia National Forest
National Parks
Very High
High
Moderate
Low
Scenic Integrity Levels
Roads
Source: USDAFS, Sequoia National Forest, 2001-2002
0 2.5 5 10 15 Miles
1:535,000
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This information was released November, 2003.
Projection: UTM, NAD27, Zone 11.

quality objectives assigned by the Forest Plan and specific to the Monument are approximately 24,500 acres of maximum modification; 124,000 acres of modification; 106,100 acres of partial retention; 42,400 acres of retention; and 29,400 acres of preservation.

The urban interface areas identified in the Forest Plan are Hume Lake, Pinehurst, Hartland, Camp Nelson, Sequoia Crest/Alpine, Ponderosa, Hot Springs, Sugarloaf, and Poso. The Forest Plan states that these areas within the conifer forest will continue to experience a dominantly natural landscape. Activities seen from these areas will remain subordinate (USDA Forest Service, Sequoia National Forest, 1988, page 4-10).

4. Socio-Economics

The San Joaquin Valley counties of Fresno, Tulare, and Kern are the areas of primary socio-economic effect of management decisions in the Monument. The Monument lies within Fresno, Tulare, and Kern Counties and is easily accessed by Highways 65, 155, 180 and 190, as well as by several less direct routes. While only a few acres of the Monument lie within Kern County, it is easily accessed via Highway 178 and the Kern River Valley. Since all three counties may experience some socio-economic effects from active management of forest vegetation and/or from tourism, primarily in levels of employment in the agricultural, manufacturing (woods work, mill), service (hotel/motel), and retail sectors, a short description of each is provided below. It is important to understand that in the San Joaquin Valley as a whole, unemployment is consistently higher then the statewide average, which reflects the seasonality of the agricultural economy and the excess growth rate of the labor force over job creation.

While all three counties enjoy some measure of tourist-related economic activity, much relating to national forests or parks, this is a relatively small proportion of the service and retail sectors. This activity is somewhat more important than the numbers would suggest because it is activity partially generated from outside these counties rather than inside. Similarly, the woods work and mill jobs, while relatively small in number (about 100 in Tulare County), are more significant economically because they are not related to the needs of local residents as much as to the demand for products elsewhere.

a) Fresno County

Situated in the heart of California's central valley, Fresno County covers a 6,000 square mile area, making it the fifth largest county in the state. It is among the nation's number one counties for agriculture production, with a gross crop value exceeding three billion dollars. While agriculture supports the county's financial base, Fresno, with a population over 750,000, has diversified into a broad range of industries, which provide approximately 87 percent of the non-agricultural wage and salary jobs. Fresno County is the financial, trade, commercial, and educational

center for the surrounding five-county region. It is also the hub for transportation facilities connecting central California to all parts of the state.

Table III-25: Fresno County Labor Force (as of February 1999, not seasonally adjusted)

Total Labor Force	372,300
Total Employed	309,700
Total Unemployed	62,600
Unemployment Rate	17%

Labor market information collected for Fresno MSA, which includes Madera County.

Table III-26: Fresno County, Labor Force by Industry Sector

Ag-Forest-Fishing	75,900	22%
Mining-Construction	13,700	4%
Manufacturing	29,900	8%
Transportation-Communications-Utilities	13,800	4%
Wholesale Trade	15,000	4%
Retail Trade	51,000	15%
Finance-Insurance-Real Estate	14,100	4%
Services	68,200	20%
Government	64,900	19%
TOTAL	346,500	100%

Source: California Department of Finance

b) Tulare County

Tulare County lies south of Fresno County, spanning the Sierra Nevada and extending into the San Joaquin Valley. Almost half the entire county area is devoted to national parks and forests, including the Sequoia and Kings Canyon National Parks, and the Inyo and Sequoia National Forests.

With a population of over 350,000, Tulare County ranks first as the most productive agricultural county in the nation. For years, Tulare County has held the distinction of leading the nation in milk, orange, grape, cattle, and cotton production.

Recently, Tulare County has seen sizable employment gains in its manufacturing industries, with jobs in durable goods showing the largest jump. New small-to-midsize firms manufacturing electronic components, plastics, prefabricated buildings, construction related products, food processing and printing services have significantly increased and diversified industrial activity.

Table III-27: Tulare County Labor Force (as of February 1999, not seasonally adjusted)

Total Labor Force	162,900
Total Employed	130,700
Total Unemployed	32,200
Unemployment Rate	20%

Table III-28: Tulare County, Labor Force by Industry Sector

Ag-Forest-Fishing	35,700	29%
Mining-Construction	3,600	3%
Manufacturing	11,900	10%
Transportation-Communications-Utilities	4,300	3%
Wholesale Trade	4,300	3%
Retail Trade	19,500	16%
Finance-Insurance-Real Estate	3,300	3%
Services	16,900	14%
Government	23,900	19%
TOTAL	123,400	100%

Source: California Department of Finance

c) Kern County

Kern is California's third largest county, covering 8,172 square miles at the south end of the San Joaquin Valley. Kern County's population of over 625,000 is centered in the San Joaquin and Antelope Valleys. Agriculture provides the backbone of Kern County's economy, providing employment to a large segment of the labor force and putting millions of dollars into the local economy. Kern County routinely ranks in the top three among the agricultural counties in the state. Cotton, grapes, carrots, and almonds are Kern County's most valued agricultural products. It is the nation's leading petroleum-producing county, yielding half the total California output of oil; the second largest cement-producing county in California; and the location of the largest flight test center in the world, Edwards Air Force Base.

Table III-29: Kern County Labor Force (as of February 1999, not seasonally adjusted)

Total Labor Force	277,300
Total Employed	238,500
Total Unemployed	38,800
Unemployment Rate	14%

Table III-30: Kern County, Labor Force by Industry Sector

Ag-Forest-Fishing	49,500	22%
Mining-Construction	19,200	9%
Manufacturing	9,800	4%
Transportation-Communications-Utilities	9,200	4%
Wholesale Trade	7,900	4%
Retail Trade	34,400	15%
Finance-Insurance-Real Estate	6,000	3%
Services	41,300	18%
Government	47,400	21%
TOTAL	224,700	100%

Source: California Department of Finance

d) Social Values Regarding Vegetation Treatments

Social analyses are conducted by the Forest Service to determine what effects the agency has on local communities and the people directly using natural resources. The social analysis also considers the effects of natural resource management on those that are not directly in contact with the area, but may have some concerns about it and/or hold values about its management. This includes sectors of the American public that may never visit Giant Sequoia National Monument but take satisfaction in knowing it is there. In order to understand how people and their values relate to management of the Monument, it is important to understand its history.

The newly created Giant Sequoia National Monument is part of a larger natural and social ecosystem that has a relatively long history of conflict over public land management goals and practices. This conflict on the Sequoia National Forest dates from at least the 1960s, when a U.S. Forest Service proposal to develop a high-density outdoor recreation site in the Mineral King Valley was challenged in the federal courts by the Sierra Club (Nienaber, 1972). Conflicts over timber production in the 1980s led to a mediated settlement agreement, which resolved some issues but not all.

In 1990, the National Forest System marked its centennial, and the anniversary sparked discussion regarding the future of the national forests. Through the 1990s, policy and social changes affected the types of management undertaken on national forests. Policy changes included the definition and adoption of an ecosystem management approach and the implementation of environmental laws at regional and local levels. Simultaneously, outdoor recreation has increased throughout the country, and government agencies are responsible for much of the land that is still available for outdoor recreation activities (Cordell, et al, 1997).

In addition, there has been a significant change in timber supply characteristics throughout the western U.S. This was caused by a harvest policy shift on public forests. The Forest Service's traditional emphasis on timber production, road construction, and livestock grazing has shifted toward more recreation-based activities. Researchers have documented increases in recreational/visitor use on Sierra Nevada public lands over the past ten years (Daniels and Gimblett, 2001; Duane, 1996). Federal land managers have seen an increase in the numbers of constituency groups claiming an interest in, or use of, the public lands (Clarke and McCool, 1996). This social trend began about twenty years ago.

The uniqueness and limited range of giant sequoia trees only adds to the fervor with which people and groups have expressed their feelings. Those that feel the national forests must be managed for protection feel that the sequoias and their ecosystems are so unique and special that no harm should come to them, the trees must be preserved as they stand at a given time and place. Those that feel the sequoias should be managed for recreation amenities would like to see interpretive centers, historical sites marked and interpreted, and education on management policies and practices. The groups and individuals that feel the national forests should be managed for outputs see a need to preserve the giant sequoia species but want the forest to be managed through utilization.

This wide disparity in values surfaced again as a result of President Clinton's 2000 presidential proclamation creating the Giant Sequoia National Monument. In order to assess the degree to which these different values are redeemed through the range of alternatives in this Monument management plan, indicators are selected and analyzed in Chapter 4. These indicators include wood products available from protection and restoration treatments and acres where mechanical treatments would be prescribed.

C. Transportation

1. Roads

Roads on national forest lands serve such needs as recreation, fire protection, vegetation management, commercial use, grazing, research, private property use, and insect and disease control. Most national forest visitors travel on the Forest Service road system. These roads provide access to millions of visitors every year.

There are approximately 900 miles of classified road in the Monument. Most of the forest roads within the Monument were built primarily for timber harvesting between 1950 and 1980. Since that time, timber harvest levels, road construction, and road maintenance have declined considerably. However, public use of the roads has increased about three percent per year, and pleasure driving is the single largest recreational use of lands managed by the Forest Service.

A road is defined as a motor vehicle travel way over 50 inches wide that is not designated and managed as a trail. The quality of roads varies from single-lane dirt roads (the lowest standard) to paved double lane roads (the highest standard). Each of these road types requires a different level of maintenance for upkeep (see the definitions for maintenance levels below and in Appendix E). The mileage of each type of road is shown in Table III-31. Each road also has a functional designation as an arterial, collector, or local road (Table III-32). Arterial roads are the main roads, which traverse the forest and connect to major state highways or county roads. They are paved and designed for high-speed travel. Collector roads connect the arterials to local roads and balance access needs with mobility. Local roads are at the ends of collector roads, tend to be low standard, and serve a small land area.

Access to the Forest Service road system is provided by state and county roads. Access to the vicinity of the northern portion of the Monument is available on a variety of highways and county roads, including State Highways (SH) 99 and 63 and Dry Creek Road. These roads eventually focus traffic on SH 180 or County Road 245, both of which enter the Monument. SH 180 out of Fresno serves the northern portion of the Monument, where it becomes the Kings Canyon Scenic Byway. County Road 245 through Pinehurst serves the west side of the northern portion of the Monument. The General's Highway provides access to this area from the south through Sequoia National Park.

Access to the vicinity of the southern portion of the Monument is also provided by a variety of highways and county roads, including SH 65, 178, and 14, that eventually focus traffic on SH 190 and 155, or County Roads SM50, SM99, and SM107 that enter the Monument. SH 190 out of Porterville provides access to the north part of the southern portion of the Monument. SH 155 provides access from the east and west to the central part of the southern portion of the Monument. In addition to SH 155 from the east, County Road SM99 provides access to the Monument from the Kern Valley. County Roads SM56 and SM50 provide access through the south part of the southern portion of the Monument through California Hot Springs. The Western Divide Highway, SM107, provides north to south access within the southern portion of the Monument and links SH 190 to SM50.

Table III-31: Miles of Roads in the Monument by Maintenance Level

Maintenance Level	Miles
1	360
2	280
3	145
4	70
5	45
Total	900

These data were taken from the forest Transportation Inventory System (TIS) tabular database.

Table III-32: Miles of Road in the Monument by Functional Class

Functional Class	Miles
Arterial	116
Collector	147
Local	637
Total	900

These data were taken from the forest transportation atlas.

The Forest Service has five different traffic management strategies: encourage, accept, discourage, eliminate, and prohibit. The encourage strategy directs forest visitors to important destinations via desirable routes. The discourage strategy informs potential users of road conditions that may detract from the experience they seek when visiting a national forest. Eliminate and prohibit strategies are used to closed roads with physical barriers or regulatory signs and orders (USDA Forest Service, FSH 7709.59-25.3; Sierra Nevada Forest Plan Amendment, Final EIS, Chapter 3, page 446).

The Monument has many routes or wheel tracks that are not included in the forest road system. These roads are defined as unclassified. They have evolved in different ways; some were constructed as temporary roads for past timber harvest projects and were not decommissioned when the project was completed, while some are user-defined roads or paths and are considered a non-authorized use. These roads are not inventoried or maintained; they may be sources of environmental damage. According to the national roads policy, all unclassified roads will be inventoried through the Roads Analysis Process (RAP) during site-specific analysis. The Forest Service will determine whether the route is causing resource damage and if there is an administrative or public access need that warrants adding it to the road or trail system. Once site-specific analysis is completed, the Forest Service manages these roads using three methods: decommissioning, adding them to the trail system, or adding them to the forest transportation atlas and classified road system. Roads are added to the forest transportation atlas after appropriate RAP and NEPA analyses are completed.

The Sequoia National Forest decommissions about three to six miles of road per year in the Monument. Roads previously selected for decommissioning were identified through site-specific analyses of negative impacts to natural or cultural resources or lack of public and administrative use. The RAP will help determine potential roads to decommission for further analysis at the site-specific scale.

a) Costs and Funding for Road Construction, Maintenance, and Decommissioning

In recent years, the Forest Service has actively assessed the condition of its road network. The network is in a deteriorating condition, due to increased use and the

continued deferral of maintenance and capital improvements. Some roads are becoming unusable through lack of maintenance, may be causing resource damage, or are no longer needed or desired for administrative or public access. These roads are candidates for decommissioning after appropriate site-specific project planning.

National forest system roads must receive a certain minimal amount of annual maintenance to safely accommodate their intended use. If the minimal needed maintenance activities do not occur, these activities are termed deferred maintenance. Deferred maintenance can adversely affect the roads' functionality and drainage capability, which can lead to sediment transport to waterways.

To properly keep up the forest road system, the engineering roads maintenance group has historically maintained the roads on a 20-year cycle. For example, each year 5% of Maintenance Level 1 roads must be fully maintained (5% of 360 miles equals 18 miles). The estimated cost figures per mile used in Table III-33 are from the 2002 Electronic Road Log Database. This table displays annual road maintenance costs assuming all Monument roads are maintained to standard and on a scheduled cycle. Costs to adequately maintain the road system on a 20-year cycle exceed the 2002 budgetary allowance by $260,000 as displayed in Table III-33.

In recent years, annual road maintenance budgets have not been sufficient to accomplish maintenance activities on the Sequoia National Forest road system (see Table III-33). Only approximately 28% of the Sequoia National Forest road system was partially maintained in fiscal year 2001.

The existing road maintenance funding for the Monument is used to repair the most pressing safety-related road problems and unacceptable resource impacts. As a result, few of the roads are being maintained to standard or within the 20-year maintenance cycle.

Table III-33: 2001 Road Work Activity Costs to Maintain Five Percent of Monument Roads

Road Activity	Cost per Mile	Road Mile Target	Total Cost
Maintenance Level 1	$6,655	18	$119,790
Maintenance Level 2	9,292	14	130,088
Maintenance Level 3	19,475	7	136,325
Maintenance Levels 4-5	61,070	6	366,420
Total Annual Cost to Maintain Monument Road System			$752,623
Annual Monument Road Maintenance Budget			$491,300
Annual Shortfall for Road Maintenance in the Monument			($261,323)

b) Road Definitions

Classified Roads. Roads wholly or partially within or adjacent to national forest system lands that are determined to be needed for motor vehicle access, such as state roads, county roads, privately owned roads, national forest system roads, and roads authorized by the Forest Service that are intended for long-term use (36 CFR 212.1).

Unclassified Roads. Roads on National Forest System lands that are not needed for, and not managed as part of, the forest transportation system, such as unplanned roads, abandoned travelways, off-road vehicle tracks which have not been designated and managed as trails, and those roads no longer under permit or authorization (36 CFR 212.1).

Forest Transportation Atlas. An inventory, description, display, and other associated information for those roads, trails, and airfields that are important to the management and use of national forest system lands or to the development and use of resources upon which communities within or adjacent to the national forests depend.

Deferred Maintenance. Maintenance activities that are delayed.

Road Decommissioning. Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212). Decommissioned roads are closed to motorized traffic. One method of decommissioning is to convert the road to a trail.

c) Maintenance Levels

Table III-31 displays the miles of road in the Monument by maintenance level. The maintenance level represents the maintenance required for a particular type of road and the level of service that the user can expect. Maintenance levels range from one, representing lower standard roads that are closed to vehicular traffic, to five, representing a higher standard, paved road.

Maintenance Level 1. These roads are closed, although some intermittent use may be authorized. Closures must be in place for one year or more. When closed, they are physically closed with barricades, berms, gates, or other closure devices. When closed to vehicular traffic, the road may be suitable and used for non-motorized uses, with custodial maintenance to protect adjacent resources. When open, the road may be maintained at any other level (USDA Forest Service, FSH 7709.58, 12.3 – Maintenance Levels).

Several roads in the Monument that have a Maintenance Level 1 objective are not physically closed to public use, which is an ongoing administrative issue. Most Maintenance Level 1 roads in the Monument do not have physical barriers that prevent public use.

Maintenance Level 2. These roads are open for use by high clearance vehicles. Passenger-car traffic is discouraged. Traffic is minor administrative, permitted, or for dispersed recreation. Non-traffic generated maintenance is minimal.

Maintenance Level 3. These roads are open and maintained for travel by a prudent driver in a standard passenger car. User comfort and convenience are not considered priorities. Typically, these roads are low-speed and single-lane, with turnouts and native or aggregate surfacing.

Maintenance Level 4. These roads provide a moderate degree of user comfort and convenience at moderate speeds. Most are double-lane and paved, although some roads may be single-lane.

Maintenance Level 5. These roads provide a high degree of user comfort and convenience. Normally these roads are double-lane and paved, or aggregate surface with dust abatement. This is the highest standard of Forest Service road maintenance.