Chapter 3—Affected Environment

Chapter 3 describes the affected environment or existing condition by resource area, as each is currently managed. This is the baseline condition against which environmental effects are evaluated and from which progress toward the desired condition can be measured.

Vegetation, including Giant Sequoias

This section is presented in two parts. The first part presents an overview of the vegetation in the Monument, and highlights the ecology of giant sequoias. This discussion is included due to the emphasis on the protection and restoration of this species in the presidential proclamations. The second part of this section provides a more detailed look at the current condition of the vegetation types in the Monument, with an emphasis on the characteristics most relevant to promoting heterogeneity and resiliency in the ecosystems in which giant sequoia occur. These characteristics include composition, structure, patterns, and ecological processes.

Disturbance and Patterns of Vegetation

Vegetation or ecosystem disturbances may be triggered by events such as drought, fire, disease, vegetation management, avalanches, or landslides. Disturbance results in changes in vegetation structure and composition, and large areas of high tree mortality often represent the more noticeable changes. Successional or seral stages refer in part to changes in forest soils, structure, and composition over time. 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 or the exclusion of fire has had a great effect on distribution, species composition, and stand structure. The forest vegetation between 5,000 and 7,000 feet in elevation is dominated by mixed conifer and has a high degree of variability in density, age class, and species mix as a result of the varied interaction of the factors listed above. This variability is also a result of change such as that brought about by wildfire or fire suppression and exclusion.

Trees and forested stands within the Monument exist in varying degrees of health in terms of insect, disease, crowding, climate adaptations, and age. Most insect and disease populations are endemic or within a degree of severity that allows for the host to survive as a species. Conversely, white pine blister rust, an invasive and damaging fungal agent of sugar pine and other white pines, is common within the Monument and results in or contributes to uncontrolled mortality at any age. The combinations of tree age, site utilization, mistletoe, root disease, and bark beetles, in conjunction with changing climactic conditions in the Monument, currently contribute to increased tree competition for limited growing space, soil moisture, and nutrients, stress, and mortality. Crowding or full site occupancy of trees in many forested stands has contributed to tree mortality through more aggressive insect infestations, larger and more severe wildfires, and soil water limitations.

Vegetation Types

The vegetation within the Giant Sequoia National Monument occurs as three groups that reflect similar climate, geology, soils, and vegetation communities. These groups are: oak woodlands/grasslands, shrublands/chaparral, and coniferous forestlands (including giant sequoia). Within these three groups, there are five vegetation types that will be discussed:

- Blue Oak-Interior Live Oak (foothill woodlands)
- Chaparral-Live Oak (interior and canyon live oaks)
- Montane Hardwood-Conifer
- Red Fir
- Mixed Conifer (including giant sequoias)

See the tables that follow for the acres of each vegetation type, both within and outside of giant sequoia groves. The tables also display the amounts of seral stages by vegetation type. Seral stages are discussed following these general descriptions of each vegetation type.

Blue Oak–Interior Live Oak (Foothill Woodlands)

This more open woodland group is scattered along the western foothills of the Sierra Nevada, generally where moderately steep slopes and open flats mix with steep slopes. The Hot Springs Work Center (formerly the Uhl Work Center) is a point of reference within the group. The mean annual precipitation, mostly rain, is about 18 to 30 inches. The mean annual temperature is about 52 to 64 degrees Fahrenheit. The mean elevation for this group is 3,900 feet. Soils are deep and well drained, supporting blue oak and annual grasslands variably mixed with interior live oak trees. All but the larger streams are dry during a normal summer. Steeper inner gorges with shallow, somewhat excessively drained soils contain chaparral and a shrub form of interior live oak.

Changes to the species composition and burning season have occurred due to the introduction of nonnative annual grass species, which occurred in the mid-1800s. The effects of invasive, nonnative 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. Chaparral and live oak vegetation types currently make up around 55 percent of the type, which may indicate that fire suppression has been the most prevalent force. Portions of this unit are a combination of live oak and blue oak, but are mapped as live oak.

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.

In some portions of the foothill 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.

Chaparral–Live Oak (Interior and Canyon Live Oaks)

This shrub-dominated group is at low elevations scattered along the western edge of the Monument in drainages and along steep inner gorges. Slopes in these areas are often steep and include the inner gorge slopes of the Middle Fork Tule River, the Kings River, and the Kern River. The mean annual temperature is about 52 to 64 degrees F. The mean elevation for this group is 3,860 feet. The mean annual precipitation, mostly rain, is about 18 to 30 inches. 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 the occurrence of schlerophyllous (hard-leaved) vegetation that dominates this group. Common shrubs include white leaf manzanita, mountain mahogany, 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.

Montane Hardwood–Conifer

This forest vegetation group is scattered throughout the Monument in eight distinct areas that range in size from 760 to 11,060 acres. The mean elevation of this group is 4,950 feet. Soils in this group are often moderately deep and/or rocky. Rock outcrops and openings occur throughout the area. Mean annual temperature is about 50 to 60 degrees F, and mean annual precipitation, mostly rain, is about 25 to 50 inches. Runoff is rapid to the major rivers and their tributaries. California black oak is the major tree species with ponderosa pine present on deeper soils. Chaparral is prevalent on rocky, shallow soils and on hotter, south facing steep slopes. Landforms have developed through geological mass wasting processes such as rock falls, rockslides, debris flows, and channel erosion. A high amount of natural disturbance and low snowfall help maintain a high proportion of hardwood species (California black oak, canyon live oak, and interior live oak), even in areas where soils develop strong surface horizons. At higher elevations, this group includes more conifer vegetation.

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 Martir mountains 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).

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 type, chaparral on 15 percent, and live oak on 35 percent.

Red Fir

This vegetation type occurs primarily at higher elevations in the Monument. It has a mean elevation ranging from 7,500 to 8,000 feet. The mean annual temperature is about 35 to 50 degrees F. Cold temperatures limit conifer occurrence and growth. The mean annual precipitation, mostly snow, is about 40 to 60 inches. At the higher elevation range near Jordan Peak, the Needles, Mitchell Peak, and Chimney Rock, red fir forms a plant community with Jeffrey pine. Soils, which are often developed in metamorphic parent materials, are rocky, but deep and well drained. This plant community falls in the upper montane vegetation zone, one of the least altered and most contiguous forested vegetation types. Red fir is found mostly on more productive and cooler locations, whereas Jeffrey pine occurs on shallower soils and warmer aspects. At the lower range of elevation, red fir is commonly associated with lodgepole pine. The red fir-lodgepole pine-meadow plant community occurs within a mean elevation of 7,500 feet 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. This community occurs frequently in broad canyon bottoms with variable slope steepness. Meadows are a common inclusion.. Jeffrey pine 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.

Mixed Conifer, including Giant Sequoia

The mixed conifer vegetation type, which includes giant sequoia, is found between 5,000 and 7,000 feet in elevation. The mean annual temperature varies from 40 to 55 degrees F. Soils are generally deep, well-drained, and located on gentle to steep slopes. The mean annual precipitation ranges from 30 to 60 inches. Snow is a critical form of this precipitation allowing higher soil moisture through the spring or into the summer months. Tree communities normally consist of at least three different species with white fir, cedar, pines, and black oak common. These conifer species occur in four major plant community types and reflect the variability in soils, climate, past disturbance, slope, and elevation.. These types are: (1) Mixed Conifer (MC)-giant sequoia, (2) MC-ponderosa pine, (3) MC-white fir-sugar pine-giant sequoia, and (4) upper MC-Jeffrey pine-giant sequoia.

Areas with shallower soils often support more open mixed conifer forests with higher percentages of pines and hardwoods. Where soils are deep, giant sequoia groves may comprise up to 18 percent of the area. In these productive areas, white fir is common and found in the main canopy. This occurs more on the northern end of the Monument, such as in the Converse and Evans Complex groves, where the mean elevation is 6,000 feet. On hotter, drier sites at the lower elevation extreme with a mean of 5,000 feet, ponderosa pine is a more common associate of the mixed conifer group. Giant sequoia can be found in the mixture with ponderosa pine in the Deer Creek Grove and in drier portions of Converse Basin. In the southern portion of the Monument from Dillonwood Grove to Sunday Peak and with a mean elevation of 6,600 feet, the mixed conifer community is composed of white fir, sugar pine, and giant sequoia.

Sugar pine may make up a large portion of the species composition where site conditions are more open due to fire, shallow soils, or southerly aspects. Red fir is also present at the upper range in elevation and in cold air drainages. Giant sequoia inclusions can be found on up to five percent of this group. Mixed conifer with Jeffrey pine and giant sequoia occurs within a similar mean elevation 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 of the Tule River. A smaller area is located between Dennison Peak and Sequoia and Kings Canyon National Parks. Where Jeffrey pine occurs, soils are shallow and excessively well drained. This favors drought-tolerant Jeffrey pine rather than a more mesic white fir. Sugar pine occurs at lower elevations wherever open stand conditions prevail. Giant sequoia inclusions are found on less than five percent of this subgroup.

Giant Sequoia Ecology

Location and General Habitat

Giant sequoia trees are seldom found in pure stands. They are more often found mixed with sugar pine, ponderosa pine, white fir, incense cedar, and black oak, forming groves at elevations between 5,000 and 7,000 feet in the central and southern Sierra Nevada (Rundel 1971). Annual precipitation in groves varies from about 35 to 55 inches, but varies greatly. Usually, less than about an inch falls between June 1 and September 30, and most of the precipitation is snow between October and April. Snow depths of over six feet are common in midwinter (Rundel 1969). Large giant sequoia trees are found on sites ranging from wet to dry, but are commonly found on moist sites with more gentle slopes and rich soil. Mesic sites that are not too wet for root survival are best for maintaining and growing giant sequoia. In some groves the shape of the topography, along with deep, more fertile soils, indicates there is more water available than expected from precipitation. One study has suggested that more available soil moisture within a grove is associated with subterranean flow from higher elevations (Rundel 1972).

Environmental Threats to Giant Sequoia

The greatest current threat to most sequoia ecosystems is the heavy buildup of surface and ladder fuels which could do serious damage to existing larger trees and the soil resources that support the giant sequoia. Associated with this is the abundant ingrowth of white fir and incense cedar. These species are more tolerant of shade. They reduce the growth of other tree species by using soil moisture and casting shade. They also serve as ladder fuels which could damage or kill the

crowns of the largest trees. Sugar pine may be the species of greatest concern, due to the additional threat of white pine blister rust.

Many forest trees have insects, diseases, and other factors that shorten their lifespan. The giant sequoia is very resilient to these kinds of environmental threats. Threats to giant sequoia health include altered fire regimes, emergent disease complexes, invasive species, air pollution, and a changing climate (York et al. 2012).

Although cutting large giant sequoia is no longer a threat on National Forest System lands, humans can affect giant sequoia in many ways. Walking or driving over tree roots can affect soils and the roots of sequoia trees (Demetry and Manley 2001). Sequoia roots can reach out over a hundred feet from the base of the tree (Harvey et al. 1980). Roads and buildings can also damage root systems. Road construction can change how much or at what time water enters or leaves the soils where sequoia trees grow (Vale 1975).

Clearing land, burning, or even growing too many trees within a grove may also influence water availability to giant sequoia (Meyer and Safford 2011) and other tree species in mixed conifer forests (Zald et al. 2008). These changes in water availability and inter-tree competition may reduce the vigor of trees (as indicated by radial growth), even in very large giant sequoias (York et al. 2010). In the absence of prescribed fire and other treatments designed to reduce surface and ladder fuels, giant sequoia groves may be at risk of elevated crown fire potential (Kilgore and Sando 1975). Hence, as these fuels increase beyond threshold values, the risk they pose to larger trees is increased (Stephens et al. 2002). For a full discussion of the susceptibility of vegetation to wildfire, see the Fire and Fuels section next in this chapter. While root rot does not normally kill most sequoias, it weakens the root system and may cause uprooting even in large trees (Piirto et al. 1984). A weakened root system will reduce the ability of a giant sequoia to extract water and nutrients from the soil. However, the effects of root dieseases and insect species on giant sequoia remains poorly understood (Piirto 1992).

Existing Conditions

The following summarizes the status of key ecological conditions, both within the giant sequoia groves and in the surrounding mixed conifer forest. The purpose of this section is to quantify the existing baseline conditions. The Clinton proclamation noted the lack of regeneration of giant sequoia and the risk of the groves to catastrophic fire. It also noted the changes in the forest from past harvesting and the exclusion of fire. Special attention is given in this section to important characteristics of structure, species composition, age class distribution, and fuel loading for the giant sequoia ecosystem. The foundation for these ecological conditions is the report "An Ecological Foundation for Management of National Forest Giant Sequoia Ecosystems" (Piirto & Rogers 1999). This report describes specific structural and process indicators in the mixed conifer-giant sequoia forest ecosystems in the Giant Sequoia National Monument.

In the Monument, approximately 70 percent of the 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 70 percent of the grove acreage (Stephenson, 1996). The dramatic changes in certain climatic growing conditions for giant sequoia during the last 130 years or so has 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 percent, the vast majority was logged near the turn of the 20th century and was concentrated in several groves (Converse Basin, Grant, Indian Basin, and Big Stump) in the northern end of the monument. These harvested groves have revegetated with conifers, and 2nd growth giant sequoias are a significant component of the stand composition. Since the logging however, other opportunities (via disturbance) have been foregone for new generations of giant sequoia to become established.

There is considerable information available about the range of existing conditions in the Monument, particularly those problem areas emphasized in the

Presidential 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; maps using geographic information systems (GIS) that display 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 the existing conditions in the Monument.

Heterogeneity and Resiliency

Forest ecosystems that are resilient to disturbances, such as insect attacks, extended droughts, diseases, and wildfire, tend to exhibit high structural heterogeneity (North et al. 2009). This ability to withstand and respond to these events is considered the resiliency of the vegetation. This section discusses the key characteristics of vegetation age (seral stages), species composition, and forest structure as a reflection of overall heterogeneity and the resiliency of vegetation.

Seral Stages

Each vegetation type has varying amounts of seral stages. Seral stages represent age groups of the vegetation within the vegetation type. Healthy and resilient vegetation types have a diversity of seral stages. Early seral stages are important in order to provide recruitment for mid and late seral stage vegetation and associated wildlife habitat. These seral stage amounts vary across the Monument landscape and are affected by the sizes and degrees of disturbance by events such as fire or tree cutting. These seral stages are identified and described using the diameter ranges which define each size class of the California Wildlife Habitat Relationships (CWHR) as follows:

Table 64 Classifications of Seral Stages

Size Class	Diameter	Seral Stage
1: Seedling	Less than 1 inch	Early
2: Sapling	1 to 6 inches	Early
3: Pole	6 to 11 inches	Mid
4: Small	11 to 24 inches	Mid
5: Medium/large	Greater than 24 inches	Late
6: Multi-layered	Size Class 5 trees over a distinct layer of Size Class 4 or 3 trees, with over 60 percent canopy closure	Late

The following tables display major vegetation types by seral stage. The Monument encompasses approximately 328,300 acres of national forest lands. There are approximately 243,100 acres of major vegetation types within the Monument that lie outside the grove boundaries.

Table 65 Acres of Major Vegetation Types Outside Groves

Vegetation Type	Acres			
	Early Seral	Mid Seral	Late Seral	Total
Blue oak	20	4,570	90	4,670
Chaparral	690	1,020	0	1,710
Mixed conifer	1,080	87,720	28,940	117,740
Montane hardwood	1,620	74,260	4,160	80,030
Red fir	130	30,870	7,980	38,970
Total	3,530	198,430	41,160	243,120

Sequoia groves encompass 27,830 acres in national forest ownership. The groves are heavily dominated by the mixed conifer vegetation type. There are approximately 26,600 acres of major vegetation types in these groves.

Table 66 Acres of Major Vegetation Types within Groves

Vegetation Type	Acres			
	Early Seral	Mid Seral	Late Seral	Total
Blue Oak	0	0	0	0
Chaparral	50	N/A	0	50
Mixed conifer	220	11,980	10,690	22,890
Montane hardwood	70	2,340	140	2,550
Red fir	0	610	400	1,010
Total	340	15,040	11,230	26,610

Plantations (early seral stages)

During the last 25-30 years, 4 percent (approximately 1,000 acres) of the grove acreage in the Monument has had sufficient disturbance (through logging and subsequent burning for fuel reduction and site preparation) to initiate regeneration of young giant sequoia and associated mixed conifer species and other vegetation. After harvest occurred in these areas, they were re-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. Naturally occurring young mixed conifers, as well as oaks, also became re-established to complement the planted trees. 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. There is a need to move these existing openings towards desired conditions, particularly in heterogeneity in species composition and diversity of age and size classes. These areas represent early to mid seral stage vegetation, as the average tree diameters are between 6 and 12 inches. When comparing the species mix of the planted trees 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.

Regeneration in Undisturbed Groves

The following graph displays the amount of giant sequoia regeneration in a sampled subset of groves that have not been disturbed by fire or harvesting. The results clearly indicate that giant sequoia trees are almost non-existent in the smaller diameter classes within the groves that have been inventoried. This is not to say that young giant sequoias do not exist, but that their levels are very low. If and when these groves are exposed to wildfire or prescribed fire under existing high fuel loading, many of these young giant sequoias are very likely going to be lost. Given this expected level of mortality from various agents (drought, insects, tree competition, fire), there are not enough young trees to provide recruitment of future monarch trees. Only Deer Creek grove has any significant small trees (approximately 60 trees less than 10 inches in diameter per acre). These results give a grove-wide perspective on the status of younger sequoias. When specific projects are considered for each grove, more intensive information will be needed to validate the site-specific conditions of the groves.

Historic Harvesting in Giant Sequoia Groves

Approximately 20 percent of the grove acreage 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 fully and naturally revegetated with conifers, and second-growth giant sequoias are a significant component

of the stand composition. The mixed conifer-giant sequoia stands in these historically logged areas are now dominated by mid-seral stage vegetation. Since the logging, however, no other disturbances have occurred to promote the establishment of additional new generations of giant sequoia.

Stand Structure in Sequoia Groves

Giant sequoia groves are a subcomponent of the mixed conifer vegetation type. They occupy a wide variety of site conditions, but often encompass the more productive, moist sites that grow not only the largest giant sequoias, but the largest pines and firs in the mixed conifer group. In most size classes, the average species size distribution follows the common inverse relationship of size and number of trees where the larger the tree, the fewer the number.

Of the groves/grove complexes in the Monument, only 13 have had significant disturbances in the last 120 years that have led to the establishment of substantial new conifer vegetation (early seral stages).

The structure of the regeneration that has become established in the last 120 years is very different from regeneration established prior to that time. The primary disturbance agent in the 1000-year period up until 1875 was a regime of low to moderate intensity, high frequency fires. This fire regime typically created a mosaic of vegetation and gaps, with the gaps typically less than 0.5 acre in size. Larger gaps were more infrequent, although intense wildfires were observed that were possibly several hundred acres in size. The variability in gap size provided a range of growing conditions, which led to a variety of species, from shade-intolerant (pines, giant sequoia, black oak) to shade-tolerant (incense cedar, white fir). The shift in the primary disturbance regime to extensive logging has led to a shift in the structural characteristics of openings. For instance, the Converse Basin Grove was almost completely cutover, and the regrowth is a mostly 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 (1999).

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 Giant Sequoia National Monument). The approximately 1,000 acres of openings average 10 to 15 acres in size, which is often outside the estimated natural range of variability for giant sequoia groves (Bonnickson and Stone 1981, Demetry 1995, Piirto and Rogers 1999) and Sierra Nevada mixed conifer forests (North et al. 2004, Knapp et al. 2012). Many of these canopy openings were re-planted predominantly to pines and lesser amounts of other species such as white fir, sugar pine, and giant sequoia. Although shade-tolerant tree species are becoming more common in giant sequoia groves due to the absence of fire, mechanically-created canopy openings may still retain substantial densities of both planted and naturally regenerated giant sequoia and other shade-intolerant trees (York et al. 2010, Meyer and Safford 2011b).

Across all groves, in most tree size classes, the average species size distribution follows the common inverse relationship of size and number of trees, where the larger the tree, the fewer the number, especially in groves where fire has been excluded (York et al. 2012). Trees in the large to intermediate size classes are underrepresented, especially in the 20- to 28-inch size class, as shown in the following table and figure. All of the following figures were based on the 1999 inventory of half the groves in the Monument and the 2009 inventory of the remaining half. This apparent deficiency is due to the lack of disturbance in many of the groves and the lack of recruitment of pines and giant sequoia. The following tables display the very high amounts of shade-tolerant seedling and saplings (almost exclusively white fir and incense cedar) and the sudden "drop-off" in intermediate-sized trees and the existing and desired amounts of mixed conifer species.

The lack of recent disturbances, such as fire and harvesting over the last decade or more which create canopy gaps and expose mineral soils, has resulted in many groves lacking significant natural sequoia regeneration less than thirty years old (e.g., Stephenson 1994, Meyer and Safford 2011b, York et al. 2012). The lack of more favorable summer rains or soil moisture during the summer and fall has likely been an additional factor in poor survival and growth of new seedlings (e.g., Stephens et al. 1999, York et al. 2010). Sequoia seedlings planted during this time

Figure 3 Number of Trees per Acre by Diameter Class

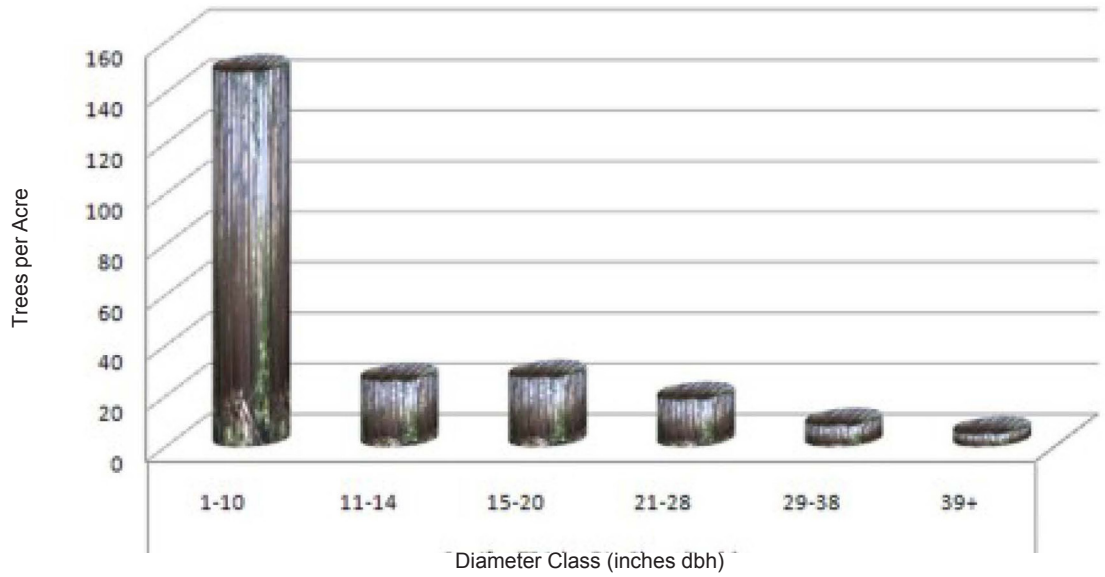
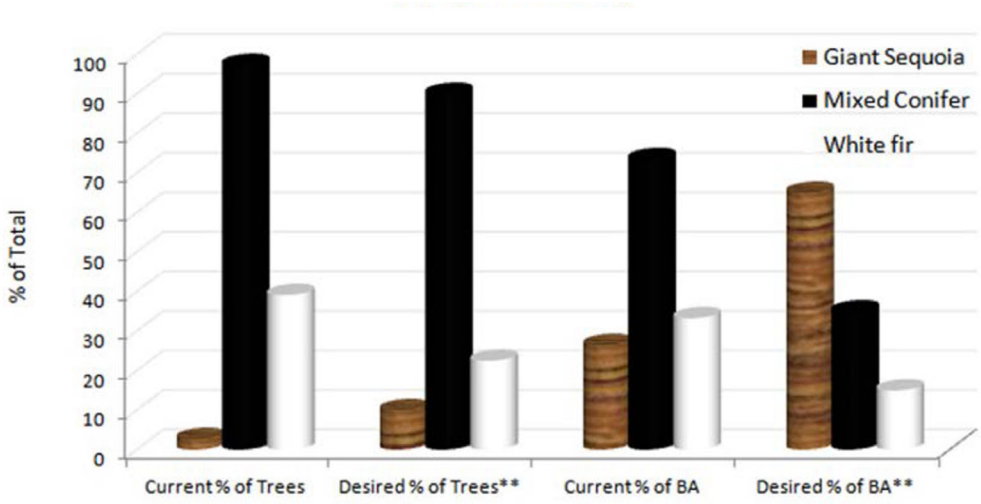


Figure 4 Comparison of Existing and Desired Percentages of Giant Sequoia, White Fir, and Other Mixed Conifer Species



have survived and established well in the limited openings available for regeneration projects.

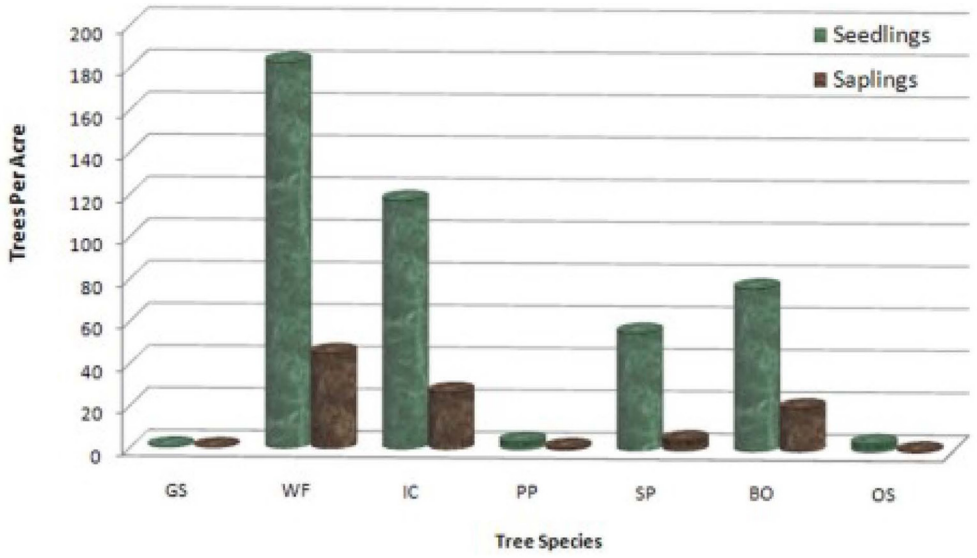
White fir and incense cedar are well-adapted to low understory light conditions with relatively moist soils and are often highly abundant in closed-canopied coniferous stands (Gray et al. 2005, Zald et al. 2008). These two species, which were not as common when the groves burned more frequently, make up about 75 percent of the seedling-sized trees in groves, with black oak and sugar pine being the next most abundant (see Appendix I of this FEIS). Giant sequoia seedlings and saplings may be abundant in occasional openings, but are relatively rare under mature canopies (Demetry and Duriscoe 1996, Meyer and Safford 2011b). Giant sequoia regeneration often depends upon adequately disturbed soils, sufficient soil moisture, and canopy openings for sufficient growth and survival (Harvey et al. 1980).

Tree mortality in groves follows a pattern common in most forests, where most dead trees are smaller and suppressed, but with a greater than expected relative mortality of large-diamer trees (Smith et al. 2005).

Similarly, fewer of the dead, fallen trees are over 24 inches in diameter (see Appendix I of this FEIS). The high mortality of larger white fir, sugar pine, incense cedar, and black oak in some groves is most likely due to overcrowding, drought, and insects. Higher mortality such as this can be expected in many groves given the current drought; future predictions that we may see warmer and drier growing conditions; increasingly higher densities of trees; and older ages of pines, oaks, cedars, and firs.

With a lack of adequately disturbed soils and canopies, giant sequoia only averages about 1 seedling per acre. In 2009, the average number of mixed conifer tree seedlings, including black oak, was 444 trees per acre across 26 groves. A more desirable species mixture would contain 44 giant sequoia seedlings per acre or 10 percent of the total. The following figure displays the amount of early seral stage (seedlings and saplings) mixed conifer species.

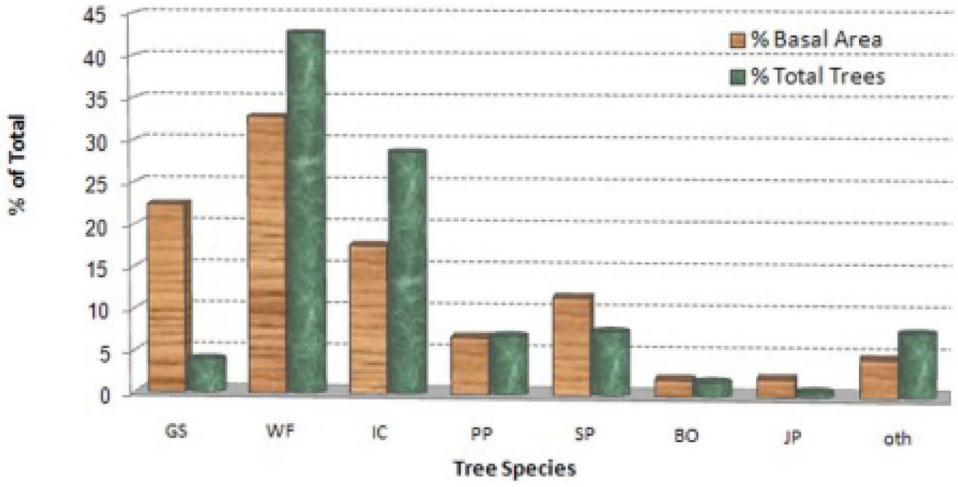
Figure 5 Seedlings and Saplings by Species in Groves



GS=giant sequoia, WF=white fire, IC=incense cedar, PP=ponderosa pine, SP=sugar pine, BO=black oak, OS=other species.

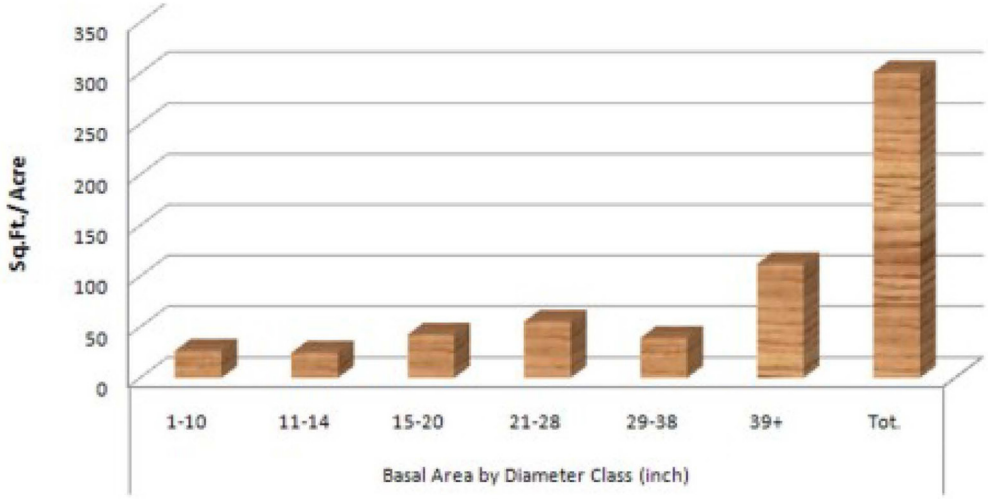
The following figures show additional data for tree species composition and tree density for the giant sequoia groves in the Monument.

Figure 6 Percent of Basal Area and Trees/Acre by Conifer Species in Groves



GS=giant sequoia, WF=white fire, IC=incense cedar, PP=ponderosa pine, SP=sugar pine, BO=black oak, JP=Jeffrey pine, Oth=other species.

Figure 7 Basal Area by Diameter Class in Groves



Gaps

The findings of York et al. (2003, 2004, 2010) are consistent with well-established research on gap size in forest ecosystems across the nation. Small gaps may not provide enough light for shade intolerant species. They found that giant sequoia seedlings compared to other tree seedlings responded best to increases in light. For small gap or group sizes less than 2 acres, the study demonstrated that ample light was lacking in southern portions of the opening for trees that need more light for growth, mainly sequoia and pines. York et al. (2004) found that seedling growth was greatly increased in canopy openings that exceeded between 0.7 and 1.5 acres in size, especially where the opening diameter was 2.6 times the height of the edge trees. The increases in growth rates due to increases in opening sizes were not linear. York at al. (2009) found that growth rates of young giant sequoia seedlings and sugar pine increased rapidly when openings were increased from 0.1 acres to 0.5 acres. The rate of increase was less in openings from 0.5 to 1 acre in size. However, seedlings of both tree species had similar growth rates in the center of gaps that varied between 0.2 and two acres in size. In addition, in an experimental canopy gap study in Redwood Mountain Grove, York et al. (2010) demonstrated that planted giant sequoia seedling growth rates more than doubled as gap size increased from 0.1 acre to 0.6 acre, even though seedling mortality rates did not vary with gap size. These combined experimental studies demonstrate that even relatively small canopy gaps (i.e., 0.4 to 0.7 acre) can significantly increase the growth rates of giant sequoia seedlings and other tree species, such as sugar pine (e.g., York et al. 2004).

Due to the uncertainty of sugar pine regeneration, due to the effects of white pine blister rust, more attention needs to be placed on the artificial regeneration of more rust-resistant sugar pine to help assure its important role in mixed conifer ecosystems, including giant sequoia groves.

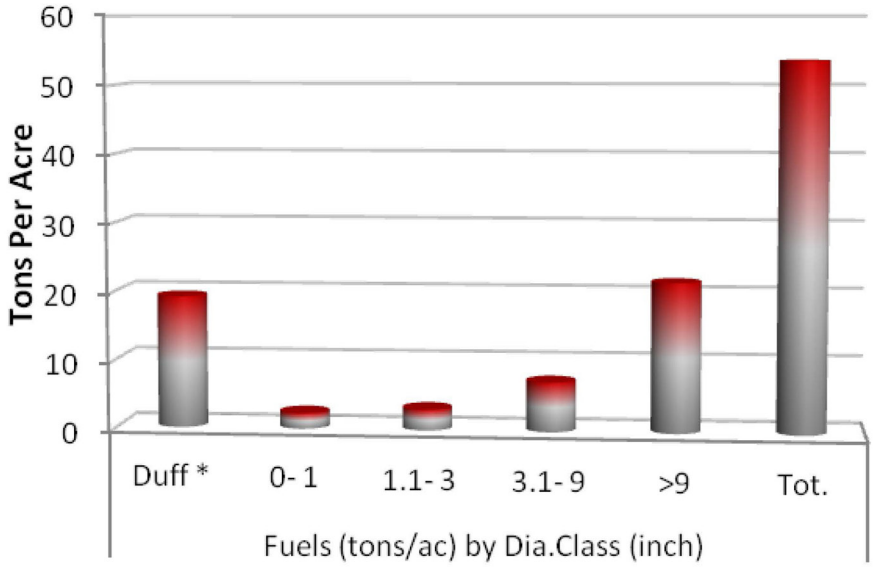
In the Monument, it is anticipated that up to 10 percent of tree planting mixes will include sugar pine, a major species in mixed conifer communities, including giant sequoia groves, that is threatened by the blister rust disease. In order to better manage this species, it will be important to assure ample sunlight in gaps where sugar pine is desired. This will help assure favorable growth and improve resistance to drought, bark beetles, and other factors in addition to the threat that blister rust poses in managing this species. Larger openings in the upper canopy will provide conditions that sequoia and pines need to keep up with or outgrow shrubs, white fir, and incense cedar.

Fuel Loadings

The greatest current risk to most groves is the heavy buildup of surface and ladder fuels which could do serious damage to existing larger trees. Associated with this is the abundant ingrowth of white fir and incense cedar. These more shade tolerant species serve as ladder fuels which could damage or kill the crowns of the largest trees. Tree mortality follows

a pattern common in most forests where most dead trees are smaller and suppressed. In 1999 there was an average of 21 standing dead trees per acre over 16 groves. Only 10 percent of these were dominant or larger trees. Similarly, less than 30 percent of the dead, fallen trees were over 24 inches in diameter. The high mortality (42 standing snags per acre) of larger white fir, sugar pine, incense cedar, and black oak in the Mountain Home Grove was most likely due to overcrowding, drought, and insects. Higher mortality such as this can be expected in many groves given the current drought; future projections of warmer climate conditions; increasingly higher densities of trees; and older ages of pines, oaks, cedars, and firs. Higher tree mortality in groves such as Alder Creek (56 snags per acre) and Mountain Home will likely contribute to a higher fuels loading. Alder Creek and Mountain Home groves in 1999 already had total fuel loads of 92 and 75 tons per acre, respectively. Many groves now have an excessive buildup of surface and ladder fuels and a lack of canopy openings needed for abundant regeneration. The average surface fuels, shown in the following figure, and the density of white fir (shown in a later figure), are currently about twice the amount desired for managing fuels and tree species composition in a sequoia grove.

Figure 8 Current Surface Fuel (Averages from 16 groves from 1999)



* 9.4 tons/acre per inch of duff depth = tons per acre of duff

Early seral stages, where surface fuels are reduced and direct light is increased, are generally required to promote and retain regeneration of desirable species like sequoia, ponderosa pine, Jeffrey pine, and possibly sugar pine (York et al. 2004, Zald et al. 2008). Many sequoia groves that experienced decades of fire exclusion have a buildup of surface and ladder fuels (Kilgore and Sando 1975) and a lack of canopy openings that greatly reduce the densities of sequoia regeneration (Harvey et al. 1980).

White fir and incense cedar do not require the early seral stages of seed dispersal, germination, and growth. They can regenerate under many diverse conditions of light, forest floor cover, and soil moisture found in groves. Smaller white fir and incense cedar trees up to 6 inches or more in diameter are easily killed in light to moderate intensity burns. Tree mortality resulting from the effects of fire depends on many factors such as bark thickness (insulation), tree diameter, crown damage, intensity of heat at the base of the stem, duration of the heating event, surface and ground fuel consumption, and weather (Ryan and Reinhardt 1988, Ryan and Amman 1996, Stephens and Finney 2002). Larger diameter trees are generally more resistant to fire injury due to an increase in crown base height and bark thickness (Ryan et al. 1988). Consequently, tree diameter is often a significant factor influencing the probability of mortality in a variety of Sierra Nevada tree species, including giant sequoia, sugar pine, and ponderosa

pine (Stephens and Finney 2002). In addition, crown injury is a consistently significan factor predicting post-fire mortality of tree species in conifers throughout the Sierra Nevada (Schwilk et al. 2006, Hood et al. 2010).

Prescribed fires of low to moderate intensity often kill small trees that serve as ladder fuels either by stem or foliar damage. Trees of many sizes may have foliage close to the ground that could be ignited. Stephens and Finney (2002) observed that tree diameter was a significant parameter in all mortality models developed except for giant sequoia and sugar pine. The insignificant diameter factor in the giant sequoia model was presumed to be a result of giant sequoia's ability to resist high amounts of crown damage. Where crown damage was not a major factor, trees 10 inches and larger had a high probability of surviving prescribed fires.

The presence of a wide range of sizes and ages of incense cedar and white fir thus indicate that these shade tolerant species are a part of the natural giant sequoia ecosystems under a sporadic fire regime. Historically, the mean fire return intervals in giant sequoia ecosystems typically ranged between 10 and 20 years (Swetnam et al. 2009, Van de Water and Safford 2011), depending on the topography and scale of analysis. Past human interventions preceding the more recent fire suppression likely resulted in unnaturally frequent burning cycles. Based on this, the recommended management entries for returning low to moderate intensity fire to national forest giant sequoia groves, should be in the range of 5 to 20 years (Piirto and Rogers 2002). Although fire may have occurred in most groves on a similarly frequent basis, it is likely that only portions of a grove burned. Nearly all groves in the Monument have missed several maximum fire return intervals, resulting in negative effects to sequoia ecosystems (e.g., increased insect and disease risk, reduced sequoia regeneration) and increased risk of large high-severity wildfires (York et al. 2012).

Giant Sequoia Regeneration

Many groves currently have scattered trees or groups of small sequoia trees 30 to 100 years old in small openings or other disturbed areas. The lack of recent disturbances, such as fire and vegetation management over the last decade or more which create canopy gaps and expose mineral soils, has resulted in many groves lacking significant natural sequoia regeneration less than thirty years old (e.g., Stephenson 1994, Meyer and Safford 2011b, York et al. 2012). The lack of more favorable summer rains or soil moisture during the summer and fall has likely been an additional factor in poor survival and growth of new seedlings (e.g., Stephens et al. 1999, York et al. 2010). Sequoia seedlings planted during this time have survived and established well in the limited openings available for regeneration projects.

White fir and incense cedar are well-adapted to low understory light conditions with relatively moist soils, and are often highly abundant in closed-canopied coniferous stands (Gray et al. 2005, Zald et al. 2008). These two species, which were not as common when the groves burned more frequently, make up about 75 percent of the seedling-sized trees in groves, with black oak and sugar pine being the next most abundant (see Appendix I of this FEIS).

Giant sequoia seedlings and saplings may be abundant in occasional openings, but are rare under mature canopies. Giant sequoia does not normally regenerate naturally without adequately disturbed soils and openings in canopies. Sugar pine regeneration often requires a combination of adequate soil moisture and litter cover, but seedlings can be found under variable canopy cover conditions (Gray et al. 2005). Sugar pine, ponderosa pine, and Jeffrey pine seedlings can benefit from prescribed fire and mechanical treatments that increase understory light and available soil moisture (York et al. 2004, Moghaddas et al. 2008, Zald et al. 2008).

Early seral stages, where surface fuels are reduced and direct light is increased, are generally required to promote and retain regeneration of desirable species like sequoia, ponderosa pine, Jeffrey pine, and possibly sugar pine (York et al. 2004, Zald et al. 2008). Many sequoia groves that experienced decades of fire exclusion have a buildup of surface and ladder fuels (Kilgore and Sando 1975) and a lack of canopy openings that greatly reduce the densities of sequoia regeneration (Harvey et al. 1980).

Some research has suggested that most groves today lack sufficient young giant sequoias to maintain the present density of mature trees in the future, especially in the absence of recent fire (Stephenson 1994, 1996). However, the few groves that have experienced repeated recent prescribed burning have substantially greater densities of sequoia regeneration than nearby unburned groves (York et al. 2012). Rundel (1971) speculated that giant sequoia regeneration has been declining over a period of 100 to 500 years or more. Given the longevity of the species, the tendency to grow best following canopy-removing disturbances, and the frequency of droughts, it is not likely that sequoia regeneration would follow a smooth pattern of successful seedling establishment. It is likely that sequoia regenerates only during years when the site conditions and soil moisture are optimal (e.g., York et al. 2010). Schubert (1962) recognized that to support the establishment of a young sequoia, moisture and adequate light were critical throughout the growing season.

Although young sequoias must grow large enough to survive the effects of repeated fires, sequoia regeneration may benefit from repeated prescribed burning. In Sequoia and Kings Canyon National Parks, giant sequoia regeneration increased following single-entry prescribed burns, and increased again following second-entry burns (York et al. 2011). In a related study, giant sequoia regeneration was detected following second-entry burns, but not first-entry burns (Webster and Halpern 2010). These results emphasize that repeated prescribed burning in sequoia groves can have beneficial effects on giant sequoia regeneration. Patches of giant sequoia regeneration in clusters of a few trees or small even-aged patches frequently occur in canopy gaps of up to an acre (Demetry and Duriscoe 1996, Stephenson 1996). Even-aged cohorts greater than approximately an acre are relatively uncommon, but may be found as a result of past stand-replacing wildfire or mechanical harvest (Bonnickson and Stone 1982, Stephenson 1996).

Another major concern in most sequoia ecosystems is the heavy buildup of surface and ladder fuels which could do serious damage to existing larger trees and the soil resources that support the giant sequoia in the event of a wildfire. Associated with this is the abundant in-growth of white fir and incense cedar (Bonnickson and Stone 1982). These species are more tolerant of shade (Schubert 1965, Laake 1990). They reduce the growth of other tree species by competing for light and soil moisture. They also serve as ladder fuels which could damage or kill the crowns of the largest trees (Stephens et al. 2009). Sugar pine may be the species of greatest concern, due to the additional threat of white pine blister rust (Schwandt et al. 2010).

Regeneration of giant sequoia requires adequate soil moisture to allow young seedling roots to grow and reach soil depths that will maintain the seedling during the long, warm summer and fall (Harvey et al. 1980, Harvey and Shellhammer 1991). After seedling roots are established young sequoias will grow rapidly depending on the amount of soil moisture and light reaching its foliage.

Giant sequoia has been considered shade intolerant throughout the various stages of its life (Harvey et al. 1980). Young giant sequoia seedlings, however, can tolerate low light conditions and may even require shade to reduce excessive avaporative water loss until more extensive root systems are established (Stark 1968, York et al. 2010). Survival of sequoia seedlings in the first year appears to be very sensitive to the amount of direct sunlight reaching the seedling. This may also be related to the timing of growth of roots and amount of duration of heat during the growing season. While it is clear that established giant sequoia grows best in direct sunlight, first year seedlings may not (Harvey et al. 1980). Field observations indicate that exposure to sunlight in extremely hot weather where the canopy opening is greater than 70 percent may reduce the growth and survival of first year sequoia seedlings. After the initial establishment, sequoia trees grow better in full sunlight. Under continued shade, they will grow slowly and can remain alive as a small tree (5 to 15 feet tall) for 30 to 100 years or more. As with many trees that show an intermediate tolerance to shade in the juvenile stages, giant sequoia will die after several years under a very dense canopy (Hanna pers. comm.). It will still require field testing to determine why survival of sequoia seedlings in the shade in the first year may be much better than survival in full sunlight. This may become more important to study if we continue to experience warmer, longer, and drier summers.

Picture 1 A 40-year-old giant sequoia 7 feet tall and 2 inches in diameter at the base suppressed and killed by overcrowding and 100 percent canopy cover in Alder Grove.

White fir and incense cedar regeneration is highly adapted to shade-tolerant conditions, but can also grow successfully in open canopy conditions typical of high intensity burned or harvested areas (Zald et al. 2008, Meyer and Safford 2011b). In these conditions, there can be sufficient sunlight and available moisture for seed dispersal, germination, and growth. White fir and incense cedar can regenerate under many diverse conditions of light, forest floor cover, and soil moisture found in groves (Meyer and Safford 2011b). The ability of these species to regenerate and persist under a wide variety of conditions is reflected in the high amounts in the giant sequoia groves and in the mixed conifer vegetation type. The presence of a wide range of sizes and ages of cedar and fir thus indicate that these shade tolerant species are a part of the natural giant sequoia ecosystems under a sporadic fire regime. Fire return intervals in giant sequoia ecosystems frequently ranged between four and 16 years and typically burned as low- to moderate-intensity surface fires (Stephenson 1996). Smaller patches (frequently less than one acre) of high-intensity fire were also characteristic of fire regimes within giant sequoia groves (Stephenson 1996). Based on this, using mechanical or fire treatments for returning low- to moderate-intensity fire to national forest giant sequoia groves, could promote understory treatments with occasional canopy gaps to attain restoration objectives, such as the promotion of sequoia regeneration (Piirto and Rogers 2002). However, in the long term, timing of treatments will need to account for changes in climate and shifting reference conditions (Stephens et al. 2010).

Although fire may have occurred in most groves on a similarly frequent basis, it is likely that only portions of a grove burned. Sequoia ecosystems are highly variable in moisture and topography and have adapted to fire return intervals that are irregular in both location and length of time.

Fire and Fuels

Sustainable ecosystem-based management, which is now the standard on most public lands, will be successful if fire policy and management are: (1) based on ecological principles; (2) integrated with other resource disciplines, such as wildlife, hydrology, and silviculture; and (3) are relevant for applications at large spatial and temporal scales (Keeley et al. 2009).

Within the Monument, it is desirable for fire to recur in its characteristic pattern and resume its ecological role. Restoring fire regimes will greatly enhance the resilience of ecosystems to uncharacteristically severe or damaging fires. While the restoration of fire is likely to result in long-term reduction in susceptibility to large damaging fires, consideration of human health and safety and other resource values will require prioritization of fires to specific emphasis areas.

Characteristic Fire Regimes

Restoring and maintaining long-term sustainability and health of fire-affected systems requires management objectives and strategies that are adapted to and consistent with the fire regimes of targeted ecosystems (Keeley et al. 2009). Spatial variation in forest structure is important for maintaining

the ecological characteristics of ecosystems that provide wildlife habitat, ecosystem resilience, and biodiversity. Heterogeneous forest structures are characteristic, and "average" stand conditions are rare in active-fire Sierran mixed conifer forests (North et al. 2009). Knapp et al. (2009) recommend that prescribed burning be conducted at various times of the year or with different prescriptions (firing patterns) to maximize diversity and to alleviate the potential for undesired changes that may come with repeated burning at a single time of the year.

Fire regimes can be described as varying in seasonality, frequency, size, patch size and distribution, fire intensity, severity, and fire type (Sugihara et al. 2006, Keeley et al. 2009). Van Wagtendonk and Fites-Kaufman (2006) describe the fire regimes of the Sierra Nevada, and Sawyer et al. (2009) list the fire regime characteristics for the plant communities (alliances) of California. Both publications include the Monument ecosystems. These descriptions incorporate characteristic levels of heterogeneity within the individual plant communities. For more information about fire regimes for the Monument, see the fire regime table in Appendix H of this FEIS.

Fire History

Fire history for the Sequoia National Forest shows that 60 percent of fires are attributed to lightning and 40 percent to human causes. Within the Monument, 50 percent of fires are lightning-caused and 50 percent human-caused.

A total of 2,151 recorded fires occurred in the Monument between 1969 and 2010. Eighteen of these fires exceeded 100 acres. An additional 11 fires (exceeding 100 acres) burned partially into the Monument.

In the past 40 years, lightning-caused fires have burned about 1,240 acres (1 percent), and human-caused fires have burned pproximately 26,270 acres (7 percent) in the Monument (see the following table). Between 2003 and 2011, the Sequoia National Forest managed 54,230 acres of fires caused by lightning (managed wildfire).

Table 67 Acres of Lightning- and Human-Caused Fires Over 10 Acres in Size, by Administrative Area, in the Past 40 Years

Administrative Area	Lightning-Caused	Managed Wildfire[1]	Human-Caused
Monument	1,240 acres (1 percent)	5,900 acres (11 percent)	26,270 acres[2] (7 percent)
Sequoia National Forest outside the Monument	103,650 acres (99 percent)	48,340 acres (89 percent)	349,770 acres (93 percent)
Total	104,880 acres (100 percent)	54,230 acres (100 percent)	376,040 acres (100 percent)

1. Includes managed wildfire 2003-2011
2. 16,700 acres of the 26,267 acres of human-caused fires in the Monument are attributed to the 2002 McNally Fire.

Fuels Management

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

Fuel consists of a combination of living and dead vegetation. Fuel moisture content, size (surface area to volume), distribution and structural arrangement in the stand and on the landscape, quantity (loading), and chemical content interact with weather and slope to determine fire behavior. Changes to any of these variables can influence fire behavior and fire effects and the potential to meet the desired outcomes of a management activity. Weather conditions (such as relative humidity and wind) during a fire also influence fire behavior and can be adjusted to accomplish specific desired effects if fires are prescribed to burn under a limited set of weather conditions, prescription parameters, and weather windows. Fuel management is important because it gives us the opportunity to modify the pattern of

future fire by modification of today's fuel (Husari et al. 2006).

Fuel structure can be described in terms of arrangement such as vertical or horizontal continuity, or surface or crown fuels. Ladder fuels provide continuity between surface fuels and crown fuels, providing surface fires a potential path to the canopy and increasing crown fire potential. Fuels can also be described in terms of stand structure, species composition, and chemical composition.

Fuel loading is a quantifiable measure of fuel in a given area, usually expressed in tons per acre by size class. Fuel load is a key characteristic that is useful for identifying when current fuel conditions will support fire intensities and severities that exceed historic reference conditions. Fuel loadings are often assessed before treatment to determine how much to reduce the fuels. The giant sequoia groves in the Monument have been inventoried and assessed for average fuel loading. These inventories represent the range of conditions in each of the groves and include surface fuel and duff loadings. The grove averages (for 16 giant sequoia groves), including duff, are up to approximately 60 tons per acre (see the grove inventory data in Appendix I). Where the fuel conditions are likely to support fire uncharacteristic for a particular ecosystem, fuel treatments are considered.

Fuels managers usethe fire behavior assessment to develop goals and objectives that will move fuel loads toward the desired condition. The Forest Plan recognized the role of fire as a natural process and a needed component in forest ecosystems. The policy of appropriate management suppression response was adopted with the Forest Plan in 1988. In 2001, the Sierra Nevada Forest Plan Amendment (2001 SNFPA) adopted the use of lightning-caused fires to provide for resource benefits. In recent years, the focus of fire policy and management has shifted toward the complex goal of managing fire. Current Federal Wildland Fire Policy guidelines are found in the *Guidance for Implementation of Federal Wildland Fire Management Policy* (February 13, 2009) (USDA and USDI 2009).

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 2001d, p. 242) and is a physical parameter that can be related to flame length. Fire intensity can be determined from the product of biomass consumption (energy), rate of spread of the fire, and heat content of the fuel (Agee 1996).

The historic fire regime consists of a natural baseline comparison of what fuel conditions should be. Each fire regime has a characteristic range of frequency and severity which influences and is influenced by the vegetation within it (see Appendix H of this FEIS). Fire severity is a description of fire effects on the biological and physical components of the ecosystem. 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 supported by a fuel loading and structure that existed before European settlement.

While there are many important lessons to learn from the past, we believe we cannot rely on past forest conditions to provide us with blueprints for current and future management (Stephens et al. 2010). In particular, the nature and scale of past variability in climate and forest conditions, coupled with our imprecise ability to fully reconstruct those conditions, introduce a number of conceptual and practical problems (Millar and Woolfenden 1999a). Detailed reconstructions of historical forest conditions, often dendro-ecologically based, are very useful, but represent a relatively narrow window of time and tend to coincide with tree recruitment in the generally cooler period referred to as the little ice age. As such, manipulation of current forests to resemble past conditions may not produce the desired result when considering future climates (Stephens et al. 2010).

In the Monument, ongoing fire and fuels management activities include prescribed burning, managed wildfire, and vegetation management. Site-specific project analysis is required for any fuels reduction activities.

Landscape Conditions

Fire Susceptibility

To quantify the shift of vegetation from a resilient fire-dependent ecosystem to an ecosystem that is susceptible to uncharacteristic damage from wildfire, a fire susceptibility rating was developed for the Sequoia National Forest. Fire susceptibility is an indicator of the possibility of large severe fires. There is higher potential for large severe fires in areas of high and moderate fire susceptibility under high fire danger weather conditions than in areas of low susceptibility. The rating uses severity, hazard, and risk to identify areas in the forest that have high, moderate, or low susceptibility to wildfire (shown in the following table). This index is used as a tool for prioritizing areas that need treatment, particularly around communities within high fire susceptibility areas.

Table 68 Monument Acres in High, Moderate, and Low Fire Susceptibility

	Fire Susceptibility (acres)			
	High	Moderate	Low	Total
Monument	44,830 (14 percent)	245,700 (75 percent)	37,790 (11 percent)	328,310 (100 percent)
Defense zones	11,970 (26 percent)	32,290 (71 percent)	1,090 (2 percent)	45,340 (100 percent)
Threat zones	21,280 (1 percent)	108,150 (74 percent)	16,090 (11 percent)	145,520 (100 percent)
Sequoia groves	4,160 (15 percent)	22,720 (82 percent)	950 (3 percent)	27,830 (100 percent)

Picture 2 Low Susceptibility (flame lengths generally less than 4 feet)

Picture 3 Moderate Susceptibility (flame lengths generally between 4 and 8 feet)

Picture 4 High Susceptibility (flame lengths generally greater than 8 feet)

Fire Return Interval

Fire return interval describes how often fires occur in a particular location. This is a temporal attribute of the fire regime that is measurable by determining when fire occurred last on each of the acres of the Monument and comparing this with the historic interval between fires for the vegetation type on that acre. Fire return interval 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, and complexity.

The fire return interval for a given vegetation type can be used in conjunction with fire history maps to determine which areas in the Monument have missed natural fires. This information is known as the fire return interval departure (FRID), as shown in the following table. A fire return interval departure map was developed by 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 the Monument. A fire return interval departure index was reclassified into five categories: extreme, high, moderate, low, and barren/water (see the Fire Return Interval Departure map in the FEIS Map Packet).

Table 69 Fire Return Interval Departure in the Monument

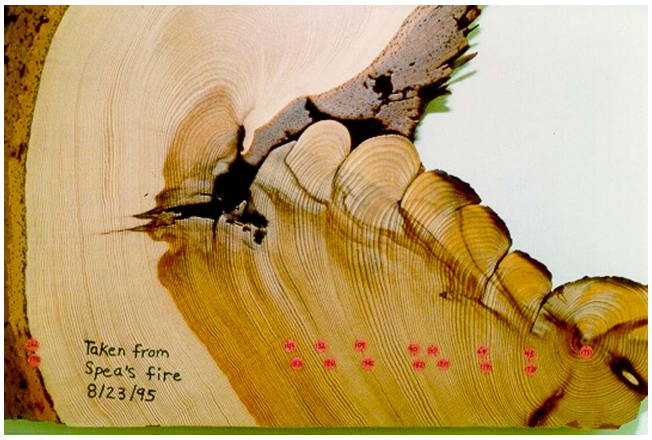
Fire Return Interval Depar-tures	Rating	Acres in Monu-ment	Percent of Monu-ment by FRID Class	Acres in Defense Zones	Percent of Defense Zones by FRID Class	Acres in Threat Zones	Percent of Threat Zones by FRID Class	Acres in Sequoia Groves	Percent of Groves by FRID Class
5-17 intervals missed	Extreme	146,160	45	23,460	52	62,860	43	19,480	70
2-4.9 intervals missed	High	72,770	22	11,630	26	27,430	19	5,410	19
0-1.9 intervals missed	Moderate	71,320	22	5,120	11	33,650	23	2,190	8
<0 intervals missed	Low	30,890	9	4,370	10	18,730	13	650	2
	Barren/ water	7,180	2	770	1	2,860	2	90	1
Total		328,320	100	45,340	100	145,530	100	27,830	100

The ecosystems of the Monument have 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. Prior to 1992, logging in the Monument on National Forest System and private lands consisted primarily of 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 pre-settlement (1875) conditions, the current Sierra Nevada forests are generally younger, denser, smaller in diameter, and more homogeneous (McKelvey et al. 1996). Because of 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 1996).

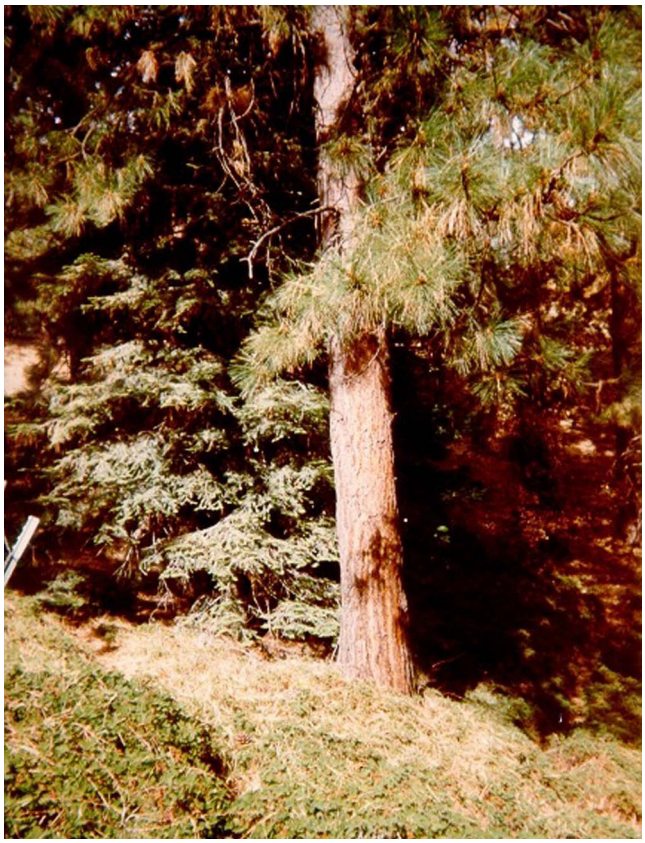
Many studies have documented the importance of large trees in forests for many ecological processes and their value for wildlife habitat (North et al. 2009). Some research suggests that, for managing fuels, most of the reduction in fire severity is achieved by reducing surface fuels and thinning smaller ladder-fuel trees. What is considered a ladder fuel differs from stand to stand, but typically these are trees from 10 to 16 inches in diameter. If trees larger than this are thinned, it is important to provide reasons other than for ladder-fuel treatment (North et al. 2009).

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 2001 SNFPA 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 compared to prescribed fires.



Picture 5 Fire Return Interval



Picture 6 High to Extreme Fire Return Interval Departure (FRID)

Picture 7 Moderate Fire Return Interval Departure (FRID)

Picture 8 Low Fire Return Interval Departure (FRID)

Restoration and Maintenance

Restoration of Fire as an Ecological Process

Fire is such a pervasive disturbance in nearly all Monument ecosystems that failure to include it as part of managing large landscapes will inevitably lead to unintended outcomes (Keeley et al. 2009). The restoration and long-term maintenance of Monument ecosystems will require the restoration of fire as an ecological process. Restoring the natural role of fire in many parts of the Monument will require a focused restoration of the fuel conditions that support fire. However, mechanical treatments and even fire treatments that are specifically applied to reduce fuel loads or manipulate potential fire behavior are temporary in nature.

Maintaining Fire as an Ecological Process

Long-term maintenance of fire-dependent ecosystems will require the return of characteristic fire regimes to Monument landscapes. Maintaining the fuel characteristics of ecosystems is only part of the solution, and fire is not likely to return simply because the fuel characteristics are restored.

Historic fires were a combination of Native American-ignited and lightning-caused fires. While many fires were ignited locally, others burned into the Monument from adjacent areas.

There are some noted examples where the use of fire alone appears to have successfully promoted spatial heterogeneity and ultimately resilient forests (Stephens et al. 2010). In two different upper elevation Sierra Nevada mixed conifer forests that have experienced about 30 years of managed wildfires, the amount of stand-replacing fire in recent large fires has been very low (3-12 percent) (Collins et al. 2007). Based on field data (Collins 2004) and satellite-derived images of fire severity (Collins et al. 2009, 2010), these large fires created a large degree of spatial heterogeneity both within individual forest stands and across the landscape (Stephens et al. 2010).

In the summer of 2010, the Sequoia National Forest managed the Sheep Fire with Sequoia and Kings Canyon National Parks, which covered over 9,000

Picture 9 Sheep Fire

Picture 11 Lion Fire

Picture 10 Sheep Fire

Picture 12 Lion Fire

acres in the Monument and national parks. This fire was allowed to burn into the Monarch Giant Sequoia Grove, effectively reintroducing fire and lowering hazardous fuel loading on fifty-two acres of giant sequoias. In the summer of 2011, the more than 20,000-acre Lion Fire was managed for multiple objectives in the Golden Trout Wilderness by the Sequoia National Forest. In this area, there is no record of a large fire occurring in the last 90 years. Deep snowpack and cool temperatures in spring and early summer provided an opportunity to reintroduce fire into this area of the wilderness, successfully achieving ecological restoration and a range of beneficial fire effects.

These recent experiences with the Sheep and Lion Fires indicate that managed wildfire is an effective treatment tool in terms of fire severity, size, and length of burning. Using fire as a tool helps to restore landscape structure and heterogeneity, as well as producing fire effects associated with natural diversity (Odion and Hanson, 2006). Fire restores its past influence as a patchwise and stand-thinning disturbance agent, as well as a facilitator of species diversity and fire-adapted conifers in Sierran forests (Odion and Hanson, 2006) (see the following Sheep and Lion Fire photos).

Certainly challenges exist in increasing the area burned by managed wildland fire, including smoke production and the risk of fires burning outside desired boundaries. Uncertainty about future climates necessitates that managers and the interested public accept more variation in fire behavior and effects

when managing both prescribed and wildland fires (Stephens et al. 2010). The status quo of focusing primarily on fire suppression policies will inevitably result in large, high severity wildfires that will not conserve any of the values that managers and the public desire from forests (high quality water, aesthetics, wildlife habitat for many species, recreation, carbon sequestration) (Stephens et al. 2010).

Wildland Urban Intermix

Wildland urban intermix (WUI) zones are areas where human habitation is mixed with areas of flammable wildland vegetation. The WUI is comprised of two zones: the defense zone and the threat zone. There are an estimated 45,340 acres of defense zone and 145,520 acres of threat zone in the Monument, as currently prescribed by the 2001 SNFPA. These zones may be further delineated during site-specific project analysis.

The Sequoia National Forest is adjacent to 41 "communities at risk" from wildfire. Thirteen of these communities have community wildfire protection plans (CWPPs) in place. The communities of Kennedy Meadows, Pine Mountain, and Alder Creek are currently in the process of developing CWPPs. The majority of these communities are serviced by the Sequoia, Alder Creek, Kern Valley, and Highway 180 Fire Safe Councils.

Air Resources

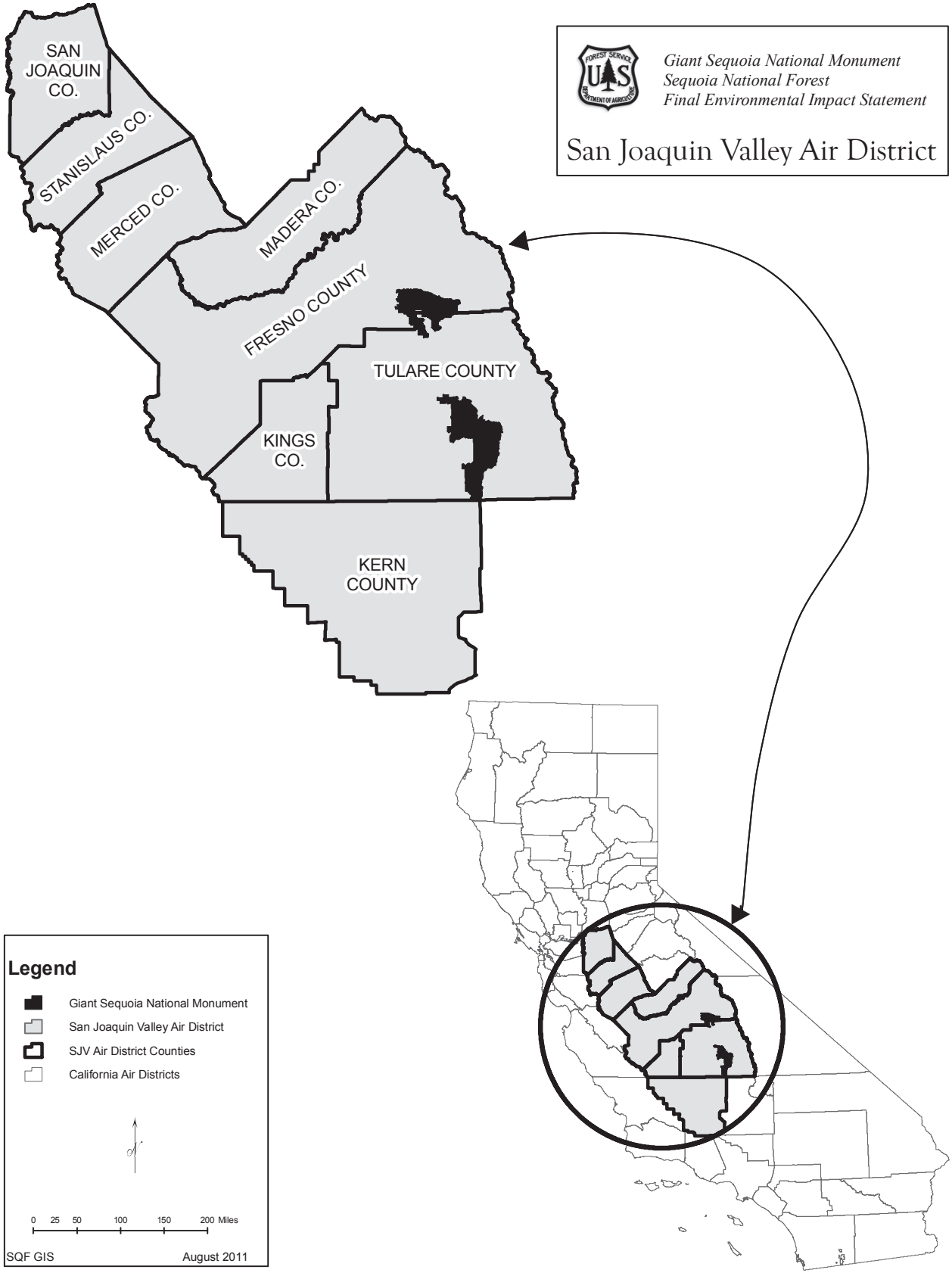
General Meteorology, Climatology, and Transport Mechanisms

The Monument lies in the eastern portion of the San Joaquin Valley Air Pollution Control District (SJVAPCD). The SJVAPCD covers 24,840 square miles, or approximately 16 percent, of the geographic area of California (see the following map). The California Department of Finance estimates that the SJVAPCD has a population of about four million people. The San Joaquin Valley has a northwest to southeast orientation, approximately 100 miles wide by 300 miles long. Major urban centers and agricultural areas are located west of the Monument in this valley. The major urban centers include Bakersfield, Fresno, Modesto, and Stockton. The Monument is located generally east (downwind) of the major urban centers.

Air pollution is typically generated in urban and agricultural areas west of the Monument and moved toward the Monument by prevailing west-to-east winds. Air circulation and the movement of smoke and other pollutants in the San Joaquin Valley are restricted in both vertical and horizontal directions. Vertical air movement is restricted by radiation and subsidence inversions. A nocturnal inversion forms in the San Joaquin Valley nearly every day of the year. During all seasons in the valley, the inversion base is 500 feet or less from the ground surface. In the winter, due to lower sun angle, heating is reduced and the inversion base is 1,000 to 1,500 feet above the ground surface. During the rest of the year, the inversion base often lifts to 1,500 to 3,000 feet above the ground surface by mid-day. In the summer, the inversion layer can be entirely destroyed. Air quality in the Monument is typically better when the inversion is lower. Localized night-time radiation inversions in mountain valleys are also common and are normally the main drivers of smoke effects on public health in the Monument.

Horizontal air movement is restricted on three sides by 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 toward the southeast of the San Joaquin Valley. During winter months, wind flows in the valley are from the south, with stagnant conditions prevailing except during passage of winter storm systems. Daytime wind speed increases as the valley heats up and is strongest in the afternoon. During storm-free periods in the fall and winter, the airflow is more variable, with light wind speed resulting in less air movement from the valley. At these times, the Monument will typically experience the best air quality. Daily and seasonal variation in air pollution

Map 8 California Air Districts



and smoke movement are dependent upon these air transport mechanisms.

During the day, air near the mountain slopes is heated, resulting in upslope and up-valley winds. With the loss of solar heating in the evening as the sun sets, 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 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, including 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 in the central and southern Sierra Nevada foothills and mountains (Zabic and Seiber 1993).

Summer wind patterns in the Sierra Nevada are complex because of 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 toward 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 toward a northwest-to-southeast direction and 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 stream provides a mechanism for rapid transport of pollutants from north to south, while the eddy cycles pollutants in the southern part of the valley, possibly leading to increased concentrations. Computer modeling during a summer pollution episode showed that the bay area and Sacramento area contributed 27 percent, 10 percent, and 7 percent to the ozone exceedances in the northern, central, and southern central valley, respectively (SJVAPCD 1994). An assessment of effects of transported pollutants on ozone concentrations by the California Air Resources Board (CARB 1993) indicates that transport of pollutants from the broader Sacramento Area, San Francisco bay area, and the San Joaquin Valley has an overwhelming effect on the central and southern Sierra Nevada.

Demographics

Population growth plays an important role in the competition for air pollution capacity and the frequency of smoke-induced public nuisance episodes. The California Department of Finance estimates that the population in the San Joaquin Valley is expected to reach 4.2 million by 2010, 5.3 million by 2020, 6.5 million by 2030, and 7.9 million by 2040. In the San Joaquin Valley, daily vehicle miles traveled has increased 210 percent from 1980 to 2009. These current growth trends are higher than other parts of the state. This has limited improvement in the SJVAPCD compared to the rest of the state, especially for ozone (CARB 2001).

Pollutants of Concern

Many 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. For the protection of ecosystems in the Monument, it is critical to understand historic levels of these pollutants and to differentiate between anthropogenic and natural process contributions.

The primary air pollutants that impair visibility and cause detrimental effects to public health and ecosystems include particulate matter, oxides of sulfur and nitrogen compounds, elemental carbon and oxides, ozone, and toxic air pollutants. Natural pollution may occur from volcanic activity, forest fires, 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.

The air pollutants of main concern in this area include particulate matter, ozone, and oxides of nitrogen.

Particulate Matter

Particulate matter in ambient air is composed of complex mixtures of inorganic and organic species. The mixture is made up of liquid or solid particles suspended in the air. These particles vary in origin, size, and composition. Major components of $PM_{2.5}$ include nitrate, sulfate, ammonium, organic carbon, and elemental carbon (Chow et al. 1994).

$PM_{2.5}$ is made up of combustion particles and re-condensed organic and metal vapors and contains secondarily formed aerosols from gas to particle conversion (WHO 2003, Liu et al. 2003, Harrison et al. 2001). $PM_{2.5}$ particles form mainly from high temperature sources or gas to particle conversion processes within the atmosphere (Harrison et al. 2001).

Particles formed from gases through nucleation originate mainly from anthropogenic sources such as combustion from motor vehicles, power generation, industry, and from residential fireplace and wood stoves (Liu et al. 2003). Vehicular traffic has been shown to be an important source of fine particles, especially near busy roads (WHO 2003, Gertler et al. 2000). Photochemical production of fine aerosols such as sulfate, nitrate, and organic aerosols increases in the summer months in the presence of higher concentrations of ozone (Parkhurst et al. 1999).

In the regulatory framework, PM is divided into fine and coarse particles. Fine particles are defined as particles with an aerodynamic diameter of less than 2.5 µm. Fine particles are made up of combustion particles and re-condensed organic and metal vapors, and contain secondarily formed aerosols from gas to particle conversion (Liu et al. 2003, Harrison et al. 2001, WHO 2003). Coarse particles are defined as particles with an aerodynamic diameter between 2.5 and 10 µm. The coarse particles are mostly composed of crust materials and dust from roads and industries (Liu et al. 2003, WHO 2003). $PM_{2.5}$ is defined as particles with an aerodynamic diameter less than 2.5 µm. PM_{10} is defined as particles with an aerodynamic diameter of less than 10 µm.

Health Effects

Short-term exposure to particulate matter has been associated with negative effects on human health. Long-term exposure to particulate matter is believed to have a much greater effect on human health, but is less certain because less is known about it (Koelemeijer et al. 2006). It has been suggested that life expectancy is lower for people living in areas with high particulate matter levels (Houthuijs et al. 2001). Fine particle concentrations ($PM_{2.5}$) are associated with adverse health effects on the general population, including increased mortality and morbidity, reduced lung function, increased respiratory symptoms (such as chronic cough or bronchitis), aggravated respiratory and cardiovascular disease, eye and throat irritation, coughing, breathlessness, blocked and runny noses, and skin rashes (Radojevic 1998, Houthuijs et al. 2001). Short exposure to PM_{10} increases mortality, hospital admissions, respiratory symptoms, and reduces pulmonary function (Houthuijs et al. 2001). Long-term exposure to PM_{10} has adverse effects on respiratory health as well.

There is strong evidence to suggest that $PM_{2.5}$ is more hazardous to human health than PM_{10} in terms of cardio-pulmonary disease and mortality (WHO 2003). Thus, epidemiological studies in the last decade have emphasized that negative health effects are mainly related to the increase in levels of fine particulate matter in the atmosphere of sizes of less than 2.5 mm (Querol et al. 2007). Fine particles measured as $PM_{2.5}$ are strongly associated with mortality and hospitalization for cardiopulmonary diseases (WHO 2003). Smaller particles induce more inflammation than larger particles on a mass basis. The reduction in life expectancy is primarily due to increased cardiopulmonary disease and lung cancer mortality. The increases in cardiopulmonary disease are likely exhibited in more respiratory symptoms and reduced lung function in children and chronic obstructive pulmonary disease and reduced lung functions in adults (WHO 2003).

Effects on Forests and Ecosystems

Particulate matter (PM) from fire has been a part of the ecosystem in the Monument. It has likely been reduced with the suppression of fire, particularly at

higher elevations where effects from anthropogenic emissions of PM are fewer. In the fire- and smoke-adapted Monument, particulate matter is currently likely to be at or below historic levels.

Ozone

Ozone (O_3) is a powerful oxidant, causing irritation in human lungs and visible injury to plant leaves and needles. First discovered in the 1840s O_3 was first shown to be toxic to animals in the 1870s and to cause crop damage in the 1940s (Caroll et al. 2003). Ozone is produced photochemically by oxides of nitrogen (NO_X), volatile organic compound (VOC) emissions from combustion engines, and biogenic emissions of reactive VOC from plants in the Sierra Nevada coupled with strong sunlight and high temperatures (Murphy et al. 2007).

The most reactive VOCs in this area are isoprene and MBO (Biogenic 2-methyl-3-buten-1-ol). High isoprene emissions occur in the foothills of the western Sierra Nevada from a dense population of oak trees, while MBO is emitted from pines at a higher elevation (Steiner et al. 2007).

NO_X condition upwind of the western Sierra Nevada and meteorology are the most important factors determining ozone production potential of isoprene and MBO emissions (Dreyfus et al. 2002). Increased temperatures in this region caused by climate change has the potential to create more ozone. Other factors that are important for local ozone production in the central valley include large-scale meteorology, mixing depths, and transport of ozone formed in other areas such as San Francisco (Steiner et al. 2008).

NO_X concentration tends to decrease from west to east, with higher concentrations occurring in urban areas (Steiner et al. 2008). Thus NO_X concentration is slightly lower in the MBO-emitting pine region than in the isoprene-oak emitting regions. As a result, production of O_3 is higher in the foothills where the plume of NO_X encounters these reactive VOCs.

Isoprene is the major factor enhancing O_3 production per unit of NO_X (Hirsch et al. 1996). Oak forests and woodlands in the western Sierra Nevada foothills are the major source of isoprene emissions to the region (Dreyfus et al. 2002). The O_3 created in this area and isoprene from oaks are transported up to higher elevations in the western Sierra Nevada following the predominant wind patterns. Oxidation of isoprene is a major source of O_3 production on the western slope of the Sierra Nevada, and it is consider the dominant VOC ozone precursor (Dreyfus et al. 2002). The contribution to O_3 production by isoprene is compounded by the fact that hot and stable conditions associated with O_3 production are the same conditions that produce the highest isoprene emission rates (Dreyfus et al. 2002).

Health Effects

According to Hayes et al. (1993), a number of health effects have been documented or suspected due to ground level O_3 exposure. Some of the effects are lung function decrements, airway hyper-reactivity, epithelial cell damage, and bronchoalveolar inflammation. All are known to occur during the exposure of humans to low levels of ozone.

According to the EPA (1999), even at relatively low levels, O_3 may still cause inflammation and irritation of the respiratory tract, particularly during physical activity. The symptoms include coughing, throat irritation, and breathing difficulty. Ozone can affect lung function and worsen asthma attacks. Ozone can increase the susceptibility of the lungs to infections, allergens, and other air pollutants. It damages lung tissue. Ozone may aggravate chronic lung diseases, such as emphysema and bronchitis, and may reduce the immune system's ability to fight bacterial infection in the respiratory system (EPA 1999). Groups sensitive to O_3 include children and adults who are active outdoors, people with respiratory diseases, and people with unusual sensitivity to ozone. Roughly one out of three people in the United States are at higher risk of experiencing O_3- related health effects (EPA 2000).

Effects on Forests and Ecosystems

Ozone can affect forest health and change biodiversity (Bytnerowicz et al. 2002). The diversity and population density of fungi growing on needles have decreased in locations with high ozone concentration. These organisms act as litter decomposers, and rates of decomposition may be affected. Fifty percent or more of the lichen species are missing due to high ozone levels. In the Sierra Nevada, atmospheric monitoring suggests that O_3 concentration occurs in doses sufficient to damage pines (Bytnerowicz et al. 2002). Most of the significant injuries continue

to be evident in the Sierra and Sequoia National Forests. Ozone also affects the production of foliar chlorophyll. Ozone may be toxic to vegetation at concentrations greater than 30 to 40 ppb; the severity of plant damage depends on the characteristics and length of exposure as well as abiotic and biotic factors (Bytnerowicz et al. 2002).

Ponderosa and Jeffrey pines are particularly sensitive to this pollutant. Ozone damages trees and increases susceptibility to mortality from other factors such as drought, insects, fire, and extreme weather. The damage to ponderosa pine needles was first observed in the 1950s in southern California's San Bernardino Mountains. In the Sierra Nevada, ozone-affected forests on the western slopes began to be identified in the 1970s. Injury to the mixed conifer forest from tropospheric ozone has been occurring in southern California since the 1950s and in the Sierra Nevada since the 1970s (Arbaugh et al. 1998). Trees damaged by O_3 demonstrate decreased radial growth and reduced tolerance to western pine beetles and other stressors. Western pine beetles kill more trees and increase at a greater rate in places with higher O_3 levels. Ozone also affects shrubs and other understory vegetation which are less resilient to drought, more likely to be attacked by bark beetles and other insect pests, and generally less able to survive pathogen infection.

Nitrogen Oxides (NO_x)

Nitrogen oxides form when fuel is burned at high temperatures, principally being generated from motor vehicles and stationary sources such as electric utilities and industrial boilers. Nitrogen oxides can negatively affect aquatic systems and visibility and are a precursor compound to ozone and to $PM_{2.5}$. The primary releases of nitrogen compounds (oxides, ammonium, and nitrates) to the air in the natural ecosystems are from microbial activity, lightning, and wildfires. Historic levels have almost doubled globally as a result of fossil fuel combustion, animal husbandry practices, and fertilization.

Nitrogen Dioxide (NO_2)

Nitrogen dioxide (NO_2) belongs to the family of nitrogen oxides (NO_X). It is recognized to cause negative effects on human health (WHO 2003). A suffocating, brownish gas, nitrogen dioxide is a strong oxidizing agent that reacts in the air to form corrosive nitric acid, as well as toxic organic nitrates. It also plays a major role in the atmospheric reactions that produce ground level ozone.

Health Effects

Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. The effects of short-term exposure are still unclear, but continued or frequent exposure to concentrations that are typically much higher than those normally found in ambient air may cause increased incidence of acute respiratory illness in children. EPA's health-based national air quality standard for NO_2 is 0.053 ppm (measured as an annual average).

Effects on Forests and Ecosystems

Nitrogen oxides in the air are a significant contributor to nitrogen deposition, which causes a number of environmental effects, such as acid rain and eutrophication. Eutrophication occurs when a body of water has an increase in nutrients, which reduces oxygen in the water, creating an environment that is destructive to aquatic life. Even moderate concentrations of NO_X and other nitrogen compounds can contribute substantial amounts of deposited nitrogen to the forests affecting growth, species composition, and surface and ground water quality (Fenn et al. 2003, Bytnerowicz and Fenn 1996, Tarnay et al. 2001).

Current Air Quality Conditions

District Designations

The SJVAPCD is considered to be in non-attainment (not meeting standards) federally for ozone and particulate matter (PM). Smoke from various sources is a contributor to PM and ozone.

Visibility Conditions

Visibility in the Sierra Nevada improves from south to north and from low to high elevation. Sequoia and Kings Canyon National Parks, the southernmost and lowest elevation Class I monitoring sites, experience some of the worst visibility conditions among western Class I areas. Smoke can 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 Effects on 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 confirm 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 pre-industrial levels, although the total amount has not been quantified. Deposition of nitrogenous and sulfurous pollutants is highest on the western slopes of the Sierra Nevada closest to the valley. Deposition from urban and agricultural sources may be approaching saturation in southern parts of the Sierra.

Climate Change

For the Monument and the surrounding Sierra Nevada, climate variability and weather events such as rain and snow storms, droughts, heat waves, floods, and lightning storms are an integral part of the natural environment. The Sierra Nevada is the highest mountain range in North America's only area of Mediterranean-type climate. As such, the range receives large amounts of winter snowfall, followed by a 3- to 5-month summer drought. The temporal misalignment of precipitation and growing season is a characteristic of Mediterranean-type climates, and leads to ecosystem patterns that are driven principally by water availability but also to a great extent by dry-season fire. Increasing changes in climate and disturbances projected for the future are expected to lead to substantial alterations in California forests and the ecosystem services they provide (Field et al. 1999, Moser et al. 2009). The International Panel on Climate Change (IPCC 2007) has identified future impacts of temperature warming, changes in precipitation, extreme weather events, severe droughts, earlier snowmelt, increasing wildfire activity, and other changes that could significantly affect forest ecosystems.

Although science has been investigating various aspects of climate change on forests for decades, our knowledge of how ecosystems respond to changing climate and react at local or regional levels where management actions are affected is still very limited (Wiener 2006, Solomon 2008). Uncertainties about outcomes will require flexibility, and land management strategies based on current or historical conditions may need to be adjusted or replaced with approaches that support adaptation to changing conditions (USFS 2008; Wiens et al., in press).

Forests can play an important role in both mitigating and adapting to climate change. Mitigation measures focus on strategies such as carbon sequestration by natural systems, increasing carbon storage in wood products, providing renewable energy from woody biomass to reduce fossil fuel consumption, and reducing environmental footprints. Adaptation measures address ways to maintain forest health, diversity, productivity, and resilience under uncertain future conditions. Adaptation and mitigation activities must also complement each other and balance with other ecosystem services (USFS 2008).

As of today, no published climate change or vegetation change modeling has been carried out for the Giant Sequoia National Monument. Indeed, relatively few future-climate modeling efforts have treated areas as restricted as the State of California. The principal limiting factor is the spatial scale of the General Circulation Models (GCMs) that are used to simulate future climate scenarios. Most GCMs produce raster outputs with pixels that are 10,000s of km^2 in area. To be used at finer scales, these outputs must be downscaled using a series of algorithms and assumptions. These finer-scale secondary products currently provide the most credible sources availablefor estimating potential outcomes of long-term climate change for California, and they form much of the basis for the climate change trend assessment found in Appendix C of this FEIS (Meyer and Safford 2011) and summarized below. Specifics regarding many mitigation measures, such as the appropriate calculations for carbon offsets and how to consider carbon sequestration rates, are still being developed, so most of our focus at the forest level

at this time is on the use of management options to improve resilience and adaptability of native ecosystems under changing conditions. Then, over the 15-year life of the Forest Plan, as issues are better understood and appropriate measures are identified, climate change strategies can be adjusted through the adaptive management process.

Summary of Current Climate and Climate-related Trends in the Southern Sierra Nevada (from Meyer and Safford 2011, Appendix C)

Mean annual temperatures in the Monument planning area have risen by 1.5 to 3 degrees Fahrenheit over the last three-quarters of a century, with most of the change occurring in nighttime temperatures. The occurrence of nighttime freezing temperatures has decreased over the last century, and hard frosts in the growing season are now relatively rare. During the same time period, mean annual precipitation has remained steady or increased at higher elevations, while many lower elevation stations have seen a moderate decrease in annual precipitation. Many weather stations in the Sierra Nevada have reported an increase in the interannual variability in precipitation (i.e., wetter wet years and drier dry years), but this pattern is not universal. At low to middle elevations, the balance of snow to rain has been shifting toward the latter. At higher elevations, overall snowfall and spring measure of snow water equivalent in the snowpack have remained steady at most southern Sierra Nevada stations, although some stations have seen increases.

Changes in temperatures and amounts and timing of precipitation have led to earlier peak streamflows in most Sierra Nevada streams, with higher spring flows and lower summer flows. Warming temperatures are leading to glacial recession across the southern Sierra Nevada. Forest fire frequency, size, total area burned, and severity have all been increasing in the Sierra Nevada over the last two to three decades. Non-fire driven mortality of adult trees also appears to be increasing in lower and middle elevation forests in the Sierra Nevada, but not at higher elevations (greater than 7500 feet), where warming temperatures have lengthened the short summer growing season. Studies of terrestrial vertebrate mammals, birds, and butterflies show that many species have been shifting their ranges to higher elevations, probably in response to warming temperatures and changing precipitation patterns.

Summary of Projected Future Trends in the Southern Sierra Nevada (from Meyer and Safford 2011, Appendix C)

Although climate change models vary in their projections for the latter half of the 21st century, all predict significant warming (about 4 to 9° F in mean annual temperatures by 2100), and most expect precipitation to remain similar or slightly reduced compared to today. Most models also agree that summers will be drier on average than they are now, regardless of levels of annual precipitation. Although the southern Sierra Nevada snowpack has generally remained steady (or risen) over the past half-century, continued warming is likely to erode the temperature buffer in the high southern Sierra Nevada. Most modeling projects a continuously increasing rain to snow ratio and earlier runoff dates for the next century, with decreased snowpack and growing-season stream flow even in the higher elevation river basins. Hydrological modeling projects lower spring and summer runoff in most Sierra Nevada river basins, but winter and early spring runoff is projected to be higher under most climate scenarios, as higher temperatures cause snow to melt earlier. The flood potential in Sierra Nevada rivers fed principally by snowmelt (i.e., higher elevation streams) is projected by most models to rise, principally due to earlier peak daily flows and an increase in the proportion of precipitation falling as rain. If overall precipitation increases over time, streamflow volumes during peak runoff will increase even more, leading to notably higher flood risk downstream.

Vegetation and fire modeling linked to future climate scenarios suggests that the area of conifer-dominated forest in the southern Sierra Nevada will decrease, as hardwood species respond positively to warmer nighttime temperatures and changing disturbance regimes (especially if precipitation increases). Many scenarios also expect grassland area to increase at lower and middle elevations, as woody vegetation retracts in the face of increased fire frequency. Current trends of increasing fire activity and burned area are expected to continue under almost all future climate scenarios, and some models project increases in fire intensity as well.

Potential Implications of Climate Trends for Monument Ecosystems

As of October 2011, two collaborative groups had completed broad-spectrum climate change vulnerability assessments for the southern Sierra Nevada in the general vicinity of the Monument (SSP 2010, Koopman et al. 2011).

The Southern Sierra Partnership assessment (SSP 2010) lists "changes in fire regime" as the principal threat (ranked as "Very High") to the sustainability of mixed conifer forest, the forest type that comprises the majority of National Forest System lands in the Monument planning area. Threats ranked as "High" to mixed conifer forest are: climate change, roads, pests and pathogens, airborne pollutants, and incompatible vegetation management practices. Five other threats were ranked "Medium." Across all southern Sierra Nevada ecosystems, the SSP assessment found that riparian and aquatic ecosystems were at the highest risk, followed by the different forest types (oak woodland, mixed conifer, subalpine/alpine), and migratory and wide-ranging wildlife. Overall, the highest ranked threats were surface and groundwater withdrawals ("Very High"). A certain number of overall threats ranked "High" are influenced by Forest Service management, such as water management, climate change, roads, changes in fire regime, livestock grazing practices, invasive nonnative plants and animals, pests and pathogens, and habitat loss outside the planning area.

The SSP assessment (SSP 2010) discusses that species distribution projections and future climate projections suggest that the southern Sierra Nevada landscape is likely to experience relatively more stability and less climate stress than many other parts of the State of California. This is mostly due to the high elevation range, high landscape connectivity, and large area of protected lands in the planning area.

The SSP assessment (SSP 2010) makes a number of hypotheses of likely future change for nine separate ecosystem types. For mixed conifer forests, the assessment finds that increased large tree mortality and increased outbreaks of wood-boring insects and disease are "Very Likely" outcomes of future climate change.

Future projected trends for carbon storage are highly variable, depending on the direction of future climate change. Some models show increases in C storage, others show decreases. SSP (2010) suggests that, "Active restoration of forests through thinning and prescribed burning has been shown to be an effective strategy to minimize catastrophic wildfire emissions and maintain natural sequestration."

According to the Geos Institute report (Koopman et al. 2011), "Based on climate change model projections from three global climate models, as well as peer-reviewed scientific publications, local experts and leaders identified the following changes as likely to occur in Fresno County (and neighboring areas) by the end of the 21st century":

- Hotter, drier, and longer summers
- More severe storms
- 80 percent decline in snowpack
- Increase in wildfire
- Increase in erosion and sediment
- Declines in water quality and flow in streams and rivers
- Lower groundwater recharge rates
- Loss of some native species and functioning ecosystems
- Less productive range for cattle
- Increase in invasive species
- Increase in severe heat days that cause illness and death
- Further declines in air quality
- Increase in stress that impacts human mental health
- Increase in natural disasters (floods, droughts, fires)
- Stress to water and flood infrastructure
- Reduced number of "chill hours"
- Changes to agricultural production
- Loss of coniferous forests due to increased extent and severity of wildfire and drought
- Declines in blue oak and valley oak woodlands
- Increased fragmentation of aquatic and riparian habitats

Meyer and Safford (2011; see Appendix C), identify other potential effects from ongoing and future climate change, including changing geographic distributions of animal and plant species, and changing patterns of dominant vegetation composition and structure.

Regarding animal species of critical conservation concern in the southern Sierra Nevada, Lawler et al. (2011) recently published a study investigating the possible direct and indirect effects of climate change on selected species of the genus Martes. They found that macroclimate conditions closely correlated with Pacific fisher presence in California were likely to change greatly over the next century, resulting in a possibly pronounced loss of suitable habitat. Their results suggest that martens and fishers will be highly sensitive to climate change, and will probably experience the largest climate impacts at their southernmost latitudes (i.e., in the southern Sierra Nevada). The authors noted that fisher habitat is driven to a great extent by mesotopographic and local vegetation features that could not be incorporated into their climatic modeling. Consequently, they also looked at stand-level implications of fire under a series of future fire scenarios, since fire occurrence and behavior is driven to a large extent by climate and weather. Lawler et al. (2011) recommended protecting fisher habitat through targeted forest-fuel treatment, and applying more liberal fire management policies to naturally ignited fires during moderate weather conditions.

Wildlife and Plant Habitat

Wildlife Habitat

Terrestrial and Aquatic Habitat

Management of terrestrial and aquatic wildlife species and habitat, and maintenance of a diversity of animal communities, is an important part of the mission of the Forest Service (Resource Planning Act of 1974, National Forest Management Act of 1976). Management activities on National Forest System lands are planned and implemented so that they do not jeopardize the continued existence of threatened or endangered species or lead to a trend toward listing or loss of viability of Forest Service Sensitive species.

The proclamation refers to the diverse array of rare animal species in the Monument, including fishers, great gray owls, American martens, northern goshawks, peregrine falcons, California spotted owls, California condors, rare amphibians, western pond turtle, and other species listed as threatened or endangered by the ESA, or sensitive by the Forest Service.

Existing information and knowledge about the distribution of the terrestrial and aquatic species in the Monument were used to develop the list of species analyzed in detail for the Monument. Federally listed species, Forest Service sensitive species, management indicator species, and other species of concern were based on the potential for these species or their habitats to be affected by management of the Monument. Local knowledge and sources including corporate databases, maps of the distribution of special status species and vegetation maps, were used to select species for the analyses. The following table provides a list of all the special status species considered in detail for this document. A total of 28 species, plus aquatic macroinvertebrates, are included in the FEIS. The detailed analysis includes one invertebrate, one fish, four amphibians, two reptiles, twelve birds, and eight mammals.

General Habitat

The Monument lies within the western portion of the Sequoia National Forest, and encompasses a broad range of habitats and elevations, ranging from blue oak woodland at 1,000 feet to upper montane red fir and foxtail pine forest at over 10,000 feet. Habitat types in the Monument include: annual grassland, montane and mixed chaparral, oak woodlands, mixed conifer (including giant sequoia groves), red fir, wet meadow, riparian, aquatic, and barren rock outcrop.

Annual grasslands are found throughout the lower elevations of the Monument. These areas are dominated by nonnative annual grasses such as bromes (*Bromus spp*.) and wild oats (*Avena spp*.), but also contain patches of native perennial grasses such as needlegrass (*Achnatherum spp*.). Dominant forbs in annual grasslands include owl's clover (*Castilleja spp*.), fiddleneck (*Amsinckia intermedia*), and stork's

bill (*Erodium spp*.). These grasses and forbs may occur in pure stands or contain an overstory of scattered oaks (*Quercus spp*.) or California buckeye (*Aesculus californica*). Many wildlife species use annual grasslands for foraging. Typical animals in this habitat would include western fence lizards, California ground squirrels and western meadowlarks.

Montane and mixed chaparral are found in patches throughout the Monument. These are shrub communities dominated at lower elevations by buckbrush (*Ceanothus cuneatus*), birchleaf mountain mahogany (*Cercocarpus betuloides*), poison oak (*Toxicodendron diversilobum*), and at higher elevations by mountain whitethorn (*Ceanothus cordulatus*), deerbrush (*C. integerrimus*), chinquapin (*Castinopsis sempervirens*), and greenleaf manzanita (*Arctostaphylos patula*). Chaparral provides habitat for a wide variety of wildlife, including numerous rodent species and birds such as fox sparrows and scrub jays.

Oak woodlands include blue oak (blue oak savanna) (*Quercus douglasii*) with a chaparral and annual grass understory, interior live oak (*Q. wislizenii*), canyon live oak (*Q. chrysolepis*) and at higher elevations, mixed conifer/oak woodlands with black oak (*Q. kelloggii*). A wide range of animals, including mule deer, black bears and acorn woodpeckers depend on mast production from oaks. Fishers and their prey species also utilize cavities and mistletoe brooms for denning or resting sites.

Mixed-conifer forests contain a mixture of two or more dominant conifer species, including giant sequoia (*Sequoiadendron giganteum*), ponderosa pine (*P. ponderosa*), Jeffrey pine *(P. jeffreyi*), white fir (*Abies concolor*), incense cedar (*Calocedrus decurrens*), and sugar pine (*P. lambertiana*), with a complex understory of manzanita (*Arctostaphylos spp.*), Ceanothus, and other shrubs. This is the most common habitat type in the Monument. Fishers, California spotted owls, pallid bats, and northern goshawks are important species in the mixed-conifer forests of the Monument.

Red fir forests in the Monument are dominated by red fir (*Abies magnifica*), interspersed with lodgepole pine (*Pinus contorta*) and some areas of western white pine (*P. monticola*). American martens are typical animals in this habitat type. Above 10,000 feet, alpine and subalpine vegetation dominate. American pika and rosy finches are characteristic wildlife species in these high elevation areas.

Wet meadows are wetland habitats associated with groundwater seeps and margins of seasonal drainages. This plant community is dominated by grass and grass-like species growing with varying combinations of herbaceous perennials. Riparian habitat is associated with the margins of seasonal and perennial drainages, and with seeps and wet meadow margins at scattered locations in the Monument. Riparian habitat is dominated by willows including Lemmon's willow (*Salix lemmonii*), Sierra willow (*S. eastwoodii*), and Scouler's willow (*S. scouleriana*), with occasional quaking aspen (*Populus tremuloides*) and mountain alder (*Alnus incana spp. tenuifolia*). Wet meadows in the Monument provide habitat for amphibians including Pacific chorus frogs and western toads. Several bird species, including spotted sandpipers and mallards depend on meadows for nesting habitat. Riparian areas provide exceptionally high value for many wildlife species. Wilson's warblers and yellow warblers are neotropical migrants that rely almost entirely on riparian areas.

Aquatic habitat in the Monument includes many miles of streams, rivers and lakes. Riverine and lacustrine habitat is important to a large number of animal species including bald eagles, Little Kern golden trout and southwestern pond turtles.

Barren rocky outcrops, talus or rock scree are sparsely vegetated habitats or entirely devoid of vegetation. These areas are important habitat for marmots, provide nesting areas for peregrine falcons and foraging habitat for bats.

Desired Conditions for Wildlife

Lands in the Monument continue to provide a diverse range of habitats that support viable populations of associated vertebrate species, with special emphasis on riparian areas, montane meadows, and late successional forest.

The Monument possesses "an extraordinary number of habitats within a relatively small area" and is home to "a diverse array of plants and animals, many of which are rare or endemic to the southern Sierra Nevada" (Clinton 2000).

Using the California Wildlife Habitat Relationships (CWHR) System, there are 25 habitat types inside the Monument boundary. That variety of habitat is a key to the tremendous diversity of species. Many of the rare species in the Monument depend especially on riparian areas, meadows or late successional forest. These particular habitat types were often adversely affected by past land uses, such as timber harvests, road building and overgrazing. Currently, there are approximately 240 acres of riparian habitat, 1,510 acres of montane meadow habitat and over 51,500 acres of late successional forest inside the boundary of the Monument.

Natural Fire Regime

Fire is a key element in defining the mosaic of vegetation types, age classes, and successional stages on the landscape. A century of fire suppression on the Monument has caused forests to become more dense in many areas, with increased dominance of shade-tolerant tree species. Within the Monument, it is desirable for fire to recur in its characteristic pattern and resume its ecological role.

Restoring Plantations to Natural Conditions

There are approximately 26,700 acres of plantations in the Monument. These areas were planted primarily with ponderosa and Jeffrey pine. Lesser amounts of other species were planted, including white fir, 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 dominant species 100 years ago. Plantations tend to provide lower quality habitat for some wildlife species because of their lack of diversity, structural complexity, and large trees.

Burned Forest Habitat

Fire occurrence, size, uniformity, and severity have been a major influence on shaping landscape patterns and influencing productivity throughout the Southern Sierra for thousands of years (Lyon et al. 2000). Within the Monument, burned forest habitat is an important feature that exists in various stages of recovery depending upon the age and severity of the fire. The habitat changes caused by fire greatly influence the faunal populations and communities that occur in those areas. Understory fires or low severity fires reduce the understory plant biomass and can create a single stratum forest structure characterized by large old trees and few understory trees (O'Hara et al. 1996). Mixed severity fires generally cause selective mortality of fire-susceptible species in both the understory and overstory resulting in a complex mosaic of forest age and structure (Lyon et al. 2000). Stand replacing fire can dramatically alter habitat structure, killing the majority of trees in a stand and consuming most of the surface vegetation (Lyon et al. 2000).

A reorganization of animal communities may occur in response to fire, with increases in some species accompanied by decreases in others, depending on the amount of structural change in vegetation from the fire (Huff and Smith 2000). Overall, burned areas reduce hiding cover and expose prey species, thereby favoring raptor species. Burned forest habitat resulting from a low- to mid-severity fire often experience a short term increase in productivity and availability of forage and browse which in turn contributes to the increase in herbivore populations such as small mammals and deer. Stand-replacing fires reduce habitat quality for species that require dense cover such as fisher, but improve it for species that prefer open sites. Additionally, wood boring insects increase substantially after high severity fires, which are an important food source for insect-eating birds, such as black-backed woodpeckers.

Migratory Landbird Conservation in the Monument

Under the National Forest Management Act (NFMA), the Forest Service is directed to "provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives" (P.L. 94-588, Sec 6 (g) (3) (B)). The January 2000 Landbird Conservation Strategic Plan (USDA Forest Service 2000c), followed by Executive Order 13186 in 2001, in addition to the Partners in Flight (PIF) specific habitat conservation plans for birds and the January 2004 PIF North American Landbird Conservation Plan, all reference goals and objectives for integrating

bird conservation into forest management and planning.

In 2008, a memorandum of understanding (MOU) between the USDA Forest Service and the U.S. Fish and Wildlife Service to promote the conservation of migratory birds (USDA Forest Service and USFWS 2008) was signed. The intent of the MOU is to strengthen migratory bird conservation through enhanced collaboration and cooperation between the Forest Service and the Fish and Wildlife Service as well as other federal, state, tribal, and local governments. Within the national forests, conservation of migratory birds focuses on providing a diversity of habitat conditions at multiple spatial scales and ensuring that bird conservation is addressed when planning for land management activities.

The draft avian conservation plan for the Sierra Nevada bioregion identified montane meadows, riparian habitat, late successional/old growth forest, and oak woodlands as priority habitats for conservation (Siegel and DeSante1999). Maintaining a diversity of habitats, including those identified as important for bird conservation, is identified as a desired condition in all the alternatives.

Wildlife Species Considered in Detailed Analysis

Threatened, Endangered, or Proposed Species

The Wildlife Biological Assessment (BA) covers programmatic effects of long-term management of the Monument on animal species, including fish and aquatic species listed under the Endangered Species Act (ESA). Species that were evaluated in detail are shown in the following table.

The following federally-listed species were determined to occur within the Monument, and may be affected as a result of programmatic direction for the Monument: California condor (*Gymnogyps californianus*), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), and Little Kern golden trout (*Oncorhynchus mykiss whitei*). The following summaries of species specific information were taken from the Wildlife BA. The entire Wildlife BA can be found in Appendix N of this FEIS.

California Condor *(Gymnogyps californianus)*

The historic distribution of California condors in the Sierra Nevada included the area that is now the Monument. In 1987, the last documented case of California condors reproducing in the wild occurred on the Western Divide Ranger District (formerly Hot Springs Ranger District) of Sequoia National Forest (now a part of the Monument). Lion Ridge was historically used as a roosting area. Historic foraging areas in close proximity to the Monument include oak-woodlands and grasslands.

California condors were listed by the U.S. Fish and Wildlife Service as a Federal Endangered species in 1967. Critical habitat has been designated and there are approximately 800 acres of critical habitat within the Monument (90 acres in the Blue Ridge Condor area and 710 acres in the Tulare County Rangelands).

The 1988 Forest Plan (USDA 1988) identified the historic Starvation Grove Nest Site (approximately 2,960 acres based on the current GIS layer) and the Lion Ridge Roost Site (490 acres based on the current GIS layer) as areas receiving special management. A Nest Site Management Plan was developed for the Starvation Creek Grove Condor Nest Management Area (USDA 1986) which includes specific requirements intended to maintain or enhance habitat characteristics important to condors. The guidelines also include measures to reduce potential disturbance from management activities, roads, and recreation should condors nest in the area. The Lion Ridge Roost Site receives modified management to minimize conflicts with condor recovery needs.

Valley Elderberry Longhorn Beetle *(Desmocerus californicus dimorphus)*

This species' range includes the western Sierra Nevada foothills up to 3,000 feet in elevation. Habitat consists of elderberry shrubs in a variety of plant communities, but most often in riparian, elderberry savannah or moist valley oak woodlands. Known or potential habitat for valley elderberry longhorn beetles within the Monument includes chaparral, riparian, and oak woodland below 3,000 feet. This includes some areas in the northern section of the Monument near the Kings River, as well as the Tule River canyon, and California Hot Springs.

Valley elderberry longhorn beetles were listed as Federally Threatened on August 8, 1980 (45 Federal Register 52807). Critical habitat for this species has been designated by the U.S. Fish and Wildlife Service in the Central Valley, but none occurs in the Monument. Surveys within the Sequoia National Forest found potential exit holes in shrubs near Pine Flat Reservoir, in the vicinity of the Monument and in the Tule River Valley (EA Engineering 1999), which is located within the Monument.

Little Kern Golden Trout *(Oncorhynchus mykiss whitei)*

Little Kern golden trout are endemic to the Little Kern River basin in Tulare County. The majority of the population is within the Golden Trout Wilderness; however there are approximately five miles of perennial streams within the range of this species in the Monument.

The U.S. Fish and Wildlife Service listed Little Kern golden trout as a Federally Threatened species, with critical habitat, on April 13, 1978 (Federal Register 43:15427). The critical habitat consists of the entire Little Kern River watershed and is entirely within Sequoia National Park and Sequoia National Forest. Approximately 4,580 acres of critical habitat is within the Monument. The entire Wildlife BA can be found in Appendix N of this FEIS.

The following table lists the wildlife species considered in detailed analysis. The effects analysis for Wildlife can be found in Chapter 4 of this FEIS.

Table 70 Wildlife Species Considered in Detailed Analysis

Species	Status	Effects Analysis Document
California condor (Gymnogyps californianus)	FE, CH	Biological Assessment
Valley elderberry longhorn beetle (Desmocerus californicus dimorphus)	FT	Biological Assessment
Little Kern golden trout (Oncorhynchus mykiss whitei)	FT, CH	Biological Assessment
Northern goshawk (Accipiter gentilis)	FSS, CSSC	Biological Evaluation
Little willow flycatcher (Empidonax trailii brewsterii)	FSS, SE	Biological Evaluation
Bald eagle (Haliaeetus leucocephalus)	FSS, SE, SP	Biological Evaluation
Great gray Owl (Strix nebulosa)	FSS, SE	Biological Evaluation
California spotted owl (Strix occidentalis occidentalis)	FSS, CSSC, MIS	Biological Evaluation, Management Indicator Species Report
Pallid bat (Antrozous pallidus)	FSS, CSSC	Biological Evaluation
Townsend's big eared bat (Corynorhinus townsendii townsendii)	FSS, CSSC	Biological Evaluation
Western red bat (Lasiurus blossevillii)	FSS, CSSC	Biological Evaluation
California wolverine (Gulo gulo luteus)	FSS, ST, SP, FC	Biological Evaluation
American marten (Martes americana)	FSS, CSSC, MIS	Biological Evaluation, Management Indicator Species Report
Pacific fisher (Martes pennanti pacifica)	FSS, FC, CSSC	Biological Evaluation

Species	Status	Effects Analysis Document
Relictual slender salamander (Batrachoceps relictus)	FSS, CSSC	Biological Evaluation
Foothill yellow-legged frog (Rana boylii)	FSS, CSSC	Biological Evaluation
Mountain yellow-legged frog (Rana muscosa)	FSS, FC, CSSC	Biological Evaluation
Southwestern pond turtle (Actinemys marmorata pallida)	FSS, CSSC	Biological Evaluation
California legless lizard (Anniella pulchra)	FSS, CSSC	Biological Evaluation
Aquatic macroinvertebrates	MIS	Management Indicator Species Report
Fox sparrow (Passerella iliaca)	MIS	Management Indicator Species Report
Mule deer (Odocoileus hemionus)	MIS	Management Indicator Species Report
Yellow warbler (Dendroica petechia)	MIS	Management Indicator Species Report
Pacific tree (chorus) frog (Pseudacris regilla)	MIS	Management Indicator Species Report
Mountain quail (Oreortyx pictus)	MIS	Management Indicator Species Report
Sooty grouse (Dendragapus obscurus)	MIS	Management Indicator Species Report
Northern flying squirrel (Glaucomys sabrinus)	MIS	Management Indicator Species Report
Hairy woodpecker (Picoides villosus)	MIS	Management Indicator Species Report
Black-backed woodpecker (Picoides arcticus)	MIS	Management Indicator Species Report

Status Codes for the table above: FE=federally endangered; CH=designated critical habitat; FT=federally threatened; FC=federal candidate; SE=state endangered; ST=state threatened; SP=state fully protected; CSSC=California species of special concern; FSS=Region 5 Forest Service sensitive species; MIS=Forest Service management indicator species.

Sensitive Species

The Wildlife Biological Evaluation (BE) evaluates programmatic effects of long-term management of the Monument on sensitive animals, including fish and aquatic species. Species evaluated in detail are shown in the following table. Summaries of species-specific information taken from the BE follow. The entire Wildlife BE can be found in Appendix M of this FEIS.

Northern Goshawk *(Accipiter gentilis)*

Northern goshawk habitat generally consists of older-age forest habitat with large trees for nesting, closed canopy for protection and thermal cover, and open spaces allowing maneuverability below the canopy. Snags, downed logs, and high canopy cover appear to be preferred habitat features. Many of the species that provide the prey base for northern goshawks are associated with open stands of trees or natural openings containing an understory of native shrubs and grass.

There are 14 known goshawk territories and over 200,000 acres of moderate and high suitability habitat for northern goshawks in the Monument (using the CWHR model). The California Department of Fish

and Game has designated northern goshawks as a California species of special concern.

Little Willow Flycatcher *(Empidonax trailii brewsterii)*

There are three subspecies of willow flycatchers in California. The "little" willow flycatcher, *Empidonax trailii brewsterii*, is considered the subspecies that was historically found in the Monument. All willow flycatcher subspecies are listed as endangered by the state of California.

Little willow flycatchers are neotropical migrants which historically nested in meadows throughout the Sierras. Nesting habitat is generally willows or other shrubs either in montane meadows or other areas with riparian deciduous shrub zones. The nesting period for little willow flycatchers in the Sierras is generally June 1 to August 31.

The Sierra Nevada Forest Plan Amendment FEIS identified 82 known little willow flycatcher sites on National Forest System lands. Five of these sites are within the Monument at Millwood, Converse Meadow, Summit Meadow, Crane Meadow and Holey Meadow. Since 2001, multiple surveys of these sites failed to detect occupancy by little willow flycatchers and it is likely this species has been extirpated from the Monument.

Bald Eagle *(Haliaeetus leucocephalus)*

Bald eagles can be found throughout the Sierras, but most breeding occurs in the northern part of their range. They are generally found near large bodies of water or near free-flowing rivers with abundant fish and adjacent snags or other perches.

No breeding sites have been discovered within the Monument. Winter use in the Monument occurs along the White River, near California Hot Springs, the lower Tule River, the Kings River, and Hume Lake. Bald eagles also utilize Pine Flat Reservoir and small lakes near Pinehurst, which are adjacent to the Monument. There are no known important roost sites within the Monument.

Bald eagles were listed as a threatened species by the U.S. Fish and Wildlife Service in 1978 and de-listed in July 2007. They continue to be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Bald eagles are listed as endangered by the state of California.

Great Gray Owl *(Strix nebulosa)*

In the Sierra Nevada, great gray owls are found in mixed conifer forest from 2,400 to 9,000 feet elevation where such forests occur in combination with meadows or other vegetated openings. Nesting usually occurs within 600 feet of the forest edge and adjacent open foraging habitat. Most nests are made in broken top snags (generally firs), but platforms such as old hawk nests, mistletoe infected limbs, etc., are also used. Nest trees or snags are generally greater than 21 inches dbh and 20 feet tall.

There have been several historic detections of great gray owls in the Monument, mostly in the northern section but also near Camp Nelson. A nest was located on the Hume Lake District in 2009, and at least two chicks successfully fledged. The site was again occupied by a pair of great gray owls in 2011.

Great gray owls are a Forest Service sensitive species in both Region 4 and Region 5. They were classified as an endangered species by the State of California in October 1980.

California Spotted Owl *(Strix occidentalis occidentalis)*

The California spotted owl is one of three recognized subspecies of spotted owls. In the Sierra Nevada, 80 percent of California spotted owl nest sites have been found in mixed conifer forests. Nesting and roosting habitat for California spotted owls generally have high canopy cover, high total live tree basal area, a high basal area of hardwoods and conifers, and a high snag basal area.

There are 73 known territories and over 210,000 acres of moderate and high suitability nesting and foraging habitat for spotted owls in the Monument. California spotted owls are listed as a California species of special concern by the California Department of Fish and Game.

Pallid bat *(Antrozous pallidus)*

Pallid bats are usually found at low to middle elevations (below 6,000 feet) using a variety of habitats, including grasslands, shrublands, woodlands,

and coniferous forests. They are one of the bat species most commonly encountered in giant sequoia groves.

There have been few bat surveys in the Monument, but pallid bats are presumed to be present within their elevation range. Pallid bats are listed as a species of special concern by the California Department of Fish and Game.

Townsend's Big-eared Bat *(Corynorhinus townsendii townsendii)*

Townsend's big-eared bats in California are found from low desert to mid-elevation montane habitats. Habitat associations include coniferous forests, mid-elevation mixed conifer, mixed hardwood-conifer forests, and riparian communities.

Townsend's big-eared bats are year-round California residents that roost and hibernate in caves and mines. There have been few bat surveys across the Monument, but this species is known to use mines in the southern portion of the Monument and caves in the Windy Gulch Cave Complex. The Townsend's big-eared bat is listed as a species of special concern by the California Department of Fish and Game.

Western Red Bat *(Lasiurus blossevillii)*

Western red bats are found throughout California in elevations up to 3,000 feet. They primarily use riparian and wooded habitats, particularly willows, cottonwoods, and sycamores. Generally these bats roost singly within tree foliage or shrubs, and often along edge habitat adjacent to streams or open fields.

Western red bats have not been detected within the Monument, but there have been few surveys and the mapped range for this species includes the western portion of Monument. Western red bats are listed as a species of special concern by the California Department of Fish and Game.

California Wolverine *(Gulo gulo luteus)*

Historically, wolverine distribution in California included the northern coast mountains and the Sierra Nevada. However, in recent years there have been occasional anecdotal reports but no verified sightings of wolverines within the Monument. Habitats, historically used by wolverines in the Sierra Nevada, include mixed conifer, red fir, and lodgepole pine.

In December 2010, the U.S. Fish and Wildlife Service determined that the distinct population segment of wolverine occurring in the contiguous United States is warranted for listing under the Endangered Species Act, but is precluded by higher priority actions. The contiguous U.S. Distinct Population Segment of the wolverine was added to the USFWS candidate species list. Wolverines are listed as threatened by the state of California.

American Marten *(Martes americana)*

American martens are currently distributed throughout the Sierra Nevada, most often at elevations above 7,200 feet. Extensive carnivore surveys have been conducted across Sequoia National Forest, with numerous detections of American martens in the Monument.

American marten habitat includes mature moderately moist conifer forests interspersed with meadows, providing abundant small mammal prey, features for resting and denning, and sufficient canopy coverage for protection from avian predators. Using the CWHR model, there are over 139,000 acres of high suitability habitat for the American marten in the Monument.

American martens are listed as a California species of special concern by the California Department of Fish and Game.

Pacific Fisher *(Martes pennanti pacifica)*

Historically, fishers in California ranged from the northern Coast Range eastward to the southern Cascades, and then south through the western slope of the Sierra Nevada. Their current range in the Sierras is limited to the west slope from Yosemite National Park southward, including the Monument. Sequoia National Forest provides habitat for the southernmost population of fishers in the world. Despite what appears to be historical isolation from populations to the north, the small southern Sierra fisher population has persisted for many decades

In the southern Sierra Nevada, fishers are typically found in mid-elevation forests of the following habitat types: Jeffrey pine, montane hardwood-conifer, Ponderosa pine, Sierran mixed-conifer and white fir. Using one model (CWHR2.1), there are almost 150,000 acres of moderate and high suitability habitat in the Monument.

An assessment by the U.S. Fish and Wildlife Service determined the west coast population of fisher to be warranted for listing under the Endangered Species Act but precluded by other higher priorities. They are currently a "candidate" species. This species is currently listed as a species of special concern by the California Department of Fish and Game.

Relictual Slender Salamander *(Batrachoceps relictus)*

Relictual slender salamanders are endemic to California. Their range is limited to the west slope of the Sierras from the Tule River drainage in Tulare County south to the Greenhorn Mountains and Kern River Canyon in Kern County. This includes most of the southern portion of the Monument. This species is found at elevation ranges of 1,500 feet in the lower Kern Canyon to 8,000 feet in the Greenhorn Mountains.

Relictual slender salamanders are most often associated with streamside zones, seeps/springs, meadows, and moist wooded canyons in oak woodland and mixed conifer forests. Habitat for this species is often localized in relatively small mesic sites that contain an overstory of trees or shrubs and abundant rocks, litter, or woody debris. Relictual slender salamanders are listed as a species of special concern by the California Department of Fish and Game.

Foothill Yellow-legged frog *(Rana boylii)*

Historically, foothill yellow-legged frogs were common in most Pacific drainages from Oregon to southern California, including the Sierras. This species' historic elevation range in California extended from near sea level to approximately 6,000 feet. In the Sierra Nevada, foothill yellow-legged frogs have disappeared from most of their historic range.

There are numerous historical records of foothill yellow-legged frogs in the Monument, but no known extant populations. The only known populations in the area are two confirmed detections in tributaries to the North Fork Kern River in the Rincon Roadless area, which is east of the Monument.

Foothill yellow-legged frogs have been found primarily in shallow channels with riffles and at least cobble-sized substrates. Streams and rivers used by this species have either permanent or intermittent flow, low or high gradient, and alluvial or bedrock channels. Foothill yellow-legged frogs are listed as a species of special concern by the California Department of Fish and Game.

Mountain Yellow-legged frog *(Rana muscosa)*

The historic range of mountain yellow-legged frogs in the Sierra Nevada spanned from southern Plumas County to southern Tulare County at elevations mostly above 6,000 feet. Mountain yellow-legged frogs are found in high mountain lakes, ponds, tarns, and streams. This species extensively uses deep water ponds that have open shorelines and lack introduced fish.

This species was once extremely abundant in aquatic habitats. The most recent assessment of this species' status in the Sierra Nevada indicates that mountain yellow-legged frogs currently are found at fewer than ten percent of the sites in which they were historically observed. Currently, there are three known extant populations in the Golden Trout Wilderness, adjacent to the Monument, but none inside the Monument boundary.

An assessment by the U.S. Fish and Wildlife Service found the Sierra Nevada distinct population of mountain yellow-legged frogs to be warranted for listing under the Endangered Species Act, but precluded by other higher priorities. They are currently a "candidate" species. This species is currently listed as a species of special concern by the California Department of Fish and Game.

Southwestern (Pacific) Pond Turtle *(Actinemys marmorata pallida)*

Southwestern pond turtles were historically found from San Francisco Bay south into northern Baja California, from sea level to over 5,900 feet in elevation. The southwestern pond turtle has disappeared from 30-40 percent of its historic range in California. Southwestern pond turtles have been observed at numerous locations within the Monument.

Southwestern pond turtles historically occurred in a wide variety of permanent and intermittent aquatic habitats, generally slow-moving waters below

5,000 feet elevation. Populations have been found in rivers, streams, lakes, ponds and other seasonal and permanent wetlands. Nests are generally found in open areas dominated by grasses or herbaceous annuals, primarily on south or southwest aspects.

Southwestern pond turtles are listed as a California species of special concern by the California Department of Fish and Game. The entire Wildlife BE can be found in Appendix M of this FEIS.

California legless lizard *(Anniella pulchra)*

California legless lizards are found from the southern edge of the San Joaquin River in northern Contra Costa County south to Baja California. They are found in scattered locations in the San Joaquin Valley, and along the southern Sierra Nevada mountains. About one-third of the Monument is within the known range of this species. California legless lizards have been found in the Sequoia National Forest, north of Kernville near Bull Run Creek and in the Springville area adjacent to National Forest System land. It is presumed to be present within the Monument.

California legless lizards are associated with sandy or loose, loamy soils in sparse pine-oak woodlands and mixed hardwood riparian areas. The species is frequently found under cover objects, such as logs and rocks. The California legless lizard is listed as a California species of special concern by the California Department of Fish and Game.

Management Indicator Species (MIS)

Management indicator species were intended to be species that reflect the effects of management activities and allow for analysis of the relationship between population trends and habitat changes. MIS were identified in the Sierra Nevada Forests MIS Amendment Record of Decision (ROD) signed December 14, 2007. That document directed Forest Service resource managers to (1) at the project scale, analyze the effects of proposed projects on the habitat of each MIS affected by such projects, and (2) at the bioregional scale, monitor populations and/or habitat trends of MIS. The habitats and ecosystem components and associated MIS analyzed for the Monument are shown in the following table.

Those MIS, whose habitat would be indirectly affected by the alternatives, are aquatic macroinvertebrates, fox sparrow, mule deer, yellow warbler, Pacific tree frog, mountain quail, sooty grouse, California spotted owl, American marten, northern flying squirrel, hairy woodpecker, and black-backed woodpecker. The Management Indicator Species Report can be found in the project record and online at http://www.fs.fed.us/r5/sequoia/gsnm_planning.html, and is incorporated by reference.

Table 71 Management Indicator Species Habitat

Habitat	MIS	Acres
Riverine and lacustrine (LAC, RIV)	aquatic macroinvertebrates	340
Shrubland (MCP, MCH)	fox sparrow	48,250
Oak-associated hardwood & hardwood conifer (MHW, MHC)	mule deer	88,860
Riparian (MRI, VRI)	yellow warbler	240
Wet meadow (WTM, FEW)	Pacific tree (chorus) frog	1,510
Early and mid seral coniferous forest (PPN, SMC, WFR, RFR, JPN; tree sizes 1, 2, 3, 4)	mountain quail	134,880
Late seral open canopy coniferous forest (PPN, SMC, RFR, EPN, JPN; tree size 5, canopy closures S and P	sooty grouse	640
Late seral closed canopy coniferous forest (PPN, SMC, WFR, RFR, JPN; tree size 5, canopy closures M and D)	California spotted owl American marten northern flying squirrel	50,850
Forested habitat types	hairy woodpecker	294,300
Snags in burned forest	black-backed woodpecker	<100 acres

Nonnative Animal Species

Aquatic Species

Historically, trout were absent above the approximately 5,200 feet elevation level in the Sierra Nevada. Since the mid-1800s there have been widespread trout introductions into formerly fishless lakes and streams to enhance recreational fishing. Trout stocking by the California Department of Fish and Game is still being carried out today in the Monument.

Bullfrogs (*Lithobates catesbeianus*) are known to be present in some of the man-made lakes in the Monument, including Hume Lake and the lake at Montecito Lake Resort.

Terrestrial Species

Opossums (*Didelphis virginiana*) and nonnative eastern red foxes (*Vulpes vulpes fulva*) may be present in low elevation portions of the Monument and could present a threat to native species through depredation or competition.

Botanical Resources

Four major biotic provinces converge in the Sequoia National Forest. The southern Sierra Nevada is a floristic meeting ground between the central valley, Mojave Desert, high Sierra, and the southern California mountains. This confluence of diverse floras creates a high density of rare endemic plants and many interesting plant communities.

The Sequoia National Forest maintains two different lists of rare plants. The Sensitive Plant List contains federally threatened plants, federally endangered plants, and plants in danger of becoming federally threatened or endangered. The Watch List contains those rare plants that are not in as much danger of becoming federally threatened or endangered. There are 64 sensitive and 29 watch list plant species currently designated in the Sequoia National Forest (93 in total). A majority of these have known occurrences in the forest; however, some are only suspected to occur at this point in time, as potential habitat may exist, and occurrences are found nearby. An occurrence refers to a relatively discreet group of individuals, separated from the next nearest group of the same species by at least ¼ mile. Many of these species require special management attention to ensure their continued viability, and they have been included on either the Sequoia National Forest sensitive plant list or watch list.

Of the 93 species designated in the forest, 32 species are known to, or potentially occur, within the Monument (see the following table).

Table 72 Pacific Southwest Region Sensitive Plant Species Reviewed for the Monument

Species	Habitat Type/Soils	Populations in Monument	Analysis Included
Little Kern River milk-vetch (*Astragalus shevockii*)	Pine needle duff in upper montane Jeffrey pine forest; sandy, granitic soil	Potential, no known occurrences	Yes
Scalloped moonwort (*Botrychium crenulatum*)	Among thick grass and herbs in wet meadows; moist fine sediment and peaty soils	Potential, no known occurrences	Yes
Mingan moonwort (*Botrychium minganense*)	Among thick grass/herbs inmeadowswithin conifer forest; moist fine sediment and peaty soils	Known occurrence	Yes
Mountain moonwort (*Botrychium montanum*)	Among thick grass/herbs in meadows within conifer forest; moist fine sediment and peaty soils	Potential, no known occurrences	Yes
Kaweah brodiaea (*Brodiaea insignis*)	Grassy slopes of foothill blue oak savanna; loamy clay soils in granitic substrate	Potential, no known occurrences	Yes
Bolander's bruchia moss (*Bruchia bolanderi*)	Upper montane stream banks of small meandering creeks; moist fine sediment and peaty soils	Known occurrence	Yes

Species	Habitat Type/Soils	Populations in Monument	Analysis Included
Shirley meadow star-tulip (*Calochortus westonii*)	Meadow edges or openings in mixed conifer/ black oak woodland; deep loamy or shallow rocky derived from granitics or metamorphics	Known occurrences	Yes
Muir's raillardella (*Carlquista muirii*)	Openings in chaparral, ponderosa pine, or mixed coniferous forest; granite ledges/cracks or gravelly/sandy flats	Potential, no known occurrences	Yes
Springville clarkia (*Clarkia springvillensis*)	Disturbed areas in grassland, blue oak woodland, and chamise chaparral, loose sandy granitic soils	Known occurrences, federally endangered	Yes
Tulare cryptantha (*Cryptantha incana*)	Openings in lower mixed conifer forest and pinyon-juniper woodland; gravelly soils	Known occurrences	Yes
Unexpected larkspur (*Delphinium inopinum*)	Open rock outcrops and ridges in conifer and red fir forest; metamorphic substrates (granite occasionally)	Known occurrences	Yes
Tulare County bleeding heart (*Dicentra nevadensis*)	Sandy, gravelly slopes or crevices in lodgepole and sub-alpine forest; decomposed granite soil	Known occurrences	Yes
Pierpoint Springs liveforever (*Dudleya cymosa ssp. costafolia*)	Rock outcrops within in canyon live oak woodland and chaparral; metamorphic carbonate substrate (limestone and marble)	Known occurrences	Yes
Hall's daisy (*Erigeron aequifolius*)	Steep, rocky, crevices in conifer forest and pinyon-juniper woodland; granitic substrate (carbonate or basalt occasionally)	Known occurrences	Yes
Twisselmann's buckwheat (*Eriogonum twisselmannii*)	Rocky openings Jeffrey pine-red fir forests; shallow rocky soil derived from metamorphic and granitic substrate	Known occurrences	Yes
Kaweah fawn lily (*Erythronium pusaterii*)	Rockfields, ledges, and steep canyon walls in montane conifer forest; outcrops and talus fields of metamorphic rock (granite occasionally)	Known occurrences	Yes
Striped adobe lily (*Fritillaria striata*)	Open areas in grassland and blue oak savanna; pockets or islands of heavy adobe clay (granitic or metamorphic)	Low potential, no known occurrences	No
Sequoia false goldenaster (*Heterotheca monarchensis*)	South-facing ledges and cracks on cliffs surrounded by chaparral; carbonate outcrop (limestone or marble)	Known occurrences	Yes
Short-leaved hulsea (*Hulsea brevifolia*)	Openings in lower and uppermontane conifer forest; soils formed in decomposed granite or volcanic pumice	Known occurrences	Yes
Water fan lichen (*Hydrothyria venosa*)	Attached to rocks in small streams within montane coniferous forest; streams that are fed by cold springs and/or groundwater	Known occurrences	Yes
Madera linanthus (*Leptosiphon serrulatus*)	Open areas in blue oak savanna to lower mixed conifer forest; rocky bare areas	Historic occurrences	Yes
Congdon's bitterroot (*Lewisia congdonii*)	Rocky cliffs and ledges within chaparral and conifer forest; rock, talus, and sand derived from granitie or metamorphic rock	Known occurrences	Yes

Species	Habitat Type/Soils	Populations in Monument	Analysis Included
Yosemite bitterroot (*Lewisia disepala*)	Gravel shelves in rock outcrops within conifer forest; decomposed granite deposits	Known occurrences	Yes
Three-ranked hump-moss (*Meesia triquetra*)	Meadows within conifer forest with sphagnum, *drosera*, and *vaccinium*; cold spring-fed acidic fens (organic meadow soils)	Known occurrences	Yes
Broad nerved hump-moss (*Meesia uliginosa*)	Short-grass meadows within conifer forest; spring-fed meadows that are permanently wet	Potential, no known occurrences	Yes
Slender-stalked monkeyflower (*Mimulus gracilipes*)	Openings in burned chaparral, oak savanna, and lower conifer forest; granitic soil in cracks in granite	Potential, no known occurrences	Yes
Flax-like monardella (*Monardella linoidesssp. oblonga*)	Rocky openings within subalpine conifer forest; talus slopes and boulders in metamorphic or granitic substrates	Potential, no known occurrences	Yes
Purple mountain-parsley (*Oreonana purpurascens*)	Open areas within lodgepole-red fir forest; dry sandy gravelly soils in granitic or metamorphic substrates	Known occurrences	Yes
San Joaquin adobe sunburst (*Psuedobahia peirsonii*)	Valley grassland or oak savanna; heavy adobe clay derived from metamorphic substrate (ophiolite)	Low potential, no known occurrences	No
Marble rockmat (*Petrophyton caespitosum ssp. acuminatum*)	Rock outcrops within montane conifer forest; rock cliffs and ledges in carbonate (limestone/marble) or granite areas	Known occurrences	Yes
Keck's checkerbloom (*Sidalcea keckii*)	Valley grassland and open areas in blue oak savanna; heavy red clay soils in mafic intrusive (gabbro) substrate	Low potential, no known occurrences	No
Tehipite valley jewel-flower (*Streptanthus fenestratus*)	Rocky areas within conifer forest; rock cliffs and ledges in carbonate or carbonate-influenced substrate	Known occurrences	Yes

Springville clarkia, Bakersfield cactus, Keck's checkerbloom, and San Joaquin Adobe Sunburst are addressed in the biological assessment.

There are two plant species that are entirely endemic to the Monument and found no where else in the world. These are: Twisselmans buckwheat, (*Eriogonum twisselmanii*), Pierpoint Springs Liveforever (*Dudleya cymosa ssp. costafolia*). In addition, there are seven plant species that are endemic to the Sequoia National Forest and adjacent federal [Bureau of Land Management (BLM), and National Park Service (NPS)] or private lands. These are: Kaweah Brodiaea (*Brodiaea insignis*), Shirley Meadow Star-tulip (*Calochortus westonii*), Springville Clarkia (*Clarkia springvillensis*), Tulare County Bleeding Heart (*Dicentra nevadensis*), Tehipite Valley Jewel-Flower (*Streptanthus fenestratus*), Kaweah Fawn Lily (*Erythronium pusaterii*) and Purple Mountain-Parsley (*Oreonana purpurascens*).

There is only one federally listed endangered plant known to occur within the analysis area, the Springville clarkia (*Clarkia springvillensis*). Springville clarkia is endemic to a limited area of central Tulare County in the vicinity of Springville on the western boundary of the Monument. Springville clarkia was listed as endangered by the U.S. Fish and Wildlife Service (USFWS) in September 1998 (USFWS 1998). The Forest Service (USDA 1997) prepared a draft recovery plan for this species before

the federal listing. Otherwise, there are no other federally listed threatened or endangered plant species within the analysis area.

Rare Plant Habitat Guilds

While the rare plant species known or suspected to occur in the analysis area vary widely in their ecological requirements and life history characteristics, many occur in similar broad habitat types. For the purposes of this analysis, the rare plant species being considered have been grouped into rare plant habitat guilds by their ecological requirements for soil type, moisture regime, and/or canopy closure as well as vulnerability to management effects.

In many cases, the habitat requirements for rare plant species are poorly defined, and there are typically several other factors affecting their occurrence other than simply the vegetation community. Plants are grouped by their ecological requirements for soil type, moisture regime, and/or canopy closure as well as vulnerability to management effects. The following rare plant habitat guilds have been selected to represent the species being addressed in the analysis:

- Species occurring in riparian/meadow/aquatic habitats
- Species in drier, upland and forest habitats
- Plants associated with rock outcrops, cliffs, and other special geologic or soil features

Detailed species accounts are shown by rare plant habitat guilds for plants with known populations or potential to occur in the Monument.

Species Occurring in Riparian/ Meadow/Aquatic Habitats

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

Botrychium crenulatum, scalloped moonwort

Botrychium crenulatum is limited to the western United States, scattered from California to Montana. In California, this species is known to exist 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 off-highway vehicle (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 of the species are near campgrounds or trails, so visitor effects could be a potential threat.

Botrychium minganense, mingan moonwort

In California, there are only 13 confirmed occurrences of *Botrychium minganense*; 11 of these occurrences are located within the Lassen National Forest, and one occurrence is known to each of the Plumas and Sequoia National Forests. In addition, there is also one unconfirmed reported location in the Modoc National Forest, a few historical occurrences in Butte County, and a report from Sequoia National Park. Occurrences often consist of only a few plants, so overall plant numbers in California are low. It is known to Butte, Fresno, Plumas, Tehama, and Tulare Counties in California and scattered locations throughout Arizona, Idaho, Nevada, Oregon, Utah, and Washington. All occurrences have few individuals. Actual trends in these occurrences are hard to determine since the sporophytes do not appear above ground every year.

Botrychium minganense was recently listed as a sensitive species for the Forest Service in Region 5, and it is also listed as a sensitive species in Region 6 and is state listed as sensitive in Idaho.

This species is found in small streams, fens, or riparian areas, which generally have streamside or wetlands management protection during vegetation management activities. These habitats are not highly unusual, so the specific limiting factors for this plant species' abundance and distribution are not known. All *Botrychium spp*. have strong mycorrhizal requirements, which may be a factor. Riparian habitats are subject to grazing and hydrologic alterations, and conifer stands are subject to vegetation management.

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, where a little disturbance and compaction is tolerated, but heavy disturbance will kill individuals. An Oregon study found light trampling seemed to benefit some species of *Botrychiums* including *B. minganense*. However, untrampled areas in *B. minganense* occurrences displayed low numbers of individuals while heavily trampled areas completely lost *Botrychium* individuals. Changes in the hydrologic regime (from erosion, roads, grazing, etc.) may also potentially threaten occurrences. Hot fires have been shown to be detrimental, especially if the conditions are very dry during the burn.

Botrychium montanum, mountain moonwort

Botrychium montanum is one of the rarest of the *Botrychium spp*. in California. At this time, there are only 13 confirmed occurrences of *Botrychium montanum* in California. The Lassen National Forest has 15 occurrences, but only 10 of these have been located since 1985. The Plumas National Forest has two confirmed occurrences, and the Modoc has only one known occurrence. In addition, there are a few historic occurrences which have not been confirmed in recent years within Butte County. In July 2005, Don Farrar confirmed a location in the Greenhorn Mountains, Sequoia National Forest in Kern County. Known occurrences often consist of only a few plants, so overall plant numbers in California are low. *B. montanum* is limited to scattered locations from British Columbia, to California, Montana, Oregon, and Washington. In California, this species has been found in Butte, Modoc, Plumas, Shasta, and Tehama counties. Actual trends in the populations are unknown, since sporophytes do not appear above ground every year, and all known occurrences have very few individuals recorded.

Botrychium montanum is currently listed as a sensitive species by the Forest Service in Region 5 and is listed as rare in Oregon. In addition, this species is considered Forest Service Sensitive in Oregon. Interim management prescriptions on several forests require the protection of individuals and their associated habitat. In other areas, *B. montanum* will be provided additional protection since it is found in riparian areas, which generally have some form of streamside or wetlands management protection during vegetation management activities on national forest lands. Soil disturbance has been shown to be very detrimental especially if on a regular basis. This includes grazing and trampling by livestock and OHV, where a little disturbance and compaction is tolerated, but heavy disturbance will kill individuals. An Oregon study found light trampling seemed to benefit some species of Botrychiums including B. montanum. However, untrampled areas in B. montanum occurrences displayed low numbers of individuals while heavily trampled areas were devoid of Botrychium individuals. Changes in the hydrologic regime (from erosion, roads, grazing, etc.) may also potentially threaten occurrences. Hot fires have been shown to be detrimental, especially if the soil conditions are very dry during the burn.

Botrychium montanum grows in varied wet habitats from marshes/meadows to coniferous forest/montane streamside areas. In California, it has primarily been found along shady streams in mixed coniferous forests. These habitats are not highly unusual, so specific factors that limit the plants' abundance and distribution are not known. All *Botrychium spp*. have strong mycorrhizal requirements, which may be a factor. Riparian habitats are subject to grazing and hydrologic alterations, and conifer stands are subject to vegetation management.

Bruchia bolanderi, Bolander's bruchia moss

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

This Bolander's bruchia 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.

Hydrotheria venosa, water lichen

Hydrotheria venosa 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 in the Sequoia, Sierra, and Stanislaus National Forests. The California occurrences are disjunct or separate from other U.S. populations.

According to the documented occurrences in California, 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 could have a detrimental effect on known 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 effects. 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.

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 moss, sundew, and huckleberry, 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 affected some populations. Status in the Monument is not fully known.

Meesia ulignosa, broad-nerved hump moss

The range for *Meesia ulignosa* 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.

Species in Drier, Upland, and Forest Habitats

These species include: *Astragalus shevockii*, *Brodiaea insignis*, *Calochortus westonii*, *Cryptantha incana*, *Hulsea brevifolia*, *Leptosiphon serrulatus*, and *Mimulus gracilipes*. These species occur within forest and chaparral habitats and are ecologically adapted to fire. All of these plants are either perennials that die back to the root crown during fire season or annuals that go to seed and die during fire season, making them tolerant of fire.

Astragalus shevockii, Little Kern River milk vetch

Little Kern River milk vetch is known from approximately 16 occurrences. Plants are scattered over roughly 1,800-1,900 acres along both sides of the lower Little Kern River. Astragalus shevockii is endemic to a six-mile stretch along the lower and middle portions of the Little Kern River drainage in the Sequoia National Forest in Tulare County. All known occurrences are in the Golden Trout Wilderness. Threats include livestock grazing and pack stock use.

Brodiaea insignis, Kaweah brodiaea

Kaweah brodiaea is a showy, herbaceous perennial in the Lily family (Liliaceae). From a fibrous bulb, it produces several linear leaves which are crescent-

shaped in cross-section, and a leafless stalk topped by a cluster of rose-purple to pink tubular flowers. It forms pink carpets in May and June within blue oak savanna. *Brodiaea insignis* is generally found on grassy, mostly west-facing slopes of foothill blue oak woodland habitat, in loamy clay soils over granitic substrate. Elevation ranges from approximately 800 to 1,600 feet.

This species was found historically in the lower Kaweah River drainage and in the lower Tule River drainage in Tulare County. Some Kaweah brodiaea 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 reintroduced site in the Tule River Canyon between Lumreau and Coffee Camp (Sequoia National Forest) did not have plants when last visited by forest staff in 1999.

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

Calochortus westonii, Shirley Meadow star tulip

There are over 1,200 acres of known habitat for *Calochortus westonii*. 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 Bureau of Land Management 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 in the 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 vegetation management, 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 120 acres of additional occurrences were found throughout the burned area during post-fire surveys (1991). These areas were flagged and excluded from salvage tree removal, 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 in 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 percent 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 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.

Clarkia springvillensis, Springville clarkia

Taxonomy

Frank Vasek (1964a) described and named *Clarkia springvillensis*; the scientific name has remained unchanged since that time. He suggested that *C. springvillensis* evolved from *C. unguiculata* (elegant clarkia), as did *C. exilis* (slender clarkia) and *C. tembloriensis* (Temblor clarkia). Although the four species are closely related, various chromosomal differences and barriers to hybridization maintain their uniqueness (Vasek 1964b, Vasek 1977, Holsinger 1985). *Clarkia springvillensis* has only one common name, Springville clarkia; both the common name and specific epithet refer to the Tulare County community of Springville, near where the species is found. The type locality is 2.9 kilometers (1.8 miles) north of the Springville Ranger Station on Balch Park Road (Vasek 1964a). *Clarkia springvillensis* is a member of the Onagraceae (evening primrose family).

Description

Clarkia springvillensis is a rather tall, willowy annual herb with showy four-petaled flowers. The petals are lavender-pink and unusually shaped; the lower half of the petal (i.e., the claw) is very narrow, and the upper half (i.e., the limb) is diamond-shaped. Typically, each petal has a prominent dark purplish spot at the base of the limb (Lewis 1993).

The upright stems of *Clarkia springvillensis* are up to 1 meter (3.3 feet) tall and typically have several branches. The leaves are lance-shaped, ranging from 2 to 9 centimeters (0.8 to 3.5 inches) long and 0.5 to 2 centimeters (0.2 to 0.8 inch) wide. Both the stems and the leaves are grayish-green and hairless. The flower buds are bent downwards. Each flower has four sepals and four petals. The long, narrow sepals are dark reddish-purple, are hairless or covered with very short hairs, and stay attached at their tips when the flower opens. The petals are approximately 1.5 centimeters (0.6 inch) long, with the claw portion accounting for approximately half the length. The claws are red, whereas the limbs are normally lavender-pink and spotted (Vasek 1964a, Lewis 1993). However, a small percentage of plants lack the purple spot on the petals (Vasek 1977). *Clarkia springvillensis* has eight stamens and a style that is 1.4 to 2 centimeters (0.6 to 0.8 inch) long, which is longer than the stamens. The inferior ovary is 1.0 to 1.7 centimeters (0.4 to 0.7 inch) long, is hairless or covered with very short hairs, and has eight lengthwise grooves. The fruit is a long, narrow capsule with many seeds; because the capsule develops from the ovary it has the same type of hairs (Vasek 1964a, Lewis 1993). The seeds are tiny, approximately 0.5 millimeter (0.02 inch) wide by 1 millimeter (0.04 inch) long (McCue and Holtsford 1998). The diploid chromosome number of *C. springvillensis* is 18 (Vasek 1964a, 1964b).

Identification

The close relatives of *Clarkia springvillensis* differ in the type of hairs on the sepals and ovaries, color of the flower parts, and style length. However, many plants have been observed that have characteristics intermediate between *C. springvillensis*, *C. unguiculata*, and *C. exilis*, or that combine the diagnostic characteristics of two or more species, making identification problematic (EA Engineering and Stone 1999, Sanders and Stewart 2000, Stewart 2002). The diagnostic character for *C. unguiculata* is the presence of long hairs on the sepals, ovaries, and capsules in addition to the short hairs, whereas *C. springvillensis* has only short hairs or no hairs on these structures. *C. unguiculata* also has longer petals that range in color from salmon to maroon and usually does not have a spot on the petals, or the spot is smaller than the one in *C. springvillensis* and has a shorter ovary. *Clarkia exilis* and *C. tembloriensis* are similar to *C. springvillensis* in that they lack long hairs on the sepals and ovary. However, *C. exilis* has shorter petals with much smaller purple spots than *C. springvillensis*, its leaves are bright green, and the style is no longer than the stamens. *Clarkia tembloriensis* differs from *C. springvillensis* in that the former has greenish sepals rather than reddish-purple, and the petals usually are not spotted (Vasek 1964a, 1977, Holsinger 1985, Lewis 1993). Among the closely-related species only *C. unguiculata* regularly co-occurs with *C. springvillensis* (Stebbins 2002).

Clarkia cylindrica (speckled clarkia) and *C. dudleyana* (Dudley's clarkia), two species that are sympatric with *C. springvillensis*, are easily distinguished from the latter because they have broad, fan-shaped petals without claws (Lewis 1993).

Historical Distribution

This species was first collected in 1895 north of Springville, but the specific collection locality is unknown. In the late 1950s, Vasek found *Clarkia springvillensis* at the type locality (Vasek 1964a, 1964b). By 1985, the species had been reported from a total of seven sites, all in the vicinity of Springville (Stebbins and Clark 1992). Additional sites were discovered over the next decade (McCue-Harvey and Holtsford 1994, CDFG 2004), bringing the total number of historical occurrences to 15. The California Natural Diversity Data Base (CDFG 2004) actually includes 16 occurrences of *C. springvillensis*, but species experts (Holsinger 1982, Stebbins and Clark 1992, Stebbins 2001) consider element occurrence 2 in the Kaweah River watershed of Tulare County to be erroneous. Thus, that occurrence is excluded from this recovery plan even though it was included in the final rule listing this species as endangered (USFWS 1998). Two other reported sightings of this species from recent surveys in the Tule River watershed are unconfirmed (USDA Forest Service 1996b), are not included in the California Natural Diversity Data Base (CDFG 2004) and will not be discussed herein. Conversely, element occurrence 16 is considered herein to represent *C. springvillensis* even though the flowers are not typical. The petals range in color from white to maroon, but the plants do not have long hairs on the sepals or ovary (USDI BLM 1996). The lack of long hairs on the ovary led Holtsford to agree that the plants probably represent *C. springvillensis* (Carter 2001), but the identification must be considered tentative because species experts have not had the opportunity to observe specimens directly (Stebbins 2002).

All 15 historical occurrences of *Clarkia springvillensis* were in the watershed of the upper Tule River in Tulare County. Four were along the Middle Fork of the Tule River with the others in the watershed of the North Fork of the Tule River, although not along the river itself (CDFG 2004). The total range was approximately 88 square kilometers (34 square miles) with the most distant points of the range approximately 13 kilometers (8 miles) apart. Based on genetic considerations, McCue et al. (1996) speculated that the distribution of *C. springvillensis* plants within their range was more continuous in the recent past, and the populations became fragmented approximately 60 years ago (shown on the following map).

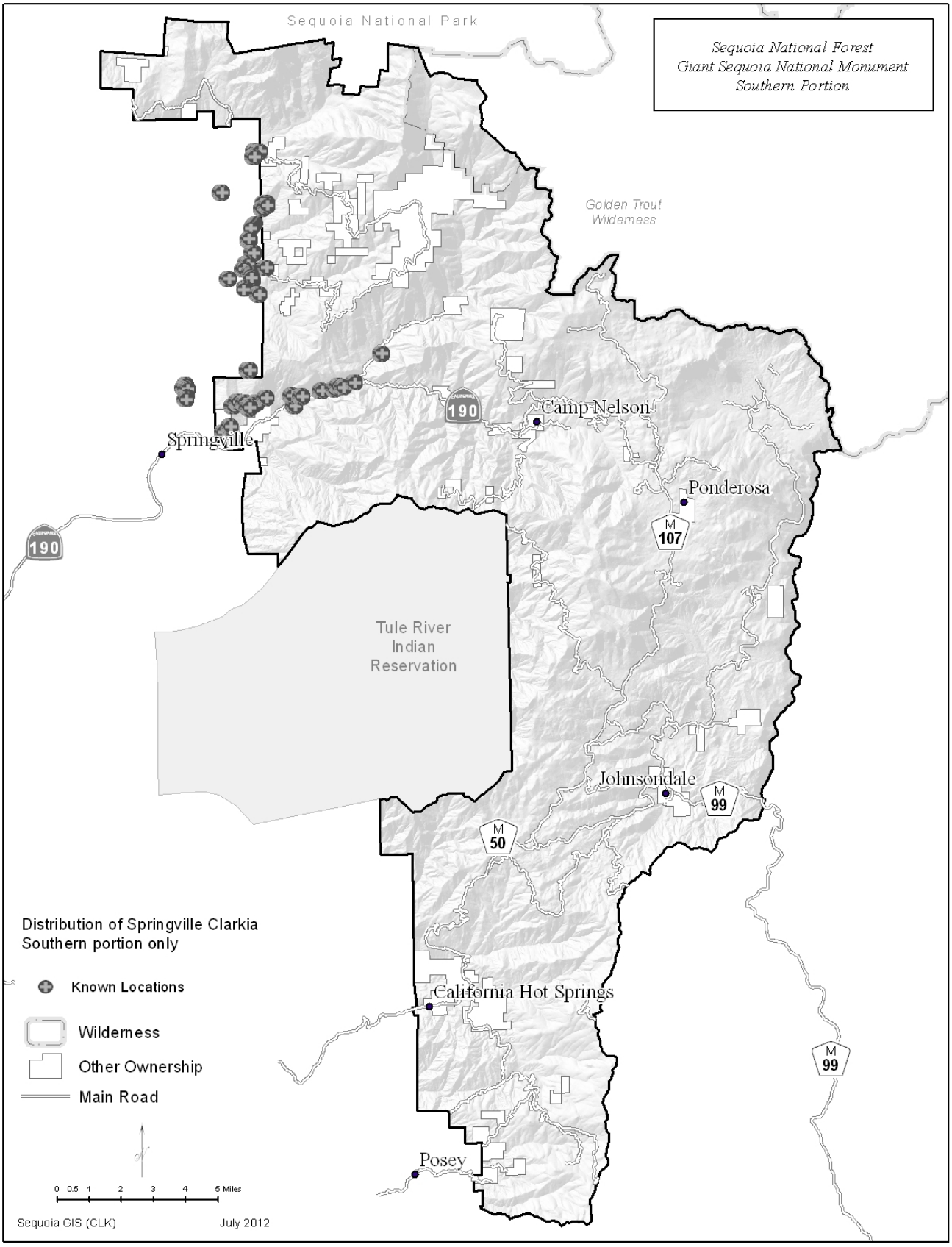
Current Distribution

The California Natural Diversity Data Base (CDFG 2004) considers 14 of the above 15 historical occurrences of *Clarkia springvillensis* to be extant with only the type locality (element occurrence 1) extirpated. However, the population at Coffee Camp (element occurrence 4) along the Middle Fork of the Tule River has not been seen since 1967 despite repeated searches (Stebbins and Clark 1992, CDFG 2004) and is most likely extirpated (Stebbins 1991, Stebbins and Clark 1992).

A number of additional populations have been discovered in recent years (USDA Forest Service 1998b, EA Engineering and Stone 1999, Sanders and Stewart 2000, Stewart 2002) that are not catalogued by the California Natural Diversity Data Base (CDFG 2004). The actual number of occurrences is difficult to determine because some are believed to be misidentification of *Clarkia unguiculata*, some are intermediate in diagnostic characteristics (see "Identification" above), and because some of those reporting new discoveries have considered each individual colony of *C. springvillensis* plants to be a separate population. If the typical approach of the California Natural Diversity Data Base to designating occurrences is applied and their species identifications are accepted, the 20 "localities" reported by EA Engineering and Stone (1999) along the Middle Fork of the Tule River in the vicinity of Siphon Canyon would constitute four occurrences, and a site reported along Plano Road in Porterville (Stewart 2002) would be another occurrence. Another site that was found in 2002 near the type locality (Stewart 2002) may be new or could be a rediscovery of element occurrence, one which was presumed to be extirpated.

If 19 *Clarkia springvillensis* occurrences are presumed to be extant (the 6 described in the previous paragraph plus the 13 mentioned in the first paragraph under "Current Distribution") 12 are wholly or partially on federal lands, 1 is partially on state land, and 3 are partially on county-owned lands. The federally-owned sites include 9 entire occurrences (element occurrences 3, 6, and 12 through 15 and three unnumbered elements, 13 and 15 are private and not federal ownership, element 9 is believed

Map 9 Distribution Map of Springville Clarkia



to be on federal land) and part of 2 others (element occurrence 8 and one unnumbered) in the Sequoia National Forest plus one (element occurrence 16) on USDI Bureau of Land Management. The state-owned Springville Clarkia Ecological Reserve encompasses part of element occurrence 5. The Tulare County Department of Education owns another part of element occurrence 5, plus parts of element occurrences 7 and 11. Element occurrences 9 and 10, parts of element occurrences 5, 7, 8, and 11, and two of the newly-discovered occurrences are in private ownership (EA Engineering and Stone 1999, CDFG 2001, Stewart 2002). Thus, the two largest populations (element occurrences 5 and 15 [15 appears to be on private land]) occur mostly or entirely on public land. One of the two of the newly-discovered occurrences on private land is in an area covered by a conservation easement (Stewart 2002). Of the two occurrences that are presumed to be extirpated, one (element occurrence 4) is in the Sequoia National Forest, and the other (element occurrence 1) is in private ownership.

The watershed of the North Fork of the Tule River remains the primary area of concentration with 11 of 19 extant occurrences (57.9 percent); within that watershed, the Rancheria Creek drainage alone supports 7 of the extant occurrences. The Middle Fork drainage of the Tule River contains 7 extant occurrences (36.8 percent), and the other is in the watershed of the lower Tule River in Porterville. Botanists familiar with the species agree that additional, as yet undiscovered, populations of *Clarkia springvillensis* likely occur along the Middle and North Forks of the Tule River (USDA Forest Service 1998c, EA Engineering and Stone 1999, Sanders and Stewart 2000, Carter 2001, Stebbins 2001). Three occurrences of *C. springvillensis* (element occurrences 3, 6, and 9) are in the lower batholith subsection of the Sierra Nevada section. All others are (or were historically) in the lower granitic foothills subsection of the Sierra Nevada foothills section (USDA 1994).

Numerous previously undocumented colonies were discovered after the Coffee Fire (1999) along the SCE flume and Siphon Canyon. The Deep Fire (2004) opened several thousand acres of habitat to possible population expansion or new discovery in the drainages above Coffee Camp and Milk Canyon. Prior to the fire the area was inaccessible due to steep terrain and dense brush. The Forest Service hopes to complete informal surveys in the area to determine presence of Clarkia springvillensis.

Reproduction and Demography

Clarkia springvillensis is an annual herb. The seeds of this species typically germinate in late November or early December under field conditions (McCue and Holtsford 1998). Germination may continue into January (USDA Forest Service 1998b), although earlier germination results in greater flower production (McCue 1997). The optimal conditions for germination have not been determined, but high rates of germination were observed in growth chambers under 12 hours of daylight at 22 degrees Celsius (72 degrees Fahrenheit) and 12 hours of darkness at 6 degrees Celsius (42 degrees Fahrenheit) (McCue and Holtsford 1998).

Clarkia springvillensis plants usually begin flowering in May and continue flowering into June (Wise 1987, Martin 1990, Martin 1991, Stebbins 1991, Hansen 1992, Stebbins and Clark 1992, USDI BLM 1999, CDFG 2004). However, in some years this species may reach peak flowering in April (Martin 1988, 1989, Stewart 2002). *Clarkia springvillensis* seems to bloom somewhat earlier than the sympatric *C. unguiculata*, although their flowering periods do overlap (EA Engineering and Stone 1999). After flowering, *C. springvillensis* plants drop their leaves (Vasek 1977). The fruits mature during June and July (Wise 1987, McCue 1997b) and disperse seeds in July or August (McCue and Holtsford 1998, USDI BLM 1999). The seeds are dispersed by gravity and have no special adaptations to facilitate dispersal (McCue et al. 1996). Dead plants can remain in place for a year or more; some seeds can be retained inside the capsules even one year after they mature (McCue-Harvey and Holtsford 1994). The only estimate of seed production under natural conditions is from a single population in just one year; there, open-pollinated flowers produced an average of 27 seeds per capsule (McCue 1997b).

Clarkia species are pollinated by bees (super family Apoidea) (MacSwain et al. 1973), but the particular species that pollinate *Clarkia springvillensis* have not been determined. Although most of its seeds (approximately 85 to 90 percent) are produced by

cross-pollination (Vasek 1977, Holtsford and Ellstrand 1992), *C. springvillensis* is self-compatible. McCue (1997) found that the relative effectiveness of cross-pollination and self-pollination in seed set differed between the two populations she studied and in two different years. In one population, cross-pollination resulted in greater seed production in the first year, whereas in the second year in that population and both years in the other population, seed production did not differ between cross-pollinated and self-pollinated flowers.

Self-pollination is limited under natural conditions because the male reproductive parts in a given flower mature approximately 3 days before the female parts (Vasek 1977); pollen from another flower on the same plant would have to reach the receptive female parts in order for self-pollination to occur. *Clarkia springvillensis* differs from its close relatives in that five or more flowers on a single plant may be open simultaneously (Vasek 1964a), and thus the potential for self-pollination among flowers on a plant does exist.

Clarkia springvillensis seeds can remain dormant for at least 2 years, and they form a soil seed bank (McCue and Holtsford 1998). The maximum duration of dormancy for seeds in the soil seed bank is unknown. Researchers from the University of Missouri at Columbia have investigated many aspects of seed longevity and seed bank formation. When stored in coin envelopes at room temperature, 2-month-old seeds had 96 percent viability, and 14-month-old seeds had 90 percent viability. In laboratory germination tests on seeds collected directly from the plants, they found that approximately 6 percent of viable seeds remained dormant after two growing seasons, even after being exposed to conditions favorable for germination. Seeds stored at room temperature for 8 years exhibited 3 percent germination, and none of the seeds that did not germinate were viable (McCue and Holtsford 1998).

However, the viability and germination rates for seeds in dry storage are not necessarily indicative of those for seeds that remain in the soil. McCue and Holtsford (1998) also collected soil from within three natural populations in April 1993 after germination, but before seed set and subjected them to suitable germination conditions. Approximately 25 percent of the soil samples produced *Clarkia springvillensis* seedlings, which must have come from seeds that had gone through at least one growing season without germinating. Soil samples collected after seed set in July 1993 also produced seedlings which could have come from seeds produced during the growing season of 1993 or from seeds that remained dormant for two or more growing seasons. Standing dead stems from the previous year also harbored some seeds, but their viability was not tested (McCue-Harvey and Holtsford 1994). The density of ungerminated seeds in the soil throughout three populations was estimated at 65 per square meter (6 per square foot) in April 1993 after germination, but before seed set. By July 1993, McCue and Holtsford (1998) found a total of 230 seeds per square meter (21 per square foot), indicating that an additional 165 seeds per square meter (15 per square foot) were added during that growing season. Seed densities were approximately two to three times higher in the immediate vicinity of *C. springvillensis* plants than over the entire population area which included some unoccupied patches.

The number of above-ground plants is not a good indicator of population status in *Clarkia springvillensis*. The presence of a seed bank greatly increases the effective population size of this species. For example, based on the number of plants seen above ground, the effective size of one population averaged 2.4 over a 5-year period. When the density of the seed bank was taken into account, the effective population size increased to 699 (McCue and Holtsford 1998). Due to interactions between the seed bank and seasonal weather conditions, above ground population size can vary enormously from one year to the next. The number of *C. springvillensis* plants present in permanent plots within one population (element occurrence 5) was 1,478 in 1987. The population size tripled by the next year (to 5,328 plants in 1988), doubled again between 1988 and 1989 (to 10,965), then dropped to half of its original size in 1990 (718 plants). The following year, it dropped again to 191, then rebounded to 462 (Hansen 1992). Population size has not been estimated on the permanent plots since 1992 (Hansen 2001).

Rainfall patterns and temperatures during the growing season are thought to influence above ground population size, but these factors have not

been the subject of statistical analyses. Martin (1989) suggested that the amount of precipitation in November and December might be correlated with spring population size in *Clarkia springvillensis*. Hansen (1992) also noted that above ground population sizes were highest in years when the area received at least 1.3 centimeters (0.5 inch) of rain by the end of December (1987 through 1989), compared to years when that total was not reached until January or later. McCue-Harvey and Holtsford (1994) indicated that above ground population size seemed to be related to rainfall, but they did not identify particular months.

An index of relative population size is the maximum number of plants recorded in a single occurrence. At their maximum size (all of which occurred within the past 15 years), eight occurrences contained between 100 and 300 plants at their maximum size, one (element occurrence 15) contained "thousands," and one (element occurrence 5) contained over 100,000 individuals at its maximum. No estimates are available for the other three occurrences presumed to be extant (CDFG 2004).

Survival rates have not been well documented in *Clarkia springvillensis*. In a 1994-1995 field trial at two sites, none of 66 seedlings present in March at one site survived to reproduction, and at the second site only 1 of the 75 seedlings survived from March to reproduction (McCue 1997). Most likely other seedlings died between germination and the first count in March. California ground squirrels (*Spermophilus beecheyi*) were the primary mortality factor in that field study because their burrowing activities buried and uprooted seedlings (Fuller 1995). When seedlings were grown in the greenhouse the following year, 314 of 340 (92.4 percent) survived to reproduction (McCue 1997).

In a study of population genetics, McCue et al. (1996) found that the amount of genetic diversity in *Clarkia springvillensis* was in the range expected for other annual plant species with similar reproductive strategies and narrow geographic ranges. The three different populations they studied were very similar in genetic diversity overall, although one (element occurrence 3) had several unique alleles not found at the other sites. McCue and Holtsford (1998) credited the seed bank with maintaining genetic diversity in the species despite the small size of the above ground populations. Unexpectedly high levels of genetic variation within the individual populations were attributed to genetic drift, but it was not considered to be a severe problem (McCue et al. 1996, McCue 1997). Experimental inbreeding did not reveal any overall detrimental effects on seed germination, seedling survival, or reproduction, although the offspring produced by certain parent plants did suffer inbreeding depression (McCue 1997).

Habitat and Community Associations

Clarkia springvillensis grows in openings within the chaparral and foothill woodland plant communities and the transition zones between them (Stebbins and Clark 1992, USDI BLM 1996, USDA Forest Service 1998a, 1998b, CDFG 2001, Stebbins 2001). The most favorable sites for *C. springvillensis* seem to be steep slopes that face south or west and where tree and grass cover are sparse (Stebbins 1991, Stebbins and Clark 1992, McCue et al. 1996). However, others have noted that the highest densities of *C. springvillensis* occur where the trees or shrubs provide some afternoon shade (Wise 1987, Martin 1989, 1990, EA Engineering and Stone 1999). Cleared or burned areas in chaparral provide favorable habitat (Stebbins 2002). The chaparral surrounding these openings is dominated by *Adenostoma fasciculatum* (chemise), with other shrubs such as *Arctostaphylos viscida ssp. viscida* (whiteleaf manzanita), *Ceanothus cuneatus* (California lilac), *Fremontodendron californicum* (flannelbush), *Lupinus albifrons* (silver lupine), and *Toxicodendron diversilobum* (poison oak). Typical dominants in the woodland communities where *Clarkia springvillensis* (Springville clarkia) occurs are *Quercus douglasii* (blue oak), *Q. Wislizenii* (interior live oak), and *Aesculus californica* (California buckeye) (Stebbins 1991, Stebbins and Clark 1992, USDA Forest Service 1996b, EA Engineering and Stone 1999, CDFG 2004). Openings maintained by human activities along roadsides and utility rights-of-way seem to provide favorable habitat, as do recently burned areas. Sparse woody cover may be present where *C. springvillensis* grows along these corridors and grazing and herbicide spraying often are excluded (EA Engineering and Stone 1999, Stebbins 2002).

The soils that support *Clarkia springvillensis* are loams or sandy loams derived from decomposed granite (USDI BLM 1999, CDFG 2004). Two

separate studies (Wise 1987, Stebbins and Clark 1992) that characterized soil texture at *C. springvillensis* sites found that fine gravel and fine sand are the primary components (approximately 28 percent and 25 to 26 percent, respectively), followed by coarse sand (20 percent), silt and clay (17 to 18 percent combined), and gravel (9 percent). Historically, this species occurred at elevations ranging from 335 to 1,219 meters (1,100 to 4,000 feet), but the lowest elevation site that remains extant is at 610 meters (2,000 feet) (CDFG 2004).

Clarkia cylindrica (speckled clarkia), *C. Dudleyana* (Dudley's clarkia), and *C. unguiculata* (fairy fan) can be found growing with *Clarkia springvillensis* (Stebbins and Clark 1992, McCue-Harvey and Holtsford 1994, USDA Forest Service 1996, CDFG 2004). *Clarkia unguiculata* is more likely to co-occur with *C. springvillensis* in foothill woodland sites than in chaparral and in hotter, drier microhabitats rather than moist microhabitats (EA Engineering and Stone 1999).

Most of the other herbaceous associates of *Clarkia springvillensis* are nonnative species. These include the forbs, *Brassica* and *Sisymbrium* species (wild mustards), *Centaurea melitensis* (tocalote), *Erodium* species, and *Silybum marianum* (milk-thistle), as well as several grasses: *Avena* species (wild oats), *Bromus diandrus* (ripgut), *Bromus hordeaceus* (soft chess), *Bromus madritensis ssp. rubens* (red brome), *Hordeum* species (wild barley), and *Vulpia* species (annual fescues) (Stebbins 1991, Hansen 1992, Stebbins and Clark 1992, USDA Forest Service 1996, EA Engineering and Stone 1999, CDFG 2004).

Reasons for Decline

Clarkia springvillensis apparently declined due to a complex combination of past inappropriate livestock grazing (Shevock 1985, Stebbins 1991, Hansen 1992, USDA Forest Service 1996), nonnative plants (McCue et al. 1996), and altered fire regimes (McCue et al. 1996, Carter 2001, Stebbins 2002). Livestock do not specifically seek out *C. springvillensis* until late in the season when it is the only species still green and growing (Stebbins 2001), but they may consume it incidentally earlier in the season while eating the associated plants (USDA Forest Service 1998). Past inappropriate grazing practices that apparently contributed to the decline of *C. springvillensis* included (1) repeated consumption of the same plants in a single growing season; (2) grazing late in the season (May or later) so *C. springvillensis* plants did not have time to send up new shoots or set seed before dying back (McCue 1997, Stebbins 2001); and (3) livestock spending long periods in one area, which caused direct trampling of plants, soil compaction, and surface disturbance (Hansen 1992). Concern over grazing peaked in the 1980s, and several populations were then fenced to exclude livestock (Stebbins 1991). As of 1993, 8 of the 13 extant occurrences were still subject to grazing; 2 of those in the Sequoia National Forest [13 and 15 are on private land, 12 and 14 have been either fenced or deferred grazing until seed set since 1995.] were judged to have serious grazing problems at that time, whereas the other sites had less severe problems (CDFG 2004).

Nonnative plants, especially *Bromus* species, may have contributed to the decline of *Clarkia springvillensis* by competing directly for moisture and nutrients (Stebbins 2002). Dead stems of nonnative grasses create a build-up of thatch that may have prevented *C. springvillensis* from becoming established in openings, thereby isolating populations (McCue et al. 1996, Stebbins 2001). Prolonged grazing may have exacerbated these problems because soil disturbance favors nonnative plants over native species (Hansen 1992). However, in areas where livestock have been excluded completely, thatch build-up is more severe (Stebbins 2002). A related problem is that the stems and thatch of nonnative plants contribute to an increased fire frequency. Conversely, fire suppression activities may have inadvertently contributed to the decline of *C. springvillensis* by allowing encroachment of shrubs and trees into the openings where it grows (McCue et al. 1996, Carter 2001, Stebbins 2002). Lack of fire also would contribute to thatch accumulation (Stebbins 2002).

The plants growing on steep banks along roads generally have been safe from grazing animals because fences at the edge of the bank and the steep slopes prevented livestock from entering (Shevock 1985, Stebbins 2001). However, road maintenance and improvements affected *Clarkia springvillensis* on these banks to some extent (Stebbins 1991, CDFG 2004, Stebbins 2002). Road maintenance includes activities such as mowing, grading, spraying

herbicide, mechanically removing brush, and clearing culverts (USDA Forest Service 1996), whereas road improvements are activities such as widening or straightening roads or installing culverts. Mowing most likely reduced seed production because it took place when *C. springvillensis* was flowering; the timing was chosen to remove the annual grasses as soon they stopped growing (Shevock 1985). However, *C. springvillensis* population sizes and seed banks were not being monitored at that time, so effects cannot be quantified. Road improvements apparently extirpated element occurrence 1 (Stebbins 2001) and damaged, but did not eliminate element occurrences 3 (Stebbins and Clark 1992) and 16 (Carter 2001). Additional activity along main roads includes maintenance of firebreaks. Element 3 was affected on an annual basis by construction of a 3-foot wide fuelbreak scraped to bare mineral soil each year. The fuelbreak was repopulated each year, presumably from adjacent seed plants. This practice was modified in 1995 after listing; however, additional coordination/education may be needed in this area.

Residential development affected *Clarkia springvillensis* at two sites. Element occurrence 5 was damaged, but not destroyed when an access road, building pad, and well were constructed in the midst of the *C. springvillensis* population (Ashford 1989); however, the home was never built (see "Conservation Efforts"). Mobile home development apparently contributed to the extirpation of element occurrence 1. No mobile homes are currently located at that site, but road construction, maintenance, and improvement associated with the former residences are believed to be responsible for its disappearance (CDFG 2001, Stebbins 2001).

Threats to Survival

Currently, the primary threat to the survival of *Clarkia springvillensis* is competition and thatch build-up from nonnative plants (Hansen 1992, McCue 1997, Stebbins 2002). Aggressive, nonnative plants such as *Bromus* species, *Brassica* species, *Torilis* species (hedge-parsley), and *Centaurea melitensis* are present at nine occurrences, although they have not been reported as threats at all nine sites. The *Centaurea* species present at the Springville Clarkia Ecological Reserve has been incorrectly reported as *C. solstitialis* (Hansen 1992), but is actually *C. melitensis* (Cypher 2003, Stebbins 2001). Trees and shrubs, although native, also may be competing with *C. springvillensis* for available water (Martin 1990) or creating too much shade (McCue et al. 1996, USDI BLM 1999) at all of the extant sites.

Grazing is not currently a threat. Although grazing is still allowed in three allotments within *Clarkia springvillensis* habitat, the Forest Service has taken steps to prevent cattle from accessing the plants until after seed set (see also "Conservation Efforts" below). One national forest pasture where *C. springvillensis* grows is still grazed by horses, but the animals have not been observed to graze the occupied habitat (Anderson 2002, Stewart 2002). The occurrences on Tulare County Department of Education lands are only lightly grazed (Mitchell 2001). Grazing in several years has been observed to exceed the Forest Service standard of 700 lbs residual dry matter (RDM), but combined with timing and thatch removal effects do not appear to limit the population (Anderson 2004), and the timing appears to be favorable for *C. springvillensis* (Anderson 2002).

Properly managed grazing where livestock are removed by April and not allowed to spend too long in any one area actually could benefit *Clarkia springvillensis* by helping to control nonnative competitors (McCue 1997, Mitchell 2001, Stebbins 2001, Anderson 2002). Heady (1975) found early season grazing tended to favor greater cover of broad-leaved species by controlling graminoides. Controlled fires also could be used to reduce competition from both nonnative herbs and native tree and shrub species. Thus, fire suppression is a continuing threat for this reason (McCue 1997, Carter 2001). Although creating openings in chaparral would in itself be beneficial, fire could create another problem by allowing livestock access to *C. springvillensis* plants that otherwise would have been shielded by shrubs (Carter 2001). The effect of opening chaparral with both the potential for exposing new or existing populations to grazing would be mitigated on federal lands by exclosure fencing or timing of use. In addition, germinating seeds or growing plants of *C. springvillensis* would likely be killed by the heat of fires that occurred during the growing season (CDFG 1990, Carter 2001). One area fenced to exclude livestock in 1999 on National Forest System (NFS)

lands has been overtaken by brush and no longer appears to support *Clarkia springvillensis* (Loehner 2004).

Road maintenance still is a problem at five occurrences in *Clarkia springvillensis* habitat. The dirt roads along which it grows are maintained by either Tulare County, Pacific Gas and Electric, or Southern California Edison. Although this species occurs along some roads administered by the Forest Service, *C. springvillensis* is not threatened there because the roads require very little maintenance and the species occurs more than 100 meters (300 feet) from the roadside (Anderson 2002). Similarly, although *C. springvillensis* grows near State Highway 190, it is far enough from the roadway that it is not affected by California Department of Transportation maintenance activities (USDA Forest Service 1996). Mechanical brush removal which occurs along the Southern California Edison water flume and Pacific Gas and Electric transmission line is not detrimental if it is done from late summer through autumn when *C. springvillensis* is not actively growing (USDA Forest Service 1996) and in fact appears to be beneficial to *Clarkia springvillensis* if done during that time (Stebbins 2001). A management plan prepared for Southern California Edison (EA Engineering and Stone 1999) suggests guidelines to avoid effects to *C. springvillensis* during routine maintenance activities.

Grading is a problem only in level areas which are uncommon adjacent to the roads where this species grows (USDA Forest Service 1996). Of the two such occurrences one is not likely to be graded again because it is in a remote area and crosses public land; a former incidence of grading was due to miscommunication among agencies (Carter 2001). The other site where *Clarkia springvillensis* grows on the level edge of a road may continue to be affected by periodic grading and dumping of sand (Holtsford 1994).

Residential development is a potential threat to one occurrence of *Clarkia springvillensis*. Element occurrence 10 is in an area zoned to allow one dwelling per hectare (2.5 acres) as long as the dwellings are occupied by family, employees, or farm laborers. An additional dwelling is allowed for the owner (Pacheco 1997).

Nature walks for large groups conducted on Tulare County Department of Education lands were cited as a threat in the final rule (USDI USFWS 1998). However, the director of the educational facility where *Clarkia springvillensis* grows has indicated that the populations are away from the areas where tours are conducted (Mitchell 2001).

Despite the apparently small size of *Clarkia springvillensis* populations, this species does not exhibit all of the detrimental effects common to small populations. McCue and her colleagues determined that the seed bank adequately protects this species from genetic drift and inbreeding depression under current conditions, provided that the individual populations do not become any more fragmented (McCue 1997b). However, catastrophic events such as severe erosion or human activities that removed large quantities of soil could reduce or eliminate the seed bank from a site and lead to extirpation of that population.

Conservation Efforts

The U.S. Fish and Wildlife Service (1994) proposed that *Clarkia springvillensis* be listed as a federally threatened species and published the final rule listing it as threatened four years later (USDI USFWS 1998). *Clarkia springvillensis* has been listed as an endangered species by the state of California Fish and Game Commission since 1979 (CDFG 1997). The California Native Plant Society considers this species to be “fairly endangered” and includes it on List 1B (Tibor 2001).

The California Department of Fish and Game has made numerous contributions to the conservation and recovery of *Clarkia springvillensis*. In 1986, they used money from the environmental license plate fund to purchase 1.8 hectares (4.5 acres) of habitat (Stebbins 1991, Stebbins and Clark 1992), which is now designated as the Springville Clarkia Ecological Reserve. The property had been partially fenced when purchased, and in 1989 the California Department of Fish and Game fenced the remainder. Since that time, the preexisting fence was found to have been improperly aligned; thus the fenced area actually includes some land that is in private ownership, where approximately half the population of *C. springvillensis* grows (Ashford 1989; CDFG 1990, Stebbins 1991). There was extensive trespass grazing

in the reserve by both cattle and horses from adjacent private land until the fence was rebuilt in May 1999. The California Department of Fish and Game funded annual monitoring of the Springville Clarkia Ecological Reserve population from 1987 through 1992 (Hansen 1992). Funding from the California endangered species tax check-off paid for preparation of a status survey (Stebbins 1991), which helped to justify the federal listing of *C. springvillensis* and an educational booklet for distribution at the Springville Clarkia Ecological Reserve (Stebbins and Kirkpatrick n.d.). The California Department of Fish and Game also sponsored research on *C. springvillensis* population genetics and seed bank dynamics (McCue-Harvey and Holtsford 1994, McCue et al. 1996, McCue 1997, McCue and Holtsford 1998).

The Forest Service and the Bureau of Land Management manage lands supporting *Clarkia springvillensis* and have conducted various activities to further its conservation. The Forest Service prepared management guidelines for the conservation of *C. springvillensis* in the Sequoia National Forest (Anderson 1987) and instituted various restrictions on grazing in *C. springvillensis* habitat including: (1) suspending one grazing permit (Key 1994); (2) installing a fence around one population of *C. springvillensis* to exclude cattle (USDA 1998a, Anderson 2002); (3) surveying unfenced, grazed areas annually; (4) excluding cattle from another pasture until after seed set (Anderson 2002); and (5) requiring that a specified amount of vegetation remain in grazed areas at all times (USDA 1998a). Other Forest Service conservation efforts include monitoring populations on NFS lands, conducting surveys in potential habitat (Key 1994), and providing educational programs for state and county employees working in the area (Anderson 2002). The Bureau of Land Management also conducted limited surveys for this species in 1995; much potential habitat is difficult to survey due to impenetrable chaparral vegetation (USDI BLM 1996a, Carter 2001). Both agencies have plans to do controlled burns to benefit this species in cooperation with the CalFire and the California Department of Fish and Game (USDA 1998a, USDA Forest Service 1998b, USDI BLM 1999). Wildfires burned portions of element 5 in 1998, portions of unnumbered populations near Coffee Camp in 1998, and potential habitat from Coffee Camp through Milk Canyon in 2004.

Pacific Gas and Electric and Southern California Edison are working cooperatively with the Sequoia National Forest to protect the occurrences that are associated with hydroelectric facilities and power line rights-of-way on NFS land (Stewart 2002). Fencing and warning signs have been erected to forestall accidental disturbance by people working in those areas (Stebbins 1991, Stebbins and Clark 1992, Key 1994, Anderson 2002). *Clarkia springvillensis* plants have spread outside of the fenced areas since their installation in 1987 (McCue-Harvey and Holtsford 1994, USDA Forest Service 1996b, CDFG 2004).

Cryptantha incana, Tulare cryptantha

Only 3 occurrences of Tulare cryptantha are listed in California Natural Diversity Database (CNDDB), all of which are historical, and there is no information on population size. It occurs in lower montane coniferous forest (gravelly or rocky substrate), pinyon woodland at 1,700-2,250 meters (5,800-7,440-foot elevation).

It is distributed on southwestern Kern Plateau and eastern Greenhorn mountains. Three known locations are: 1) 5,800 feet on Ninemile Creek, 2) Grey Meadow, 3) Upper Peppermint Creek (Kern Plateau). The Ninemile Creek occurrence is in the Inyo National Forest, and the others are in the Sequoia National Forest. The Ninemile Creek and Grey Meadow occurrences are in national forest wilderness.

Hulsea brevifolia, short-leaved hulsea

Hulsea brevifolia is found in the Sierra Nevada from Grant Grove where Dorst Creek crosses the 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 the shade of canopy in upper montane coniferous forest. Potential threats include OHV use, vegetation management, road maintenance, and possibly prescribed burning if done in spring or early summer. Most of these threats are for populations outside of the Monument.

Leptosiphon serrulatus, Madera linanthus

Madera linathus occurs on dry slopes in cismontane woodland and lower montane coniferous forest, mostly in decomposed granite soils, but occasionally

in serpentine soils. Sites apparently vary from well-vegetated areas in blue oak woodland to more open, rocky sites. Although most are documented from blue oak woodland at lower elevations (below 3,500 feet), at least 2 are known from mixed conifer forest above 5,000 feet where winter snow remains for several months.

Madera linathus is historically documented from at least 20 occurrences, few of which have been seen in the last several decades. One occurrence at Millerton Lake in Fresno County (CNDDB element occurrence 9) was extant within the last few years (Winchell, personal communication). York records an occurrence that appears to correspond with CNDDB element occurrence 11, collected during the late 1990s as part of his study of flora of the Kings River basin. Historic locations are documented from southern Mariposa County southward to Kern County, with occurrences in Madera, Fresno, and Tulare counties. Elevations range from 260 to over 5,000 feet.

The population trend is unknown, but possibly declining based on unsuccessful attempts to relocate several historic occurrences. As most fall outside of public lands, protection varies from none for private land to some protection on National Forest System lands by virtue of the requirement for environmental analysis prior to ground-disturbing projects.

Potential threats include private land development, road maintenance or reconstruction, competition from invasive nonnative species, overgrazing and trampling by livestock, and OHV use. The higher elevation populations could be damaged by vegetation treatment and fuels reduction projects.

Mimulus gracilipes, slender-stalked monkeyflower

Slender-stalked monkeyflower is found on open sandy and gravelly flats in chaparral, foothill woodland, and lower mixed conifer forest as well as burned areas in chaparral, foothill woodland, and lower coniferous forest. It is known from fewer than 20 occurrences. Size of populations varies dramatically in relation to disturbance and rainfall. 1998 was an exceptional year; known and newly discovered populations numbered in the thousands.

It occurs in Mariposa, Tuolumne, and Fresno counties, in the Tuolumne, Merced, Fresno, Kings, and San Joaquin watersheds. Found in the Sierra National Forest and Yosemite National Park and in several locations downslope and off the forest in the vicinity of Bootjack and Wawona, also as far south as Miramonte near the Fresno/Tulare County boundary. Elevation ranges from 1,500 to at least 4,500 feet.

The trend is presumably stable, but it is only conspicuous in above average rainfall years. All populations occur on public lands and it will receive consideration during site-specific project analysis. Potential threats are: residential development (near Wawona), competition from noxious weeds (Carpenteria Botanical Area); road maintenance; vegetation treatments, possibly lack of fire, since this Monkeyflower appears to behave as a "fire follower" (fire annual).

Plants Associated with Rock Outcrops, Cliffs, and Other Special Geologic or Soil Features

These species include *Carlquistai muirii*, *Delphinium inopinum*, *Dicentra nevadensis*, *Dudleya cymosa ssp. costifolia*, *Erigeron aequifolius*, *Eriogonum twisselmanii*, *Erythronium pusaterii*, *Heterotheca monarchensis*, *Lewisia congdonii*, *Lewisia disepala*, *Monardella linoides ssp. oblonga*, *Oreonana purpurascens*, *Petrophyton caespitosum ssp. acuminatum*, and *Streptanthus fenestratus*.

Carlquistia muirii, Muir's raillardella

Carlquistia muirii 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 habitat for this plant, but none of the known populations are within the Monument.

This species occupies granite ledges and cracks, 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 livestock traffic or trail maintenance could affect populations.

Delphinium inopinum, unexpected larkspur

Delphinium inopinum is found in disjunct populations mostly in the Sequoia National Forest (the majority in the Monarch Divide, on Slate Mountain, and in the Piutes), the Sierra National Forest (Monarch Divide), and the Los Padres National Forest (Mount 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 6,000 to 8,800 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.

Dicentra nevadensis, Tulare County bleeding heart

Dicentra nevadensis is known to have approximately 10 occurrences in the Hume Lake and Western Divide Ranger Districts of the Sequoia National Forest and one occurrence in 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 in elevation. Threats include trampling, road maintenance, and plant collecting in areas of heavy recreation use (e.g., in the Hume Lake Ranger District and in Sequoia National Park).

Dudleya cymosa ssp. costifolia, Pierpoint Springs liveforever

There are two confirmed locations on a formerly private tract of land acquired by 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.

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 in the Sequoia National Forest (10) with one each in 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 5,200 to 8,000 feet in elevation, in mixed conifer forests. Populations are relatively stable due to the steep, rugged nature of the habitat, making them inaccessible for vegetation management, grazing, and most recreation. The only potential threat for known Erigeron aequifolius populations is from hikers and rock climbers.

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

Erythronium pusaterii, Kaweah fawn lily

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, approximately 7,300 to 9,100 feet in elevation.

Kaweah fawn lily occurs roughly along 18 miles (north-south) in Tulare County from the Kaweah

River watershed in Sequoia-Kings Canyon National Parks down through the Tule River watershed in Sequoia National Forest. Known locations include Hockett Lakes in Sequoia National Park and Moses Mountain, Jordan Peak, Slate Mountain in the Sequoia National Forest. Seven occurrences are known, most with at least several hundred to several thousand plants each.

The trend of this species is stable to increasing. Most occurrences are protected by the inaccessibility of the steep, rocky habitat. No threats are anticipated, due to the inaccessibility of the steep, rocky habitat.

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 effects.

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 3,650 to 6,000 feet in elevation. The only discernible threat may be competition from nonnative annual grasses.

Lewisia congdonii, Congdon's bitterroot

Lewisia congdonii has a disjunct distribution between the Kings Canyon and the Merced River canyon 50 miles to the north. All but one population are in the Merced River drainage. Elevation ranges from 1,900 to 7,000 feet.

In 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 recolonized well to highway 140. In the Stanislaus National Forest, the only occurrence is at Trumbull Peak with no visible threats. The only occurrence in 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 memorandum of understanding for protection of rare species in the Merced Canyon (signing parties are the Forest Service, BLM, Pacific Gas and Electric, Caltrans, and the California Department of Fish and Game).

Lewisia disepala, Yosemite bitterroot

Lewisia disepala species is found in Mariposa, Madera, Fresno, Tulare, and Kern Counties from 4,400 to 7,800 feet in 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 effects could result from hiking or camping near outcrops that are accessible to the public. Effects from mechanical equipment or fuelbreak construction are possible since the plants are not visible during the normal field season.

Monardella linoides ssp. oblonga, flax-like monardella

Flax-like monardella occurs in the southern Sierra Nevada and Tehachapi mountains from Tulare County to Kern and Ventura Counties. It is known from about 20 occurrences. *Monardella linoides ssp. oblonga* has a disjunct distribution with plants found in the southern Sierra Nevada and western transverse range. Occurrences found in the Los Padres National Forest are well distributed across areas of suitable habitat, and there is no apparent decline in the abundance and distribution of the species relative to its historic distribution. Monitoring of occurrences has shown that plants are tolerant of current and anticipated

levels of livestock grazing and that plants are adapted to surviving fire events. The known occurrences of *Monardella linoides ssp. oblonga* on National Forest System lands appear to be stable or increasing in size.

Monardella linoides ssp. oblonga grows among rock outcrops and general openings in mixed conifer forests, yellow pine forests, pinyon-juniper woodlands, and desert scrub habitat. It is distributed in several highly restricted occurrences, but currently is not considered to be at risk of extinction.

This taxon is known to respond positively to wildfire events; however, some occurrences are vulnerable to road/trail maintenance and OHV activity.

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 Western Divide Ranger Districts) and Sequoia and Kings Canyon National Parks in the southern Sierra Nevada of Tulare County (roughly 50 miles). Purple mountain parsley 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 effects from major activities such as mechanical equipment or road/trail construction or maintenance.

Petrophyton caespitosum ssp. acuminatum, marble rockmat

Petrophyton caespitosum ssp. acuminatum occurs on lower and upper montane coniferous forest, on carbonate or granitic, rocky substrates between 1,200-2,300 meters. Marble rockmat occurs in Fresno, Inyo, and Tulare Counties. Kings River canyon near Boyden Cave (Sequoia National Forest); west of Independence, Symmes Creek (Inyo National Forest); Big Arroyo, Tulare County (Sequoia-Kings National Parks). It grows within lower and upper montane coniferous forest, on carbonate or granitic, rocky substrates between 1,200-2,300 meters. There are occurrences reported in CNDDB; no other information is available.

The population trend is unknown. There are no likely threats to the Inyo or Sequoia National Forest occurrences. The Inyo National Forest occurrence near the wilderness boundary, growing on a cliff across a creek from a trail, is somewhat inaccessible.

Streptanthus fenestratus, Tehipite valley jewel flower

All occurrences of *Streptanthus fenestratus* are in Fresno County, mostly in Kings Canyon National Park. One population was recently found in 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 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.

Invasive Nonnative Species

The Forest Service Manual (USDA Forest Service 2000) defines invasive nonnative species (noxious weeds) as:

> Those plant species designated as noxious weeds by Federal or State law. Noxious weeds generally possess one or more of the following characteristics: aggressive and difficult to manage, poisonous, toxic, parasitic, a carrier or host of serious insects or disease, and generally nonnative.

The manual further defines undesirable plants as:

> Plant species that are classified as undesirable, noxious, harmful, exotic, injurious, or poisonous, pursuant to State or Federal laws, including those designated by the Secretaries of Agriculture or the Interior.

For the purpose of this FEIS invasive nonnative species are those plants with an extraordinary capacity for multiplication and spread at the expense of native plants. They may or may not be officially designated as noxious weeds.

Invasive nonnative species 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 2001 Sierra Nevada Forest Plan Amendment (2001 SNFPA). The 2001 SNFPA and other sources provide more detail on the extent and process of invasive nonnative species invasions than the summarized version provided here.

Many people are unaware of the extent of noxious weeds in the Monument and generally in the Sierra Nevada. In fact, the spread of the some of the most aggressive species of pest plants is still in its initial stages. However, several species of highly invasive nonnative species are poised to spread extensively throughout the Sierra Nevada, to the detriment of nearly all values and products the public expects from national forests (CIPC 2011). Whether the concern is sustaining forage for livestock and wildlife, successful reforestation, aesthetic appreciation of natural scenery, recreation, habitat for common and rare wildlife and plant species, or native biodiversity in general, invasive nonnative species sweep across landscapes and reduce the availability of all of these resources.

There are 31 invasive nonnative species known to occur within or directly adjacent to the Sequoia National Forest. Of these, 17 species are currently known to occur in the Monument. The species are shown in the following table. Of these 17 species, 5 are ranked as high priority species. The figures provided in the following table are based on currently mapped occurrences, and for the medium and low priority species, in particular, the figures likely underestimate the abundance of these species, as there are many unmapped occurrences.

Table 73 Invasive Nonnative Species Occurrences in or in Proximity to the Monument

Scientific Name	Common Name	California Invasive Plant Council Pest Rating	California Department of Food and Agriculture Pest Rating	Acres (estimated)	Monument Priority
Ailanthus altissima	Tree of heaven	Moderate	–	100	High
Brassica nigra	Black mustard	Moderate	–	100	Moderate
Bromus tectorum	Cheatgrass	High	–	1,000	Low
Carduus pycnicephalus	Italian thistle	Moderate	C[1]	100	Moderate
Centaurea melitensis	Tocalote	Moderate	–	100	Moderate
Centaurea solstitialis	Yellow star thistle	High	C	30	High
Cirsium vulgare	Bull thistle	Moderate	–	100	High
Cytisus scoparius	Scotch broom	High	C	5	High
Foeniculum vulgare	Fennel	High	–	5	Low
Holcus lanatus	Velvet grass	Moderate	–	0	Moderate
Hypericum perforatum	Klamath weed	Moderate	C	25	High
Robinia pseudoacacia	Black locust	Limited	–	5	Moderate
Rubus armeniacus	Himalayan blackberry	High	–	5	Low
Salsola tragus (S. iberica)	Russian thistle	Limited	C	100	Low
Silybum marianum	Milk thistle	Limited	–	20	Low
Taeniatherum caputmedusae	Medusahead	High	C	200	Moderate

1. A pest of known economic or environmental detriment and, if present in California, it is usually widespread. C-rated organisms are eligible to enter the state as long as the commodities with which they are associated conform to pest cleanliness standards when found in nursery stock shipments. If found in the state, they are subject to regulations designed to retard spread or to suppress at the discretion of the individual county agricultural commissioner. There is no state enforced action other than providing for pest cleanliness.

Scientific Name	Common Name	California Invasive Plant Council Pest Rating	California Department of Food and Agriculture Pest Rating	Acres (estimated)	Monument Priority
Tribulus terrestris	Puncture vine	–	C	40	Low
Verbascum thapsus	Woolly mullein	Moderate	–	200	Moderate

The Sequoia National Forest is actively mapping invasive nonnative species locations in and adjacent to the forest to monitor spread and detect new populations. On average, 130 acres of invasive nonnative species are being treated each year. The number of treated acres is expected to remain at about this level over the next five years.

The known distributions in and near the Monument of four invasive nonnative species (yellow star thistle, tree of heaven, scotch broom, and bull thistle) considered to be the most destructive and invasive are shown in the following maps (there are no mapped populations of the tree of heaven, scotch broom, or bull thistle in the northern portion of the Monument).

Biology of Invasive Nonnative Species

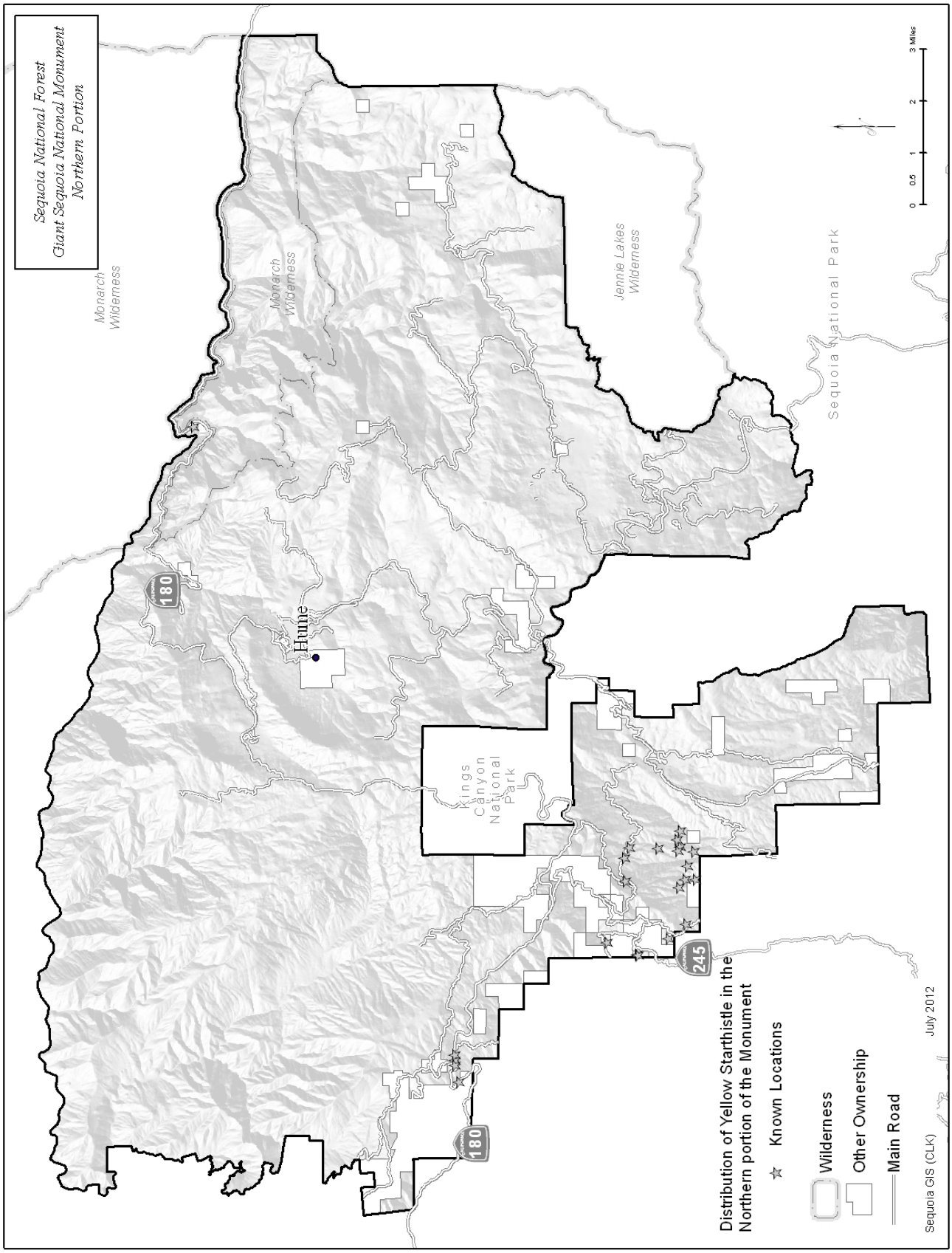
The 17 species shown above vary in their degree of invasiveness and competitiveness; hence, each weed shown in the table warrants different levels of management concern. Although all these plants out-compete native plants, compromising biodiversity, some species (for example, black mustard, cheatgrass, mullein, and tocalote) are so widespread that extensive programs of eradication would not be practical. However, measures taken to prevent the spread of these weeds is expected to minimize further spread of these pests. Careful attention to the type and timing of Forest Service activities can help diminish the presence of some species, such as black mustard and cheatgrass.

On the other hand, every effort will be made to control and eradicate highly aggressive noxious weeds such as yellow star thistle, scotch thistle, and tree of heaven. Invasions of these species into the Sierra Nevada are generally in early stages.

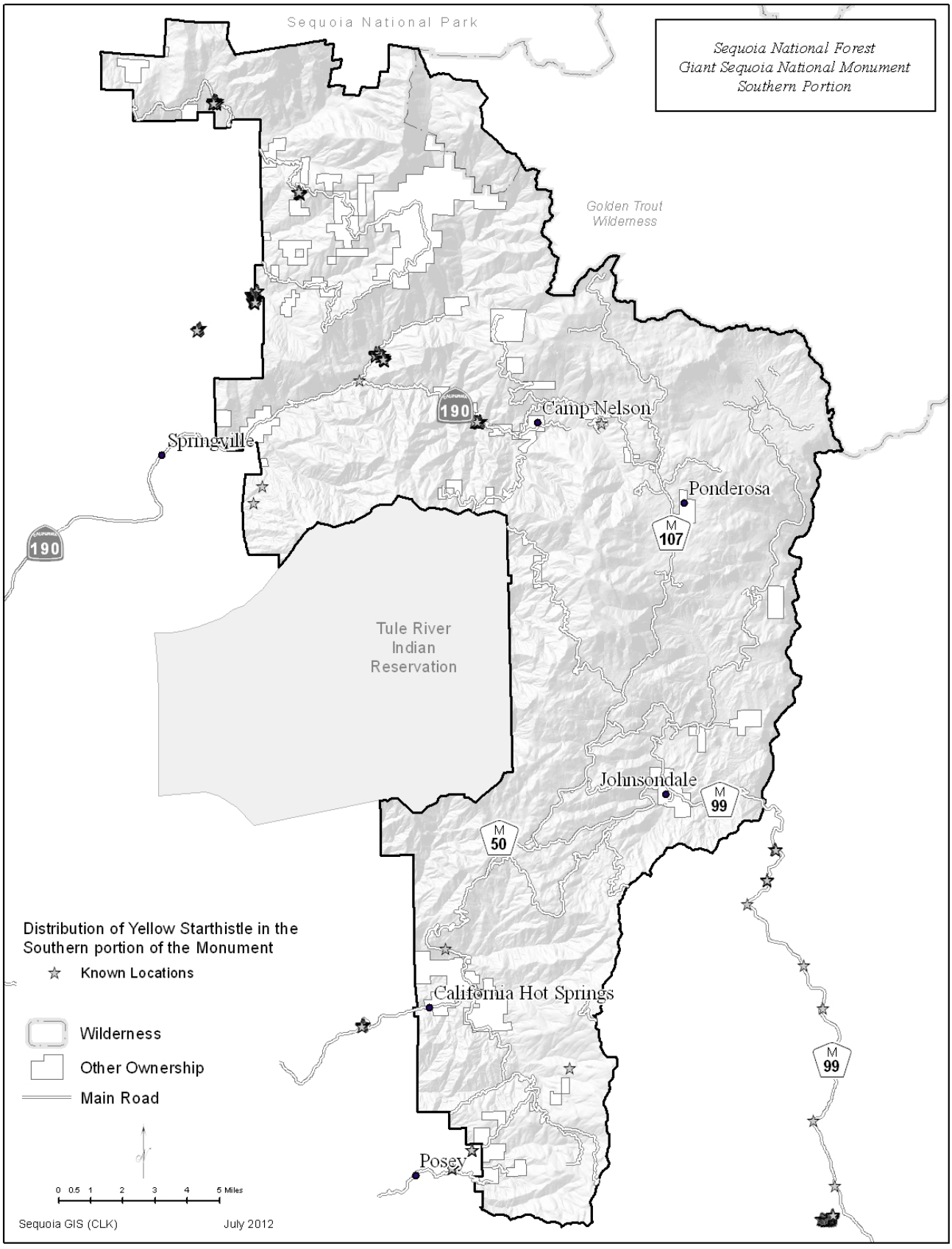
One reason noxious weeds are so destructive is that they arrive without the co-evolved predators, pathogens, and competitors that keep their populations in balance in their native habitat (Westbrooks 1998). For example, yellow starthistle is not a pest in southern Eurasia, where its populations are controlled by at least 40 insect species (Thomsen et al. 1996). Certain biological characteristics can also make weeds exceptionally successful invaders (Rejmanek 1999, Westbrooks 1998). Biological traits of individual noxious weed species vary, but most possess one or more of the following features that allow them to rapidly invade new areas and displace native vegetation:

- Early maturation (weeds begin growth and reproduction earlier in the year than native plants)
- High reproductive rates (weeds produce exceptionally high numbers of seeds or vegetative propagules)
- Long-lived in soil seed bank
- Adaptations for spread with crop seeds and by natural agents such as wind or animals
- Production of biological toxins that suppress the growth of neighboring plants
- Spiny parts such as thorns or prickles that repel grazing animals (and humans)
- Roots with extra capacity for storing food reserves
- Deep roots that extend below the rooting profile of native plants (weeds out-compete natives for water and nutrients)
- Survival and seed production under harsh conditions
- High photosynthetic rates which give weeds a competitive advantage

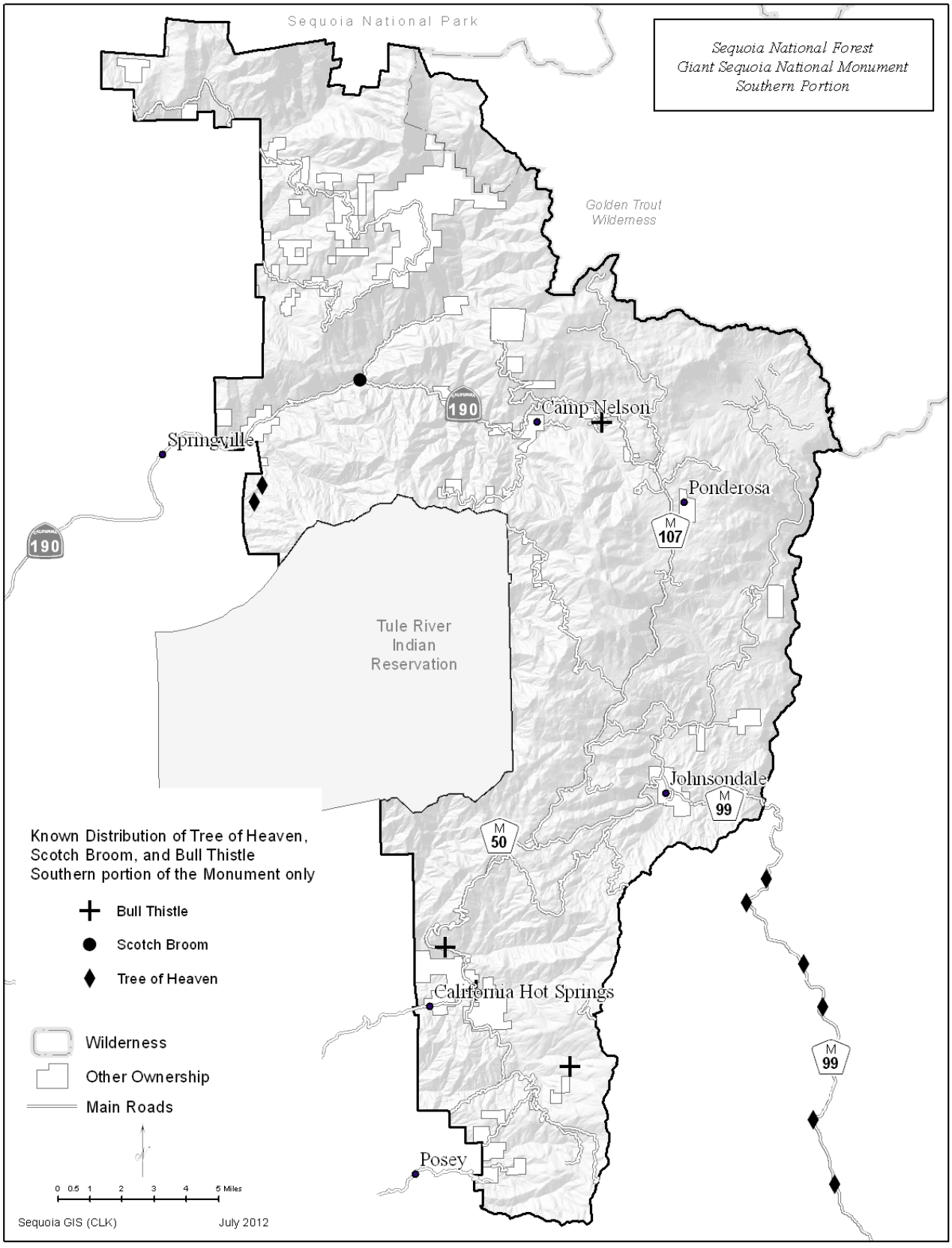
Map 10 Distribution of Yellow Starthistle in the Northern Portion of the Monument



Map 11 Distribution of Yellow Starthistle in the Southern Portion of the Monument



Map 12 Distribution of Tree of Heaven, Scotch Broom, and Bull Thistle in the Southern Portion of the Monument



Range

In 1905, Congress established the national forests and grasslands for the multiple use of resources such as range, timber, minerals, water, recreation and wildlife. The mission of the Forest Service is "To sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." The Forest Service supports livestock grazing on National Forest System lands (national forests and grasslands). Livestock grazing on these lands, if responsibly done, provides a valuable resource to permittees as well as the American people.

Livestock use has occurred on public lands since the late 1800s and is one of a variety of appropriate multiple uses of National Forest System lands. Grazing on national forests contributes to the social and economic well being of rural communities as well as sustainable local food production. Many rural communities continue to be dependent upon ranching for their economic livelihood, and most of these ranches rely on federal land grazing, either on Bureau of Land Management lands or in national forests, for at least a portion of their grazing. These ranches are located in some of California's fastest-growing communities and are at risk of conversion to development. These ranches provide open space and other ecosystem benefits, including habitat for many plants, fish, and wildlife species.

Current management direction for the Monument range program comes from several sources, which include the 1988 Forest Plan, the 1990 MSA, the 2001 SNFPA, and the Clinton proclamation. This direction is reflected in the terms and conditions (Parts 1, 2, and 3) of each term grazing permit within the Monument.

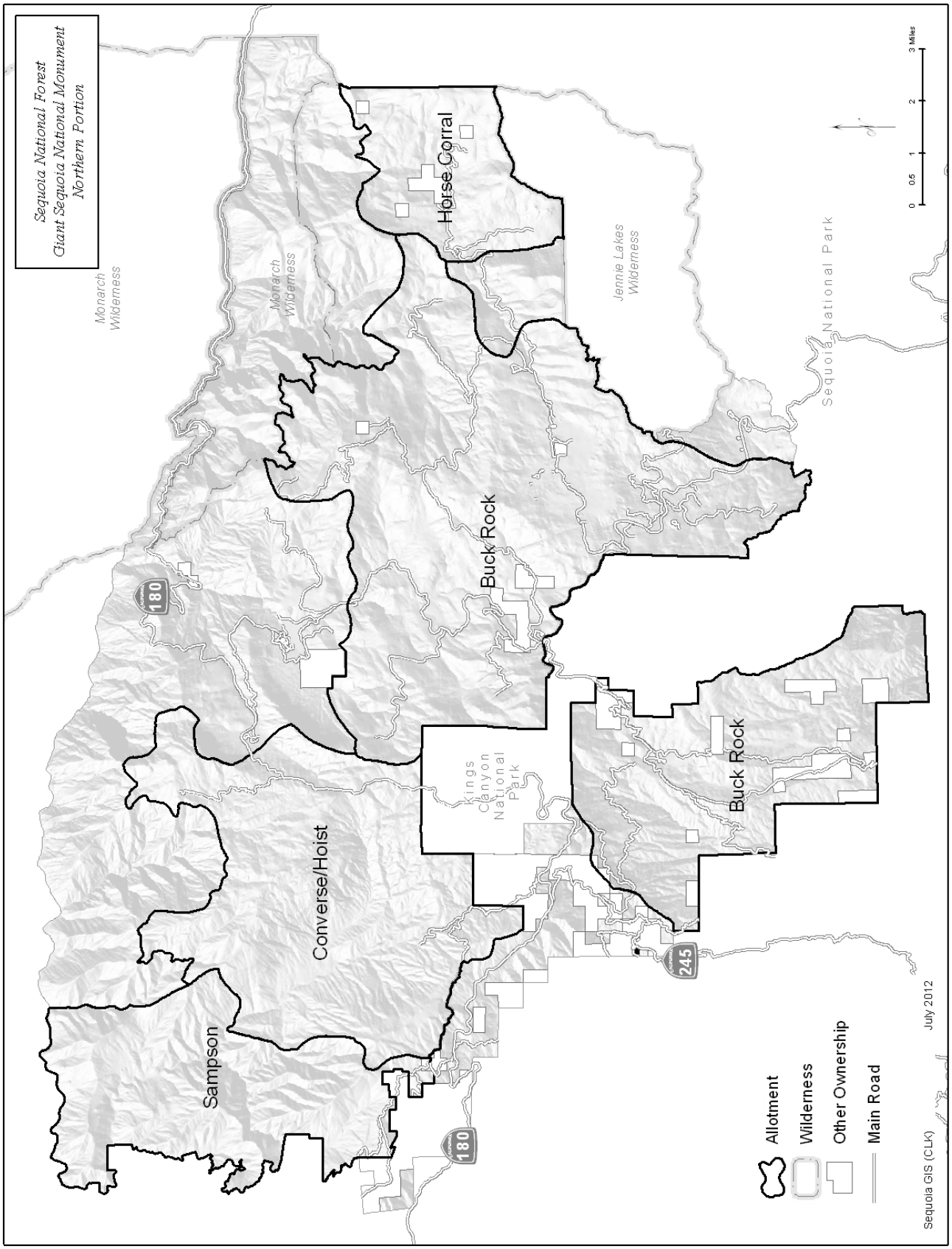
Livestock grazing within the Monument covers approximately 218,000 acres of grassland, chaparral, open forest, and riparian meadows. There are 22 grazing allotments wholly or partially within the Monument, located in two counties (see the following table and maps). Approximately 15,757 head months (HMs) of livestock grazing are permitted within the Monument.

Table 74 Grazing Allotments in the Monument

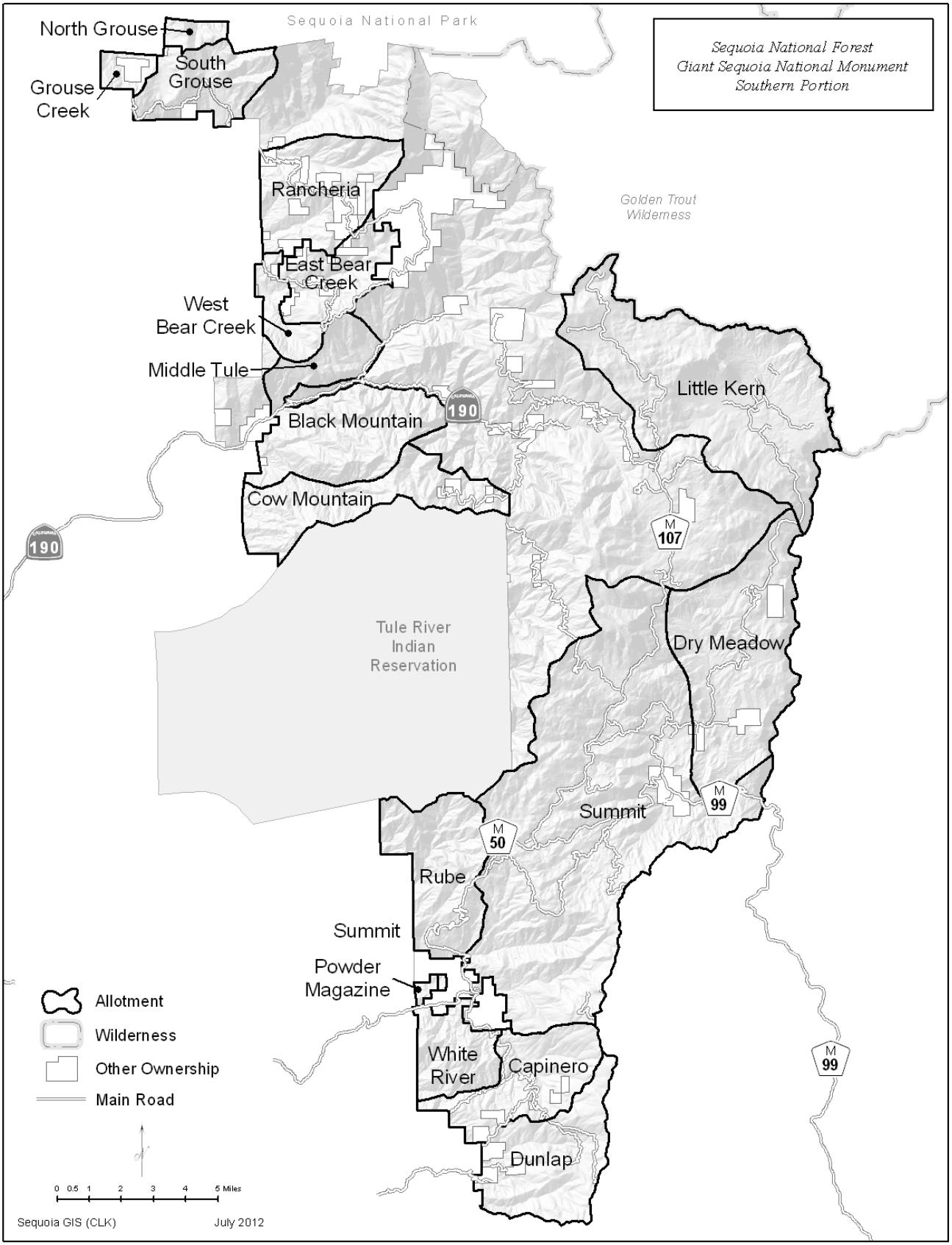
Allotment	All. #	Stock #	Stock Type	Season of Use	HM	Total Allotment Acres	NFS (Allot.) Acres within Monument	Min. Elev.	Max. Elev.	Est. Riparian acres within Monument
Hume Lake Ranger District (RD)		809			4,104	93,130	79,560			2,660
Buck Rock	1	190	C	5/01-9/20	894	44,970	42,880	5,000	8,000	1,490
		50	C	6/16-9/15	203					
		70	C	5/01-10/31	424					
Hoist/Converse	2	100	C	5/01-9/15	454	18,960	18,960	3,500	7,000	640
		125	C	6/01-9/15	316					
		25	C	6/01-9/15	88					
Horse Corral	4	57	C	7/01-9/30	173	11,900	5,910	4,000	10,000	150
		17	C	7/01-9/30	52					
Sampson	5	200	C	2/01-9/15	1,500	17,290	11,810	1,000	6,000	380

Allotment	All. #	Stock #	Stock Type	Season of Use	HM	Total Allotment Acres	NFS (Allot.) Acres within Monument	Min. Elev.	Max. Elev.	Est. Riparian acres within Monument
Western Divide RD		2,716			11,616	208,470	139,280			3,310
Black Mountain	19	17	C	10/01-9/30	204	8,440	8,400	1,500	7,000	240
		8	Y	10/01-9/30	96					
Cow Mountain	15	100	C	5/01-8/31	602	7,500	7,240	2,500	7,000	120
East Bear Creek	14	30	C	3/16-8/31	94	4,640	3,750	3,000	6,000	80
Grouse Creek	64	12	C	4/16-9/15	61	1,180	870	3,500	6,000	30
Little Kern	21	225	C	7/15-8/15	237	66,380	21,360	5,000	9,000	630
		(225)	C	8/15-9/15	237					
Middle Tule	18	15	Y	2/15-6/15	60	3,190	3,190	2,000	5,500	80
		16	C	3/01-7/31	81					
North Grouse	13	35	C	5/01-8/15	124	980	980	4,000	6,000	10
Rancheria	12	100	C	4/01-8/31	504	7,940	6,120	3,000	9,000	100
		50	C	5/01-8/31	203					
South Grouse	16	100	C	3/16-5/31	254	5,160	4,970	3,500	6,400	100
West Bear Creek	20	125	C	3/16-7/31	568	2,190	2,080	2,000	4,500	80
Capinero	23	214	C	4/16-8/31	971	6,810	6,130	3,500	7,400	100
Dry Meadow	25	260	C	5/16-8/15	787	14,700	13,920	3,400	7,000	350
Dunlap	24	220	C	5/01-6/30	442	25,770	7,570	5,400	8,500	120
		(220)	C	7/01-9/15	557					
		5	C	5/01-8/31	20					
Powder Magazine	28	40	C	2/01-10/31	360	260	260	3,000	3,400	0
Rube	27	379	C	5/01-8/15	1,334	7,850	7,790	3,400	8,400	100
Summit	26	615	C	5/01-6/30	1,234	41,520	40,700	3,500	9,000	1,050
		(465)	C	7/01-9/15	1,178					

Map 13 Range Allotments for the Northern Portion of the Monument



Map 14 Range Allotments for the Southern Portion of the Monument



The majority of the allotments and forage are based on annual grasses in the foothills below and removed from the giant sequoia groves. Six montane allotments overlap with sequoia groves. Most allotments that overlap with groves receive low to moderate use of the intermixed meadows.

There are several types of structural range improvements associated with the allotments, including spring-fed water troughs, fences, stock trails, drives, and corrals. Each range improvement is designed to improve livestock distribution throughout the allotments or provide some type of protection to a particular resource. Maintenance of these existing improvements continues during each grazing season throughout the Monument.

Range condition and trend transects (frequency plots) are established in 13 key meadows in the Monument (see the following table). The transects show that vegetation and soil elements meet high- to mid-seral ecological conditions (Weixelman 2010). Condition and trend are not applicable to vegetation that is highly variable from season to season such as annual grasslands. In annual grasslands, soil conditions and residual dry matter (RDM) remaining at the end of the grazing season are monitored (Clawson et al. 1982). Stream condition has been evaluated for many of the streams within the grazing allotments and is discussed in the Hydrological Resources section of this chapter.

Table 75 Key Area Meadows and Frequency Plot Scores in the Monument

Meadow Name		Successional Score	Satisfactory?
Lower Loggy	TR001	mid seral	Yes
Lower Clicks	TR002	lower mid seral	no
Deep	TR003	mid seral	yes
Last Chance	TR004	late seral	yes
Double Bunk	TR005	upper mid seral	yes
Parker	TR006	upper mid seral	yes
Horse	TR007	late seral	yes
Dry	TR008	late mid seral	yes
Mule	TR009	upper mid seral	yes
Big Meadows	0801	late seral	yes
Horseshoe	9901	mid seral	yes
Converse	9902	upper mid seral	yes
Eshom (Meadow Flat)	9903	low seral	no
Indian Basin	9904	low seral	no

The Clinton proclamation states, “Laws, regulations, and policies pertaining to administration by the Department of Agriculture of grazing permits… shall continue to apply…” (Clinton 2000, p. 24098). Grazing within the Monument is currently administered under the guidelines identified in the 1988 Sequoia National Forest Land and Resource Plan (Forest Plan) and the 2001 Sierra Nevada Forest Plan Amendment (2001 SNFPA), and the effects from grazing addressed in these documents apply. Site-specific environmental analysis and documentation will be prepared for each allotment within the Monument under the direction in the Rescission Act of 1995 (P.L.104-19) and its amendments.

Hydrological Resources

A watershed analysis has been performed for watersheds associated with the Monument. This analysis complies with management direction in the 2001 and 2004 Sierra Nevada Forest Plan Amendments (SNFPA) and serves as landscape analysis, which will assist the forest in identification of new projects providing definition of existing conditions (USDA Forest Service 2001, 2004). Additionally, landscape analysis provides the basis for adjustment of the SNFPA Riparian Conservation Objectives (RCOs) and is commensurate with local conditions in Monument watersheds. The watershed/landscape analysis provides science-based information regarding the existing condition of watershed level ecosystems as well as the effects of past, current, and reasonably foreseeable future management activities. The following descriptions provide characterization of the watersheds affected by the Monument plan.

The California State Water Resources Control Board, U.S. Department of Agriculture, U.S. Environmental Protection Agency, and the U.S. Department of Agriculture, Natural Resources Conservation Service conducted a Unified Watershed Assessment (UWA) in accordance with the Federal Clean Water Action Plan (CWAP) (US Environmental Protection Agency 1998). The purpose of the UWA was to identify those watersheds with the most critical water quality needs and to help guide resources toward correcting identified problems. 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 HUC watershed level.

The 2001 and 2004 SNFPAs provide the direction to use the regional stream condition inventory (SCI) protocol to assess and document aquatic conditions. The Sequoia National Forest uses SCI to document stream characteristics and to determine a range of stream attributes for the watersheds. A summary of all the SCI sites within the Monument can be found in Appendix E of the hydrology report.

Meadows were surveyed to document stability conditions. A meadow's condition is defined as functioning, functioning at risk, or impaired functioning. These ratings are summarized for the northern and southern portions of the Monument. A summary and explanation of each meadow's condition can be found in Appendix E of the hydrology report.

Potential Zones of Influence

Stream channel inventory in the vicinity of giant sequoia groves has occurred commensurate with past inventory needs. As a result, not all zones of influence (ZOI) for the groves have been "fine tuned" based on existing riparian ecotype or channel type. Identification of the nearest stable stream channel downstream of giant sequoia groves may be desired to refine the ZOI associated with a specific grove. The potential for head-ward movement is the main concern associated with defining the downstream boundary of the ZOI. This potential is highest in riparian ecotypes identified as unstable-sensitive-degraded associated with damaged or destroyed riparian areas, landslide prone naturally-unstable ecotypes, and delicate stable-sensitive ecotypes associated with meadows (Kaplan-Henry, 2007). Therefore, terminating the hydrologic zone of influence in these areas would not provide protection from head-ward erosional processes. Similarly, if the channel has not been surveyed and the stability of the stream course is unknown, it is difficult to define an area of potential influence. It is assumed that naturally-stable channels have a very low potential for head-ward movement upstream. Based on these assumptions, two conditions were identified in North et.al, (2002) and recommendations for assigning the lower ZOI boundary are as follows:

1. When riparian ecotype is unknown, the zone is terminated at the nearest confluence with the next major stream or at the first naturally-stable ecotype below the grove location depending on whichever is closer.
2. When riparian ecotype is known, the zone is terminated at the first naturally-stable ecotype below the grove location.

It is expected that stream channels where downstream riparian ecotype is unknown would eventually be surveyed and assigned an ecotype when it is

considered necessary for management. If it is considered necessary downstream riparian ecotypes could be identified and the ZOI refined. The need to survey the downstream extent of a ZOI would be based on need and a desire to refine the lower boundary. In the absence of this information a conservative and larger ZOI is employed for grove protection. Grove watersheds are prioritized herein for inventory based on the extent of past surveys. The extent of stream stability inventory necessary to refine the downstream extent of the ZOI can be found in Appendix D of the hydrology report.

Characterization of Monument Watersheds

Waters from Monument lands 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 comprised of the Tulare and Buena Vista lakes and made up the largest inland body of water west of the Mississippi River (Atwater et al. 1986, Reisner 1993). Because the lakebed lacked an outlet to the sea, it acted as a sink in most years. In 1862 and 1868, the wettest years on record, Tulare Lake encompassed 790 square miles (ECORPS Consulting Inc. 2007). During those wet periods of large-scale flooding, floodwaters reached the outlet to the Sacramento-San Joaquin River Delta.

Fourteen watersheds are at least partially within the Monument. The Lower South Fork Kings River and Mill Flat Creek watersheds contain the Kings River Special Management area, which is shared by the Sequoia and Sierra National Forests. The Mill Flat Creek, the Upper North Fork Kaweah River, and the Upper Dry Creek watersheds contain the Kings River Special Management Area and are shared with the Sequoia and Kings Canyon National Parks. The South Fork Tule River watershed is shared with the Tule River Indian Reservation. The North Fork Tule River and the Middle Fork Tule River watersheds are shared with Mountain Home State Forest. The Middle Fork Tule River is the only watershed that is completely located within the Monument. The following table displays basins and watersheds associated with the Monument.

Table 76 River Basins and Watersheds Associated with the Monument

River Basin	Watershed	Ranger District[1]	HUC6[2]	Acres within the Monument	Forest Watershed Acres
Upper Kings	Lower South Fork Kings River	HL	1803001003	35,470	57,890
	Mill Flat Creek	HL	1803001005	64,800	73,180
Upper Kaweah	Upper North Fork Kaweah River	HL	1803000704	16,180	19,200
	South Fork Kaweah River[3]	WD	1803000705	3,120	3,120
	Lower Kaweah[3]	HL	1803000706	5,190	5,220
Mill	Mill Creek[3]	HL	1803000801	8,020	12,160
Upper Kern	Middle Kern River	WD	1803000105	73,400	200,900
	Little Kern River	WD	1803000104	4,500	81,240
Upper Tule	Middle Fork Tule River	WD	1803000601	66,260	67,120
	North Fork Tule River	WD	1803000602	30,480	30,500
	South Fork Tule River	WD	1803000603	8,920	10,400

1. HL = Hume Lake, WD = Western Divide, and KR = Kern River
2. HUC6 = 6th field hydrologic unit code or watershed as defined in SNFPA 2001.
3. 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.

River Basin	Watershed	Ranger District[1]	HUC6[2]	Acres within the Monument	Forest Watershed Acres
Upper Deer–Upper White	Upper White River	WD	1803000501	6,435	6,450
	Upper Deer Creek	WD	1803000502	25,935	25,965
Upper Poso	Upper Poso	WD/KR	1803000401	7,935	38,130

The following table displays beneficial uses existing within 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 (State Water Resources Control Board 1975). Beneficial uses, together with water quality objectives and the anti-degradation policy, meet federal regulatory criteria for water quality standards. Therefore, the protection of beneficial uses of water constitutes compliance with state water quality standards (EPA 1987). According to the Water Quality Control Plan for the Tulare Lake Basin (California Central Valley Regional Water Quality Control Board 2004), 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.

The Monument contains California state appropriative water rights. These are a combination of riparian and federal reserved rights. Primary use is for domestic purposes; other uses include agricultural, mining, fire protection, and irrigation. The Monument does not affect existing water rights which will be maintained according to state and federal laws and regulations (a list of current water rights and uses is available upon request).

Aquatic Management Indicator Species (MIS)

Aquatic insects are considered management indicator species (MIS) at the regional level and are a good indicator of aquatic habitat condition. Benthic or bottom-dwelling macroinvertebrates (BMI) are the aquatic Management Indicator Species (MIS) for riverine or flowing water habitats in the Monument. BMI are appropriate as aquatic MIS because they are sensitive to changes in water quality (Hawkins et al. 2000; EPA 200; Rehn 2009). Aquatic factors of particular importance that determine the composition of aquatic communities are magnitude and timing of flow, substrate size and composition, water chemistry and temperature, bank stability, and riparian conditions. Since MIS standards direct the Forest Service to cooperate with State fish and wildlife agencies, standard operating procedures from the State's Surface Water Ambient Monitoring Program (Ode 2007) were employed.

Bioassessment samples were collected as part of standard SCI monitoring (Frazier et al. 2005). Aquatic insects are collected as part of SCI monitoring. After collection collected samples are sent to University of Utah, Logan for identification and classification. Aquatic insect reports are used as the basis for this analysis. (Vinson, 2006a, 2006b, USDI Bureaus of Land Management, 2008, Miller, 2008, Miller and Judson 2010, 2011) The 85 aquatic MIS or macroinvertebrate samples from 1992 to 2009 utilized for this analysis are presented in the following table. The map below shows the distribution of sites: 32 percent of the areas sampled are located in the southern portion of the Monument from the Middle Fork of the Kern River watershed (5th-field HUC 1803000105), and 14 percent of the areas sampled are from Upper Poso and NFMF Tule River (5th-field HUC 1803000401 and 1803000602). Thirty-nine percent of the sample sites came from the northern portion of the Monument, specifically 20 percent from the Mill Flat watershed (1803001007), nine percent from the Lower South Fork Kings River

Table 77 Beneficial Uses Associated with Monument Watersheds

Watershed	HUC 5#[1]	Beneficial Uses												
		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[2]	X		X	X
Mill Flat Creek	1803001005	X	X		X	X	X	X	X	X[3]	X			X
Upper North Fork Kaweah River	1803000704	X		X	X	X		X	X	X[4]	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[4]	X			X
Mill Creek	1803000801		X		X	X		X	X		X	X		X
Middle Kern River	1803000105	X			X	X		X	X	X[5]	X		X	X
Little Kern River	1803000104	X			X	X		X	X	X[6]	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[7]	X			X
South Fork Tule River	1803000603	X	X		X	X	X	X	X	X[7]	X			X
Upper White River	1803000501	X	X		X	X		X	X	X[7]	X	X		
Upper Deer Creek	1803000502	X	X		X	X		X	X	X[7]	X	X		
Upper Poso	1803000401	X	X		X	X		X	X	X[7]	X	X	X	X

Agr—Agriculture
Cold—Coldwater Fishery
Warm—Warmwater Fishery
Rec 1—Contact Water Recreation
Rare—Rare, Threatened or Endangered Species

Mun—Municipal
Grnd—Groundwater Recharge
Fresh—Fresh water
Rec 2—Non-contact Water Recreation

Spwn—Fish Spawning
Wild—Wildlife
Ind—Industrial
Pow—Hydropower Generation

1. HUC5 = 5th field hydrologic unit code or watershed as defined in SNFPA 2001.
2. Western pond turtle, mountain yellow-legged frogs, and willow flycatcher
3. Hardhead minnow, 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. Kern Canyon slender salamander, mountain and foothill yellow-legged frog, western pond turtle, willow flycatcher, and Kern River rainbow trout
6. Little Kern Golden Trout, mountain and foothill yellow-legged frog, and relictual slender salamander
7. Western pond turtle, mountain and foothill yellow-legged frog, relictual slender salamander, and legless lizard

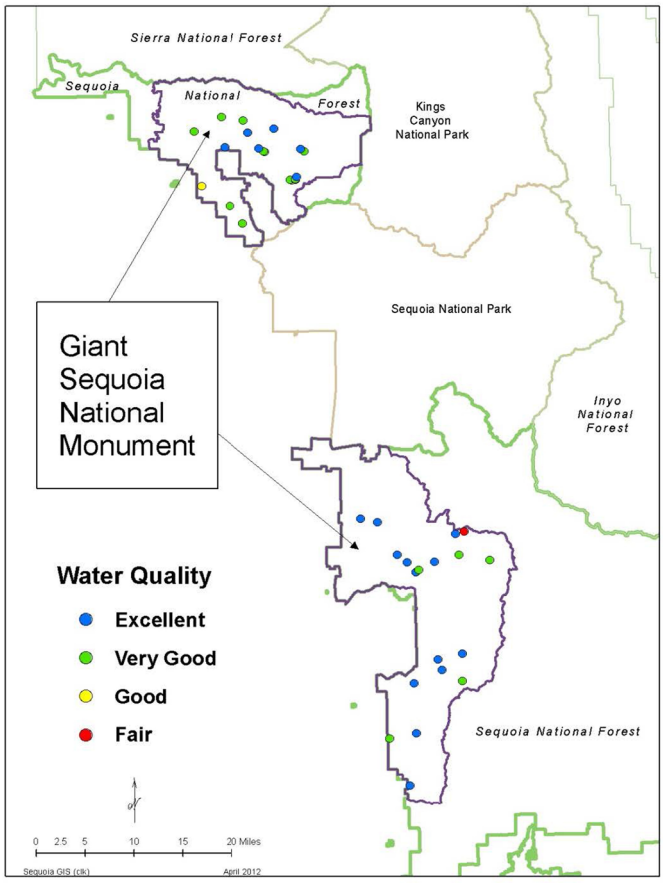
(1803001003[20]), four percent from the Mill Creek Watershed (1803000801[21]), and five percent from the Upper North Fork Kaweah (1803000703[22]).

Site conditions were evaluated using the Hilsenhoff Biotic Index[23] (HBI) which evaluates sites based on the presence of organic pollution (see the following table). Stream bioassessment surveys screened the pool of candidate metrics using a series of tests. HBI has been shown to be responsive to disturbance over a broad geographic range (i.e., the western states by Stoddard et al. 2005), and it is permissible to use the HBI scores to evaluate water quality for Monument streams (Furnish 2011, personal communication).

Monument-wide, 46 (54 percent) of the sites were in excellent condition, 29 (34 percent) were in very good condition, seven (eight percent) were in good condition, and three (four percent) were in fair condition. Thirty-three sites were evaluated in the northern portion of the Monument. Of these, 15 (45 percent) of the sites were in excellent condition, 15 (45 percent) were in very good condition, 2 (6 percent) were in good condition, and 1 (3 percent) were in fair condition. Fifty-two sites were evaluated in the southern portion of the Monument. Of these, 31 (60 percent) were in excellent condition, 14 (27 percent) were in very good condition, 5 (10 percent) were in good condition, and 2 (5 percent) were in fair condition (see the following table with figure).

Table 78 Biotic Index Water Quality Degree of Organic Pollution

0.00-3.50	Excellent	No apparent organic pollution
3.51-4.50	Very good	Possible slight organic pollution
4.51-5.50	Good	Some organic pollution
5.51-6.50	Fair	Fairly significant organ pollution
6.51-7.50	Fairly poor	Significant organic pollution
7.51-8.50	Poor	Very significant organic pollution
8.51-10.0	Very poor	Severe organic pollution



20. Watershed notations have been changed since the 2001 SNFPA provided HUC 5 designations. Lower South Fork Kings River has a new HUC5 notation of 1803001004.

21. Watershed notations have been changed since the 2001 SNFPA provided HUC 5 designations. Mill Creek Watershed has a new HUC5 notation of 1803001201.

22. Watershed notations have been changed since the 2001 SNFPA provided HUC 5 designations. Upper North Fork Kaweah River has a new HUC5 notation of 1803000703.

23. Zimmerman, M. C. 1993, The use of the biotic index as an indication of water quality, Pages 85-98, in *Tested studies for laboratory teaching*, Volume 5 (C.A. Goldman, P.L.Hauta, M.A., O'Donnell, S.E. Andrews, and R. van der Heiden, Editors), proceedings of the 5th Workshop/Conference, of the Association for Biology Laboratory Education (ABLE), 115 pages, http://www.ableweb.org/volumes/vol-5/6-zimmerman.pdf

Climate

The climate is fairly typical Mediterranean with distinct wet and dry seasons. Tree ring studies of giant sequoias have shown that the last century is one of the wettest on record. Long-term climatic change studies are ongoing through the University of Arizona Tree Ring Lab. Precipitation seems to be the controlling factor in terms of meteorology, although heating and winds also play a role in characterizing this area. The intensity, duration, and timing of precipitation have the most substantial effect on the area.

Late summer thunderstorms with intense rainfall for short duration often cause heavy erosion of soils which are hydrophobic due to the extremely dry conditions. In addition, the summer thunderstorms provide lightning, the major source of wildfire ignitions in this area. Rainfall at lower elevations is less than at higher elevations because of adiabatic effect. The lower elevations are subject to thick fog layers from November through January affecting air quality at lower elevations more so than at higher elevations due to inversion.

Annual precipitation ranges from 25 to 50 inches, with most accumulation as snow in December through March. Snow accumulation averages 100 to 300 inches depending in part on elevation. Snow accumulates from approximately 4,000 feet in elevation and above; snow will also fall and stick at lower elevations for one to several days. Substantial rain-on-snow events occur approximately at 10-20-year intervals in the south and 20-30-year intervals in the north.

Kings River Basin

Upper Kings River Basin

The Kings River basin is located in the southeastern part of the San Joaquin Valley, 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, the river 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. The Upper Kings River contains the Lower South Fork Kings and Mill Flat 5th-field HUC watersheds. Mill Flat is one of the two watersheds that contain a Critical Aquatic Refuge (CAR).

CARs provide habitat for native fish, amphibian, and aquatic invertebrate populations. CARs are subwatersheds, generally ranging between 10,000 to 40,000 acres, with some as small 500 acres and some as large as 100,000 acres, that contain either known locations of threatened, endangered, or sensitive species; highly vulnerable populations of native plant or animal species; or localized populations of rare native aquatic- or riparian-dependent plant or animal species. The desired condition and purpose of a CAR is to maintain and/or restore remnant plant and animal populations in aquatic communities while meeting state water quality stream standards.

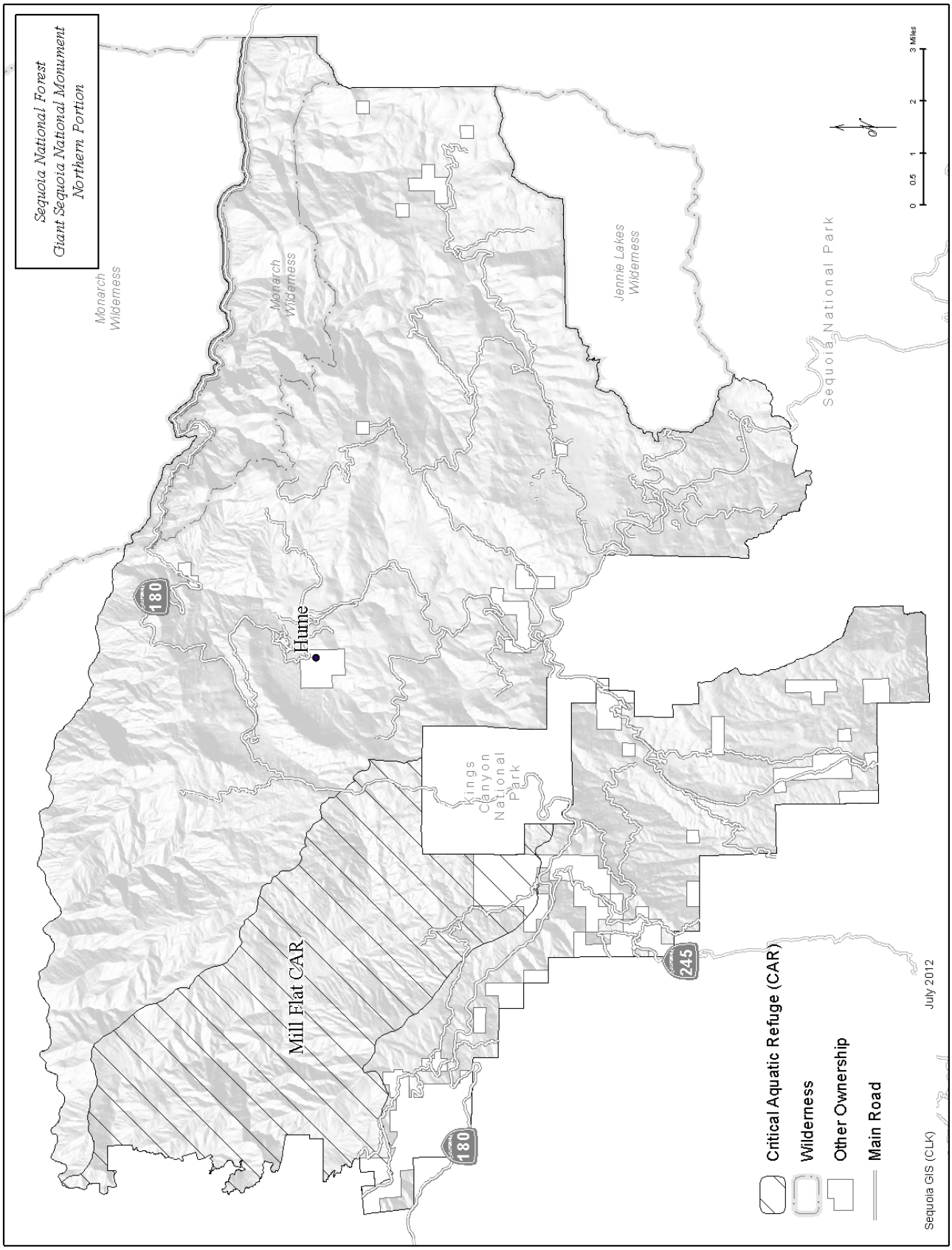
The Mill Flat CAR was designated for management of the western pond turtle and a stable native fish population that may be threatened by introduced, nonnative members of the sunfish family (see the following map).

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 Army Corps of Engineers constructed levees, channel improvements, and weirs to control flood flows (*Federal Register* April 5, 1996).

The Upper Kings River basin is 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.

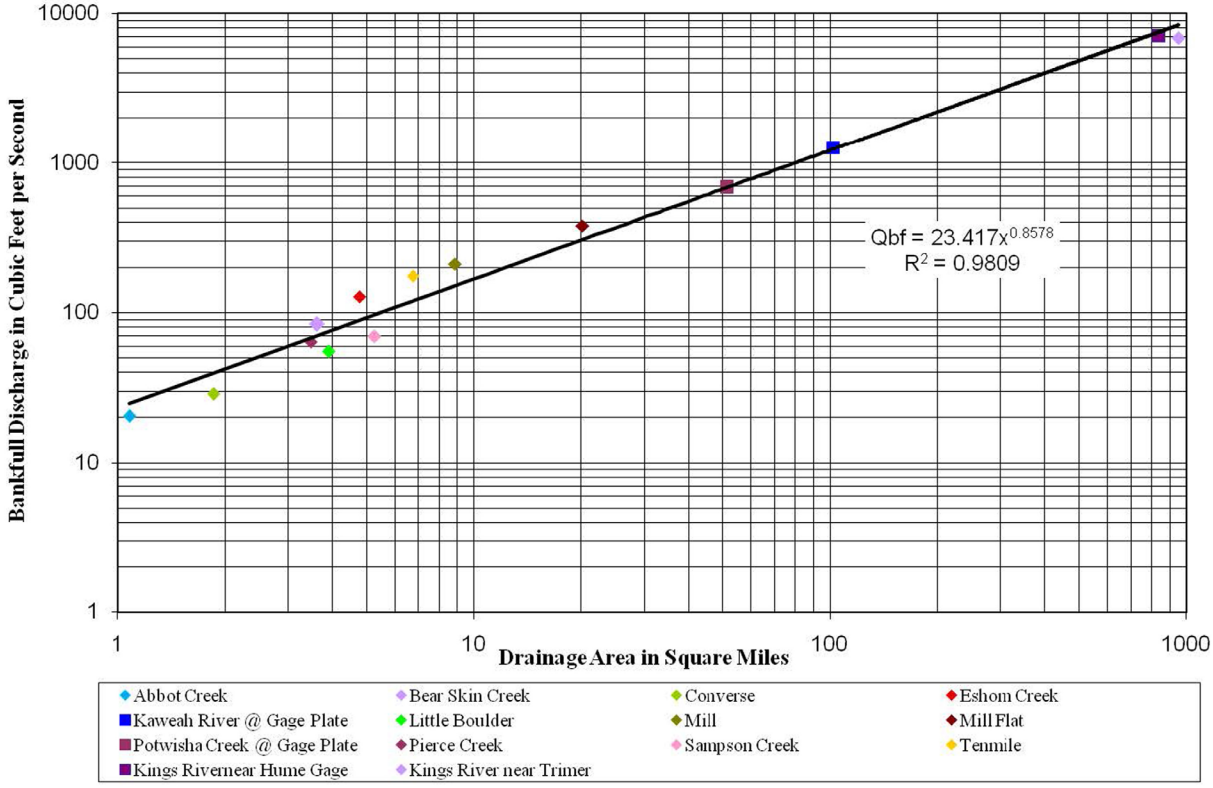
The air temperature ranges from winter highs of 20-40 degrees Fahrenheit (F) to summer highs of 88 to 96 degrees F as recorded by the remote access weather stations (RAWS) on Park Ridge and Cedar Grove in the northern portion of the Monument. Afternoon canyon winds range from 2 to 10 miles per

Map 15 Mill Flat Critical Aquatic Refuge



hour (mph). Heat and wind increase the evaporation rates, which result in relative humidity down to 15-25 percent in late summer. Regional physiographic relationships have been evaluated from 2001 to present. Discharge relationships for the Kings and Kaweah Rivers (Wright 2008) are provided in the following figure. These discharge relationships are updated as new data become available.

Figure 9 Bankfull Discharge Relationships Kings and Kaweah Rivers, CA



Stream characteristics from past inventories and SCI sites provide information on water quality parameters in the Upper Kings River basin. Sites with SCI plots include Big Meadows, Little Boulder, Sampson, Mill Flat, Abbott, Converse, Tenmile, Long Meadow, and Bearskin creeks. Ranges for large woody debris, shading, water temperature, and alkalinity are provided in the following table.

Aquatic insect data for the Upper Kings River basin indicated those waters sampled have water quality that ranges from excellent to good. Sampson Creek has site conditions that rank excellent; as is Abbott Creek; Big Meadows has excellent to good site conditions. Lower South Fork Kings River ranges from excellent to good aquatic site condition. Little Boulder Creek ranks as excellent to very good; Mill Flat Creek watershed at Bearskin Creek ranks excellent to very good; Tenmile Creek has very good site conditions; as does Converse Creek. Many aquatic insect samples

Table 79 Ranges in Channel Attributes for Upper Kings River Basin

Upper Kings River Basin	
Large woody debris (m^3/m)	0.005-0.91
Percent shading	0-95.9
Temperature (Celsius)	12-22
pH (ppm)	6.0-7.4
Alkalinity ($CaCO_3$)	40-132
Mean particle size in mm (D50)	0.03-426.3
Width-to-depth ratio	5.5-254
Hilsenhoff biotic index–rating	Excellent (2.0)–good (4.84)
Riparian impact rating	Low to extreme
Rosgen channel type	B3, B4, B4a, B4c, C5, C6, E3b, F4, G4

are collected at the same site over a period of years. Aquatic MIS site condition based on biotic ratings for these watersheds is indicative high water quality. The majority of water quality biotic ratings are excellent.

Stream stability evaluations (Pfankuch 1975) provide information on channel physical conditions. Five of the 15 indicators used in Pfankuch are selected to evaluate the function of riparian ecotypes. The five riparian indicators used for evaluation of stream effects and channel functions are vegetative bank cover, stream bank cutting, channel bottom deposition, channel bottom scour and deposition, and percent stable material. Channel types (Rosgen 1994) are used to separate channels that respond similarly. The majority of riparian impact ratings fall in the low to moderate range.

Stream surface shade measurements of 0 to 20 percent are associated with stream reaches in meadow environments; remaining measurements are associated with step pool stream systems. The majority of percent stream surface shade is in the 61 to 80 percent range.

Large woody material is an important component of stream stability and aquatic habitat. Large woody material provides stream bank and stream bed stability. Measurements taken in the Upper Kings River basin show a range of large woody material from .009 to 0.80 cubic meters per meter of stream evaluated. The lowest levels of woody debris were measured in Mill Flat and Sampson Creeks, and the highest levels of woody debris were measured in Little Boulder Creek. The majority of large woody material is in the 0.02 to 0.029 range.

Width-to-depth ratios provides information on the stability of channel conditions as a function of channel type. Stable B, C, and F channel types have width-to-depth ratios greater than 12+2, while stable E channels have width-to-depth ratios less than 12+2. G channels have width-to-depth ratios less than 12+2; however, if a G channel has width-to-depth ratios greater than 12+2 it suggests recovery. Therefore, this measurement provides information on stability, as well as channel recovery.

Water quality standards as defined by the Central Valley Water Quality Control Board (CVWQCB) provide a pH range of 6.5 to 8.3. Waters associated with pH values in excess of 8.3 need to be evaluated to determine the cause associated with elevated pH ranges. Those waters with pH levels lower than 6.5 in Monument lands appear to be associated with meadow ecosystems and urbanized areas. The majority of pH values range from 6.6 to 7.0 in this watershed basin.

Alkalinity is a measure of the amount of carbonate or bicarbonate in surface waters and is associated with the acid neutralizing capability of water. Alkalinity is associated with rock type and other local conditions such as pH. The most common values are in the 21 to 40 parts per million (ppm) followed closely by the 41 to 60 ppm range. Values in the Upper Kings River basin appear to be lower than those associated with surface waters in the Tule River basin described later in this section.

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. 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. The watershed is approximately 81,520 acres in size, of which about 57,890 acres are in the Sequoia National Forest. Approximately 23,800 acres are within the Monarch Wilderness, 7,000 acres are within the Jennie Lakes Wilderness, and 400 acres surrounded by National Forest System lands are in private ownership. Kings Canyon National Park makes up about 23,790 acres of this watershed. Approximately 35,470 acres of the watershed in the Sequoia National Forest are also in 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 composed of granite bedrock, which intruded pre-existing ocean floor sediments and now form roof pendants, comprised of marble and meta-volcanic and sedimentary rock. 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 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 creeks or meadow edges. Vegetation has good vigor and density, and meadow species are flooded for about one month each spring during snow melt. Steep bedrock and boulder channels cannot grow lush riparian vegetation along their limited floodplains. This type of riparian ecotype makes up about one-third of the watershed streams.

U.S. Geological Survey (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 1,042 to 2,097 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 South Fork Kings River basin drains approximately 13.25 linear miles of perennial streams and meadows. Included are South Fork Kings River which has not been surveyed, Lightning Creek, Lockwood Creek, Redwood Creek, Windy Gulch, several unnamed tributaries to Lightning Creek, one of which has been surveyed, and unnamed tributaries to the South Fork Kings River from Summit Meadow and Deer Meadow.

Stream characteristics from past surveys and recent SCI investigations provide information on the streams in the Upper Kings River watershed. Sites include Big Meadows and Little Boulder Creek, as shown in the following table. Extensive surveying of Big Meadows and the stream channel was conducted by Jason Olin in 2004 while producing *Stream Character and Aquatic Habitat of Big Meadows Creek* for his masters thesis. Jason performed the initial SCI work for Big Meadows while designing a restoration strategy for the meadow. Detailed cross-sections and elevations which were used to design the restoration project were surveyed in the summer of 2006. Big Meadows Creek was surveyed following restoration in 2008 and 2009. Surveys for Little Boulder Creek were done in 2003 and 2004. Surveys for Little Boulder Creek were done in 2003 and 2004.

Table 80 SCI Sites in Lower South Fork Kings River Watershed

Stream Condition Inventory Sites in the Lower South Fork Kings River Watershed								
Watershed (HUC 6)	**Watershed Number**	**Stream Name**	**Location**	**District**	**Years Surveyed**	**Channel Type**	**Riparian Ecotype**	**Impact Rating**
Lower South Fork Kings River	18030001003	Little Boulder Creek	Little Boulder Creek	Hume Lake	2003 2004	B4	Stable-sensitive	Moderate
Lower South Fork Kings River	18030001003	Boulder Creek at Big Meadows Creek	Big Meadows	Hume Lake	2004 2006 2008 2009	C6	Stable-sensitive	Low

Channel attributes associated with stream surveys are displayed in the following table. Big Meadows' attributes are shown prior to and after the 2007 restoration. The biggest change at this site is the change in width-to-depth ratios, which prior to 2007 show results that would be associated with an unstable system, while post restoration results are typical of a stable channel. Values of pH are high and may be associated with the meadow or groundwater ecosystem. Additional surveys were performed in 2009, and results are pending. The Pfankuch stability rating of fair in Little Boulder Creek is associated with bank cutting, vegetative bank protection, and bottom size distribution, giving this reach an riparian impact rating of moderate.

Table 81 Range in Channel Attributes for Streams in Lower South Fork Kings River Watershed

Range in Channel Attributes, Lower South Fork Kings River Watershed			
Parameter	Channel Type		
	B Channel Little Boulder Creek	Big Meadows	
		Pre Restoration 2004	Post Restoration 2008
Large wood debris (m^3/m)	0.69 – 0.80	0.4	0.19
Percent shading	68 – 77	0-92	0-95
Temperature (Celsius)	12 – 16	12-22	12-16
pH (ppm)	7.0 – 7.4	6.7 -6.9	6.0
Alkalinity ($CaCO_3$)	Not collected	Not collected	50
Mean particle size in mm (D50)	29-32	4.0 -10.0	0.03
Width-to-depth ratio	7.9-15.2	5.5-166	43-254
Hilsenhoff biotic index–rating	3 to 4.01–excellent to very good	3.45 to 4.74–excellent to good	5.84–fair
Riparian impact rating	Moderate	Low	Low
Rosgen channel types	B4	G4 to F4	C5

Grizzly Lakes, Jennie Ellis Lake, and Weaver Lake are the only large water bodies in this watershed and have been stocked with nonnative fish species starting in the early 1900s. Native and introduced fish species are found in perennial streams. Introduced fish species have "naturalized" over the years.

Natural disturbances to water quality include wildfires and floods. The most recent event in the Kings River watershed occurred on January 1, 1997, with 6,247 acre-feet/day flowing into Pine Flat Reservoir, and by January 2, 1997, the maximum was 32,821 acre-feet/day (a rise of 525 percent). This flood event was reported to have moved boulders the size of houses and eroded highway 180 in at least six locations.

Human-caused effects include roads, residences, recreation activities, grazing, stock use, and vegetation management. Two grazing allotments are within or extend into this watershed. Past disturbances have the potential to affect water quality. Watersheds of concern due to past disturbances include Big Meadow Creek and Buck Rock Creek.

Mill Flat and Mill Creek Watersheds (1803001005 and 1803000801)

Mill Flat watershed is divided into seven basins that drain Upper Tenmile Creek, Lower Tenmile Creek, Cabin Creek, Converse Creek, Verplank Creek, Mill Flat Creek, and Davis Creek. Approximately one-third of the Davis Creek basin lies outside the Monument.

Converse, Mill Flat, and Mill creeks are the main tributaries to the Kings River on the western slope of the Sierra Nevada and flow north into the Kings River at or above Pine Flat Reservoir. Included with this discussion is the portion of the Mill Creek watershed that falls within the Monument. While this watershed occupies a watershed distinct from the Mill Flat, it is small in comparison and was included here because of proximity. 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.

Mill Flat Creek watershed consists of approximately 101,480 acres, of which about 73,180 acres are in the Sequoia National Forest. Within the national forest, about 9,360 acres are in private ownership,

approximately 64,800 acres are in the Monument, and about 22,450 acres are in the Kings River Special Management Area. Some of these areas overlap with 9,500 acres of sequoia groves and the 26,690-acre Mill Flat Creek Critical Aquatic Refuge. The remaining 28,310 acres of the Mill Flat Creek watershed are shared; approximately 3,840 acres are in Kings Canyon National Park near Wilsonia, and 24,470 acres are in the Sierra National Forest.

Historical logging in the late 1800s affected this watershed. Much of the watershed was owned by the Hume-Bennett Lumber, Sanger Lumber, and Kings River Lumber companies. The giant sequoias were logged heavily at this time, and overall effects to this watershed from these activities are difficult to quantify.

Elevation ranges from about 900 to 8,000 feet in the drainage, which is predominantly granite bedrock. Approximately 50 percent of the area is steep, bedrock boulder-dominated river gorges draining into the main stem of the Kings River. Headwater drainages are generally bedrock boulder-dominated. The Kings River gorge is a narrow, steep, boulder bedrock-dominated channel with little vegetation. In the upland basin there are wide riparian areas, forming meadows with willow clumps along streams, and substrates ranging from boulder to sand and silt. Several of the meadows have standing water in early spring with high sinuosity and low gradient channels.

Flows from the watershed are extremely variable. It was reported on January 1, 1997, 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. Although these extreme flows occur rarely, variations in flows can and do change rapidly in the watershed.

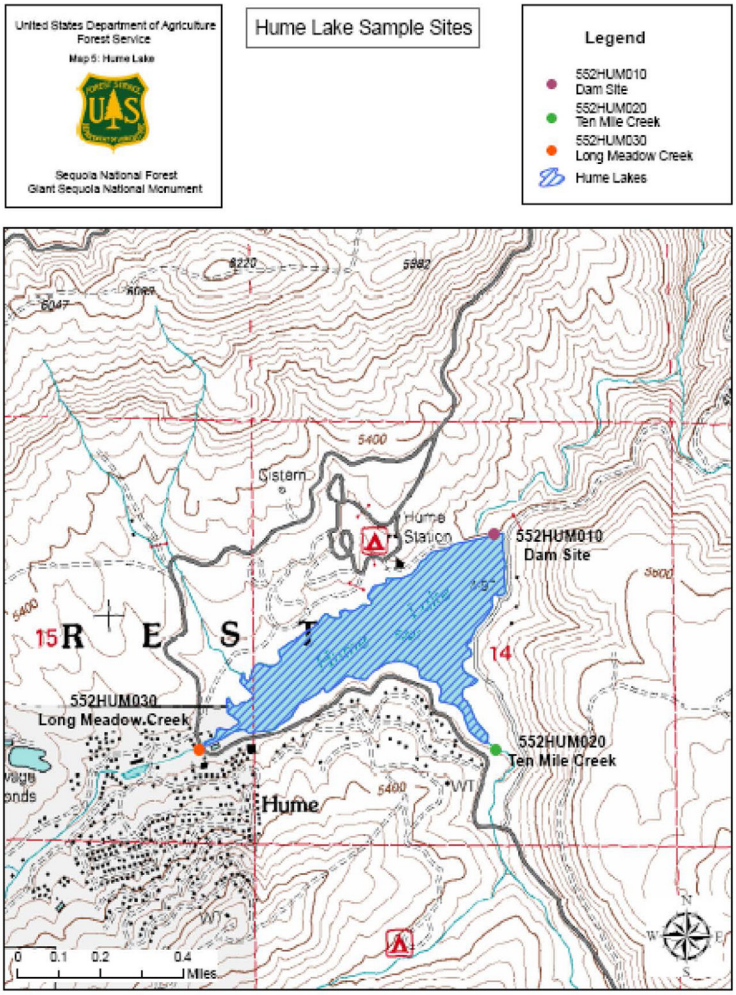
Riparian vegetation consists of stringers of willows and aspen, usually along creeks or meadow edges. This vegetation has good vigor and densities except for the aspen stands along upper Tenmile Creek which are dominated by mature and decadent trees lacking adequate regeneration. Conifer encroachment threatens these stands. 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. Bedrock/boulder drainages comprise about one-quarter of the drainages in the watershed.

Natural disturbances to water quality include floods and wildfires. The areas burned by the Robinson, Converse, McGee (1955), and Highway (2001) fires cover approximately 50 percent of this watershed. Human-related disturbances include those from roads, recreation residences, private camps and houses, recreation, Hume Lake Dam, grazing, and vegetation management activities. These disturbances currently affect the watersheds located in the Sampson Creek, Mill Creek, Upper Abbott Creek, and Mill Flat Creek drainages.

Hume Lake was listed as a potential 303(d) impaired water body by the Central Valley Water Quality Control Board (CVWQCB) in June 2009. This water segment, as identified by the board, appears to include Hume Lake to Hume Dam. Lake elevations were estimated to be approximately 5,200 feet above sea level. Sampling that placed Hume Lake in consideration for the 303(d) list is from four sites along the lake. These sites are Hume Dam, Tenmile Creek, Long Meadow Creek, and the pier below Long Meadow and Tenmile creeks. Sampling occurred from 2002 to 2004. Findings from the samples indicate dissolved oxygen (DO) values ranging from 5.47 to 14.3 mg/l. The following map displays the sample sites. Because of the location and extent of this reach, the Forest Service has documented an opposition to this listing of Hume Lake on national forest lands. Information regarding the Forest Service opposition is available upon request.

The accompanying table displays the sampling data from this study. The source of the DO is stated as unknown. Beneficial use for Hume Lake is stated as cold freshwater habitat in Appendix F, Supporting Information, Draft 2008 California 303(d)/305(b) Integrated Report, Hume Lake, Decision ID 15948, DO sections. DO values of 7 mg/l and above are appropriate for water bodies designated as cold water fisheries. Appropriate DO values for warm water fisheries are 5 mg/l and above. Hume Lake was historically a mill pond associated with logging and supports warm water fisheries. The Forest Service has requested a warm water designation for Hume Lake from the CVWQCB.

Map 16 Hume Lake CVWQCB Water Quality Sampling Sites and Data 2002-2004



Hume Lake Sampling Sites/ Station Code	Sampling Date	Data Range DO (mg/L)
Hume Lake—Dam Site 552HUM010	4/26/2002	9.04
	6/13/2002	6.72
	9/25/2002	8.12
	12/5/2002	8.71
	3/13/2003	7.4
	11/13/2003	8.75
	5/26/2004	6.24
	10/5/2004	8.5
Hume Lake—Ten Mile Creek 552HUM020	4/26/2002	9.97
	6/13/2002	6.83
	9/25/2002	7.45
	12/5/2002	14.3
	3/13/2003	8.55
	11/13/2003	8.15
	5/26/2004	6.25
	10/5/2004	6.98
Hume Lake—Long Meadow Creek 552HUM030	4/26/2002	7.78
	6/13/2002	6.51
	9/25/2002	6.58
	12/5/2002	12.3
	3/13/2003	8.09
	11/13/2003	8.02
	5/26/2004	5.75
	10/5/2004	5.47
Pier b/w 020 and 030 552HUM040	10/5/2004	8.4

Landscape analysis is ongoing in the Mill Flat watershed. Mill Flat watershed is divided into seven basins: Upper Tenmile Creek, Lower Tenmile Creek, Cabin Creek, Converse Creek, Verplank Creek, Mill Flat Creek, and Davis Creek. Eight permanent SCI sites have been established on Mill Flat Creek watershed since 2003; Sampson and Abbott Creeks were surveyed in 2009. Stream condition inventory surveys have been ongoing in Mill Flat Creek watershed since 2003. The following table provides a list of SCI sites in this watershed. Ranges in stream parameters from these surveys are displayed in the next table.

Table 82 SCI Sites in Mill Flat Creek Watershed

Streams Surveyed in the Mill Flat Watershed								
Water-shed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Mill Flat	18030001005	Long Meadow Creek	Above Hume Lake	Hume Lake	2002, 2004	B3	Naturally-stable	Low
Mill Flat	18030001005	Tenmile Creek	At Tenmile Campground	Hume Lake	2002, 2007	B4c	Stable-sensitive	Moderate-High
Mill Flat	18030001005	Mill Flat Creek	Near Goodmill	Hume Lake	2003, 2004, 2005, 2007	B3	Naturally-stable	Low
Mill Flat	18030001005	Bear Skin Creek	Near Diabetic Camp	Hume Lake	2003, 2004	C4	Stable-sensitive	Moderate
Mill Flat	18030001005	Sampson Creek	Sampson Flat	Hume Lake	2003, 2004, 2005	F4	Unstable-sensitive Degraded	Extreme
Mill Flat	18030001005	Converse Creek	Converse Creek	Hume Lake	2004, 2007	E3b	Stable-sensitive	Low
Mill Flat	18030001005	Abbott Creek	Above Mill Flat Creek	Hume Lake	2005	B2/1	Stable-sensitive	Moderate

Table 83 Range in Channel Attributes for Streams in Mill Flat Creek Watershed, 2003-2007

Parameter	Channel Type			
	A and B Channels	C Channels	E Channels	F and G Channels
Large wood debris (m^3/m)	0.002-0.24	0.24-0.3	0.22-0.5	0.005-0.3
Percent shading (averaged for reach)	53-79	49.2-65.6	66.9-72.4	89.4-95.9
Temperature (Celsius)	11-20	14-19	15-20	16-20
pH (ppm)	6.3 – 7.1	7.0	6.4-7.2	6.5-7.0
Alkalinity ($CaCO_3$)	40-60	40	68-75	120-132
Mean particle size in mm (D50)	7.6-426.3	1.3-4.0	45-71.1	1.9-40.1
Width-to-depth ratio	7.6-27	13-26.8	8.2-16.7	13.3-17.6
Hilsenhoff biotic index–rating	2.66-4.35 excellent–very good-poor	2.90-4.0 excellent to very good	3.41-4.22 excellent to very fair-poor	2.0-4.84 excellent–good
Riparian impact rating	Low–moderate high	Moderate	Low	Extreme
Rosgen channel type	B3, B2/1, B4c	C5	E3b	F4

Kaweah River Basin

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 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. Mountain peaks and ridges characterize the area above 10,000 feet. The Kaweah River is composed 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 with deeply incised canyons.

More than 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. Below Terminus Dam the foothills slope gently to the Tulare lakebed. As the Kaweah River flows toward the valley floor, many tributaries branch from the main river creating the effect of a delta. A few of the Kaweah River's tributaries eventually reach the Tulare lakebed.

Stream characteristics from past surveys and recent SCI investigations provide information on stream conditions in the Upper Kaweah River basin. SCI sites include Pierce Creek, Stony Creek, a tributary to Woodward Creek, and Eshom Creek. Parameters for these sites were collected at various times between 2002 through 2008. The values displayed in the following table are ranges found in the basin. More detailed information is provided in the Hydrology Report.

Table 84 Ranges in Channel Attributes for Upper Kaweah River Basin

Upper Kaweah River Basin	
Large woody debris (m^3/m)	0.06-3.2
Percent shading	60-96
Temperature (Celsius)	15-17
pH (ppm)	6.1-7.0
Alkalinity ($CaCO_3$)	40-170
Mean particle size in mm	3.1-474
Width-to-depth ratio	14.5-24.6
Hilsenhoff biotic index–rating	Excellent (2.86)–very good (4.0)
Riparian impact rating	Low to moderate

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.

Aquatic insect data for the Upper Kaweah River basin indicated those waters sampled have water quality that reflects excellent aquatic MIS site conditions using the Hilsenhoff biotic ratings. Many of the samples evaluated are taken from the same site. Water quality based on biotic ratings for these watersheds is very close in value and is suggestive of high water quality.

Stream surface shade for non-meadow environments ranges from 6 to 96 percent. Large woody material taken in the Upper Kaweah River basin show a range from 0.06 to 3.20 meters^3 per meter of stream evaluated. The lowest levels of woody debris were measured in Stony Creek, and the highest levels of

woody debris were measured in an unnamed tributary to Woodward Creek.

Values for the Upper Kaweah River basin for width-to-depth ratios have been separated by channel type. Measurements taken in these naturally stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements. The majority of pH values range from 6.1 to 7.0 in this watershed basin. Temperature ranges from data that were taken at a point during summer months are from 59 to 63 degrees F (15 to 17 C). Alkalinity values range from 40 to 170 ppm.

Upper North Fork Kaweah River, South Fork Kaweah River, and Lower Kaweah Watersheds (1803000704, 1803000705, 1803000706)

The Upper North Fork Kaweah River drainage is on the western slope of the Sierra Nevada. 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 in the Sequoia National Forest. U.S. Geological Survey stream gage 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 in the Sequoia National Forest and 24,480 are in the Monument. Within these boundaries, approximately 1,270 acres are in private ownership, and approximately 310 acres are in the U.C. Berkeley-managed Whitaker Forest. Approximately 62,120 acres of the Upper Kaweah drainage are in Kings Canyon and Sequoia National Parks; the remaining 22,900 acres are privately owned. The remaining 112,550 acres are outside the Sequoia National Forest and outside the Monument.

Elevation in the Upper Kaweah drainage ranges from about 4,000 to 8,500 feet. The basin is composed predominantly of granite bedrock. 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 System lands. Dry and Eshom creeks have more pronounced riparian areas 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.

Stream characteristics from past surveys and recent SCI sites provide information on water quality parameters in the Upper North Fork Kaweah River basin (see the following table). Ranges for large woody debris, shading, water temperature, alkalinity, and other parameters are provided in the next table. More detailed information is provided in the Hydrology Report.

The South Fork Kaweah, Lower Kaweah, and North Fork Kaweah watersheds encompass approximately 27,530 acres that drain approximately 36 linear miles of perennial streams within the national forest and Monument boundaries into the Kaweah River. The greatest portion of these watersheds lie outside the forest and Monument boundaries within the national park. The North Fork Kaweah and Lower Kaweah watersheds flow southwest into the Kaweah River. The South Fork Kaweah watershed flows northwest into the Kaweah River adjacent to Terminus Dam near the community of Three Rivers.

These watersheds are composed of six basins that lie within the Monument boundary: Dry Creek, Eshom Creek, Pierce Creek, Stony Creek, Woodward Creek, and Grouse Creek basins. (Stream surveys have not been conducted in the Grouse Creek Basin and are not considered further in the hydrology report.)

Table 85 SCI Sites in Upper North Fork Kaweah River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper North Fork Kaweah River	1803000704	Pierce Creek	Pierce Valley Upper Watershed	Hume Lake	2002, 2006, 2008	B3	Naturally-stable	Low
Upper North Fork Kaweah River	18030000704	Eshom Creek	Above Heartland	Hume Lake	2003, 2005	C4	Stable-sensitive	Moderate
Upper North Fork Kaweah River	18030000704	Stony Creek	Below Stony Creek Store and Campground	Hume Lake	2004	B3	Naturally-stable	Low
Upper North Fork Kaweah River	18030000704	Trib to Woodward Creek	Above Stony Creek near Montecito Sequoia	Hume Lake	2005	B2/1	Stable-sensitive	Low

Table 86 Range in Channel Attributes for Streams in Upper North Fork Kaweah River Watershed

Parameter	Channel Type	
	A and B Channels	C Channels
Large wood debris (m^3/m)	0.06-3.2	0.23
Percent shading (range)	59.7-87.2	68-94
Temperature (Celsius)	17	15
pH (ppm)	6.1-6.5	7.0
Alkalinity (CaCO3)	40-170	40
Mean particle size in mm (D50)	84.8-474	3.1
Width-to-depth ratio	14.5-24.6	16.7-24
Hilsenhoff biotic index–rating	2.86-3.24 excellent	2.90-4.0 excellent–very good
Riparian impact rating	Low	Moderate
Rosgen channel type	B3, B2/1	C4

Kern River Basin

Upper Kern River Basin

The Upper 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 more than 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 Sierra Nevada, and the Great Valley Grassland. This area includes the largest remaining contiguous riparian forest in California.

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. The combination of these forces left "hanging valleys," or basins with high waterfalls, which are a natural barrier to fish migration. The fish that survived in these cutoff high-elevation streams slowly evolved during the next 100,000 years into unique subspecies of rainbow trout.

The Kern River flows out of the Sierra Nevada across the Kern River fault. The river 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. Water is used for crop irrigation, domestic water, and allowed to seep into the alluvial river bottom to recharge the aquifers in the old Tulare 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 in Sequoia National Park. Because the Monument affects so little of this watershed it has been included in the discussion of the Kern River basin.

More than 151 miles of the North and South Forks of the Kern River above Lake Isabella were designated as 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 4-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.

Stream characteristics from past surveys and SCI sites provide information on water quality parameters in the Kern River basin. Ranges for large woody debris, shading, water temperature, alkalinity, and other parameters are provided in the following table. More detailed information is provided in the Hydrology Report.

Table 87 Range in Channel Attributes for Kern River Basin

Upper Kern River Basin	
Large woody debris (m^3/m)	0.00-1.10
Percent shading	3-100
Temperature (Celsius)	6-19
pH (ppm)	6.0-9.0
Alkalinity ($CaCO_3$)	16-140
Mean particle size in mm (D50)	0.03-87.11
Width-to-depth ratio	10.34-35
Hilsenhoff biotic index–rating	0.67-6.00 excellent–fair
Riparian impact rating	Low–moderate
Rosgen channel type	B, C, and E

Aquatic insect data for the Upper Kern River basin indicate aquatic MIS site conditions that range from excellent to fair using the Hilsenhoff biotic ratings.

Riparian ecotype impact ratings fall in the low range. Stream surface shade at non-meadow and meadow environments ranges from 3 to 100 percent.

Large woody material in the Upper Kern River basin range from 0.00 to 1.10 cubic meters per meter of stream evaluated. The lowest levels of woody debris were measured in Fish Creek.

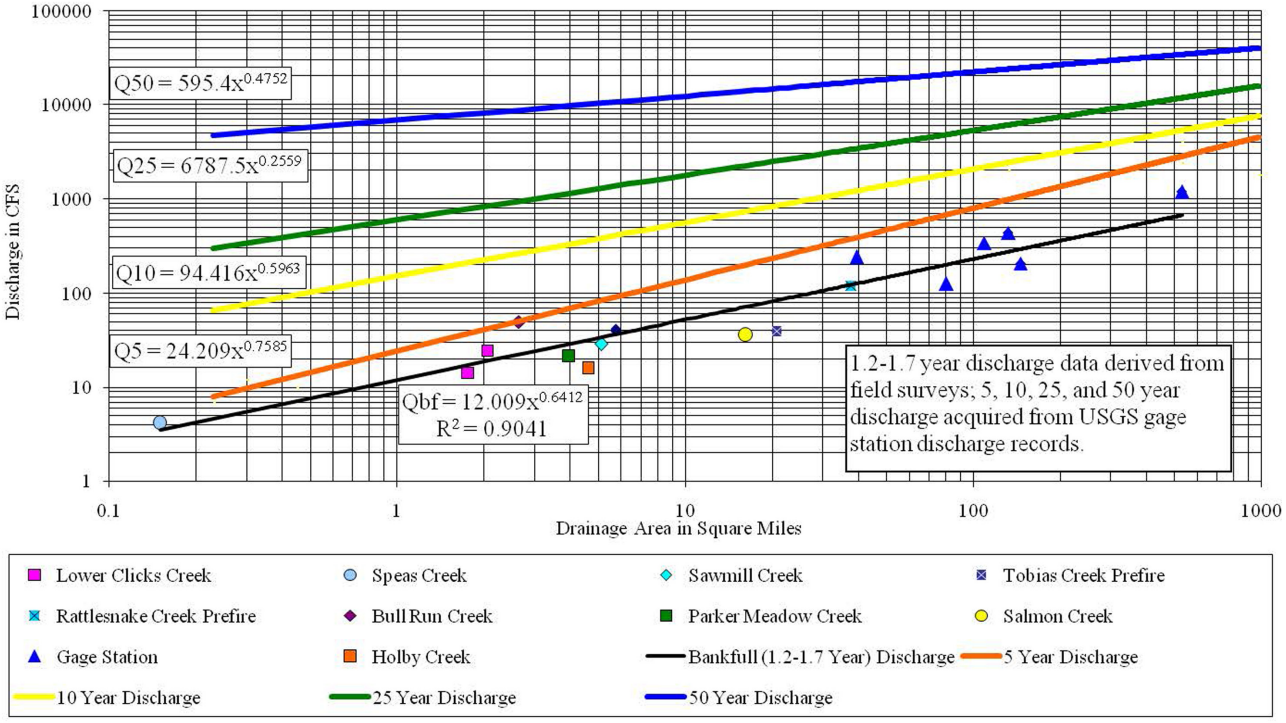
Values for the Upper Kern River basin for width-to-depth ratios have been separated by channel type. Measurements taken in naturally stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements.

Water chemistry has pH values from 6.0 to 9.0. Temperature ranges from 6 to 19 degrees Celsius. Alkalinity values range from 16 to 140 ppm.

Annual precipitation in the Upper Kern River watershed over the past 5 years ranged from 15 to 45 inches. Most occurs in the form of rain from January to March and results in an annual average snow pack of approximately 3 feet at higher elevations of the watershed. Peak flows for the North Fork Kern River

occur in April, May, and June with historic flows being highest in May. Monthly stream flow ranges from 17 to 600 cubic feet per second (cfs) with a mean annual flow of 329 cfs. Recorded peak flows ranged from 22,000 cfs in 1963 to 60,000 cfs in 1969. Substantial rain-on-snow events occur roughly on a 10-20-year cycle. Ambient summer temperatures recorded at district weather stations range from 60 to 90 degrees F and winter temperatures from 35 to 70 degrees F. Evaluations of regional physiographic relationships have been evaluated from 2001 to present. Discharge relationships for the Kern River are provided in the following figure (Kaplan-Henry 2004). Discharge relationships are updated as new data become available.

Figure 10 Local Kern River Hydrologic Physiographic Discharge Relationships Bankfull, 5-Year, 10-Year, 25-Year Recurrence Interval



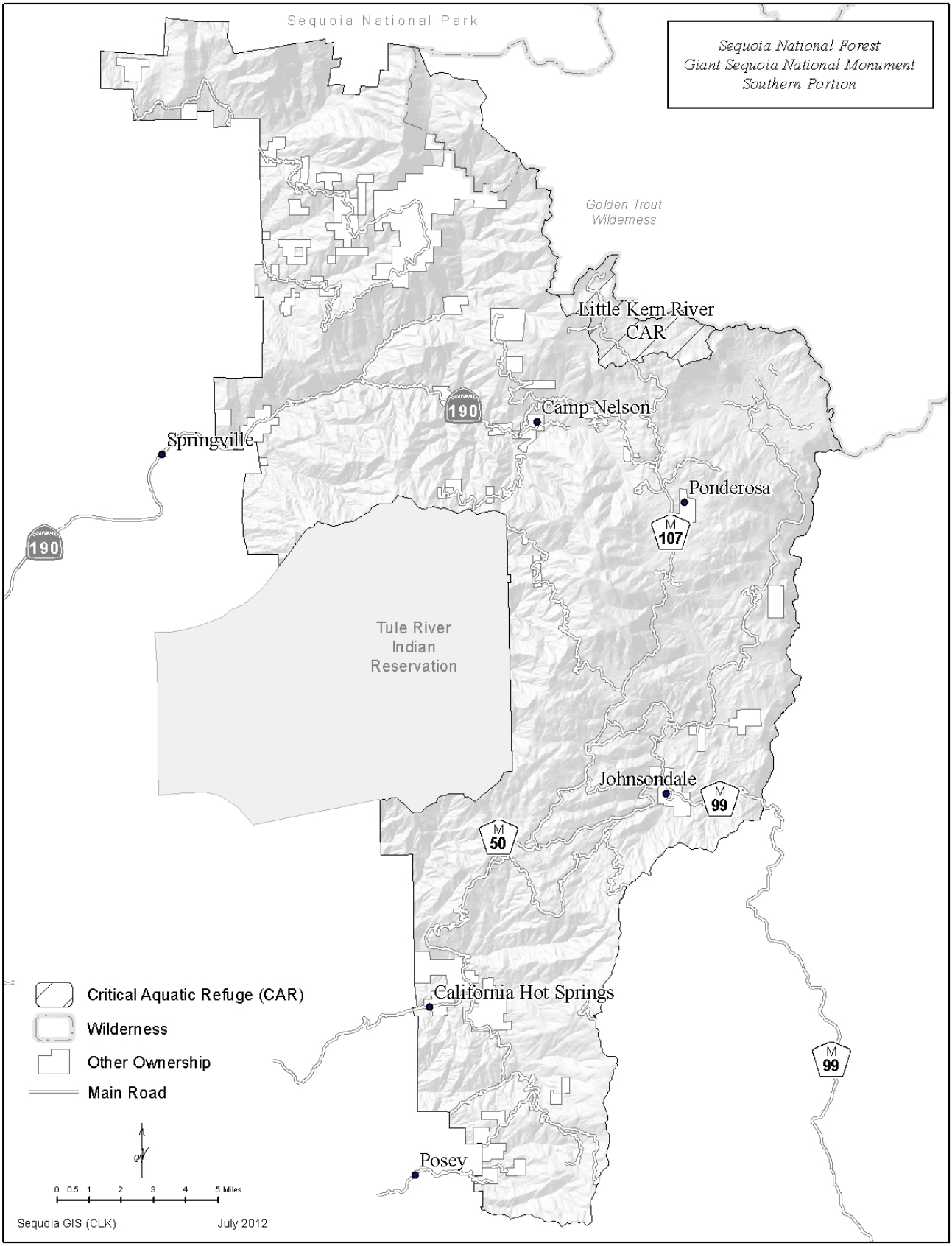
The Upper Kern basin was rated as a category II in the Unified Watershed Assessment. A category II rating describes watersheds with good water quality that through regular program activities can be sustained and improved. Category II watersheds currently meet clean water and other natural resource goals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

Little Kern Watershed (1803000104)

The Little Kern watershed is approximately 81,240 acres and lies within the Sequoia National Forest. A small portion, approximately 4,500 acres, lies within the Monument boundary. It comprises the uppermost sections of Fish Creek, Clicks Creek, and North Fork Clicks Creek. It includes Loggy Meadow, Log Cabin Meadow, Junction Meadow, and White Meadow. Of these areas, only Clicks Creek (lower) and Fish Creek at Loggy Meadow have been surveyed (see the following table). These streams and meadows drain in an easterly direction into the Little Kern River and continue into the North Fork Kern River. This portion of the watershed is part of the Jordan Grazing Allotment. Livestock use in this area is concentrated in the meadows.

The Little Kern watershed contains one of two CARs located in the Monument. The Little Kern River CAR was designated for the management of native populations of Little Kern golden trout. The majority of the CAR lies in the Golden Trout Wilderness. A small portion of the CAR is in the Monument, located on the southeastern edge of the Little Kern watershed as displayed in the following map.

Map 17 Little Kern River Critical Aquatic Refuge



Stream channel characteristics were developed from past stream surveys and recent SCI sites within the Little Kern watershed. The Monument contains a small portion of the Little Kern River watershed. However, to develop a more accurate range of attributes, all survey information is included. Five of the seven SCI sites are located in the Golden Trout Wilderness. Sites include Fish Creek, Grey Meadow (south), Tamarack, Willow Creek, and Soda Springs Creek. The following tables summarize the data ranges by channel type.

Table 88 SCI Sites for Little Kern River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Little Kern River	1803000104	Lower Clicks Creek	Above Junction Meadow	Western Divide	2002, 2007	E5	Stable-sensitive	Low
Little Kern River	1803000104	Fish Creek	Loggy Meadow	Western Divide	2007, 2008	C6	Stable-sensitive	Low

Table 89 Range in Channel Attributes for Streams in Little Kern River Watershed

Parameter	Channel Type		
	A and B Channels	C Channels	E Channels
Large Wood Debris (m^3/m)	0.00-0.19	0.00	0.05
Percent shading	13-97	20-100	3-91
Temperature (Celsius)	12-16	13	13-18
pH (ppm)	6.5-7.5	6.0	6.0-6.2
Alkalinity ($CaCO_3$)	70-88	80-84	45-80
Mean particle size in mm (D50)	22.6-82.7	0.03-0.04	1.02-10.66
Width-to-depth ratio	10.96-33.75	12.96	3.5-11.62
Hilsenhoff biotic index–rating	Not analyzed	6.00–fair	2.63–excellent
Riparian impact rating	Low–moderate	Low	Low

Middle Kern River Watershed (1803000105)

This watershed encompasses approximately 204,180 acres. About 200,900 acres are National Forest System lands, of which approximately 73,400 acres lie within the Monument and about 2,120 acres are private land. Fewer than 2 acres lie outside the 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 toward the Kern River.

Elevations range from approximately 4,000 feet along the Kern River to a high of 8,270 feet at the Needles. Streams exhibit a dendritic 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.

There are 58.84 miles of trails and 1.07 miles of roads per square mile in this watershed (USDA Forest Service 2001c). Roads in this watershed are closed from approximately November 15 to late

April annually. Ponderosa and R-Ranch are the most developed parcels of private land in the watershed. Use is predominantly during the summer months, with a small percentage of year-round residents on-site.

Human-related disturbances include roads, residences, recreation, grazing, stock use, and vegetation management. Water quality measurements, specifically high pH in the vicinity of Holby Creek, appear to be associated with urbanization in the drainage.

Concrete dams are located at both Camp Whitsett and at the base of Long Meadow. An earthen dam at the privately owned R-Ranch is currently used for recreation. The water body behind the dam was originally a millpond associated with a logging mill on the site.

Wells exist at the three organizational camps; horizontal wells exist at Lower Peppermint, Redwood Meadow, and Holey Meadow campgrounds and Jerkey Trailhead. Johnsondale Work Center has a well and water system and there are wells and community water systems on private lands at Ponderosa and R-Ranch. Several minor springs and seeps occur within the watershed.

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 in the western half of the Middle Kern watershed in the Monument form both a physical and ecological boundary. This watershed contains 10 subwatersheds 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 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.

Channel characteristics were developed from past surveys and recent SCI sites in the Middle Kern River watershed (see the following table). The Monument does not include all of the watersheds within the Middle Kern River watershed. However, to develop a more accurate range of attributes, 4 of the 11 SCI surveys in the watershed are included in the analysis. Surveyed sites outside the Monument boundary include Brush Creek, Poison Meadow Creek, Salmon Creek, and Cow Creek.

Table 90 SCI Sites in Middle Fork Kern River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Middle Kern River	1803000105	Holby Creek	Near Holby Meadow	Western Divide	2002, 2006	B4c/1	Stable-sensitive	Low
Middle Kern River	1803000105	Parker Meadow Creek	At Parker Meadow	Western Divide	2003, 2008	B4c	Stable-sensitive	Moderate
Middle Kern River	1803000105	Bone Creek	Below Last Chance Meadow	Western Divide	2008	B4a	Stable-sensitive	Moderate
Middle Kern River	1803000105	Freeman Creek	Downstream of North Road Crossing	Western Divide	2008	B4c	Stable-sensitive	Moderate

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Middle Kern River	1803000105	South Creek	SW of Johnsondale	Western Divide	2008	C4b	Stable-sensitive	Moderate
Middle Kern River	1803000105	Tobias Creek	Near Fairview	Kern River	2002, 2003, 2004, 2005	B3	Naturally-stable	Low
Middle Kern River	1803000105	Dry Meadow Creek	Off Lloyd Meadow Rd below Horse Canyon	Western Divide	2004	B3c	Naturally-stable	Low

Table 91 Range in Channel Attributes for Streams in Middle Fork Kern River Watershed

Parameter	Channel Type	
	A and B Channels	C Channels
Large woody debris (m^3/m)	0.00-1.1	0.01
Percent shading (ranges)	22-100	61-100
Temperature (Celsius)	6-19	17
pH (ppm)	6.5-9.0	6.5
Alkalinity ($CaCO_3$)	16-140	120
Mean particle size in mm (D50)	4.85-87.11	18.64
Width-to-depth ratio	10.34-35	11.05-17.97
Hilsenhoff biotic index–rating	0.67-5.58–excellent to fair	Not analyzed
Riparian impact rating	Low–moderate	Moderate

Tule River Basin

Upper Tule River Basin

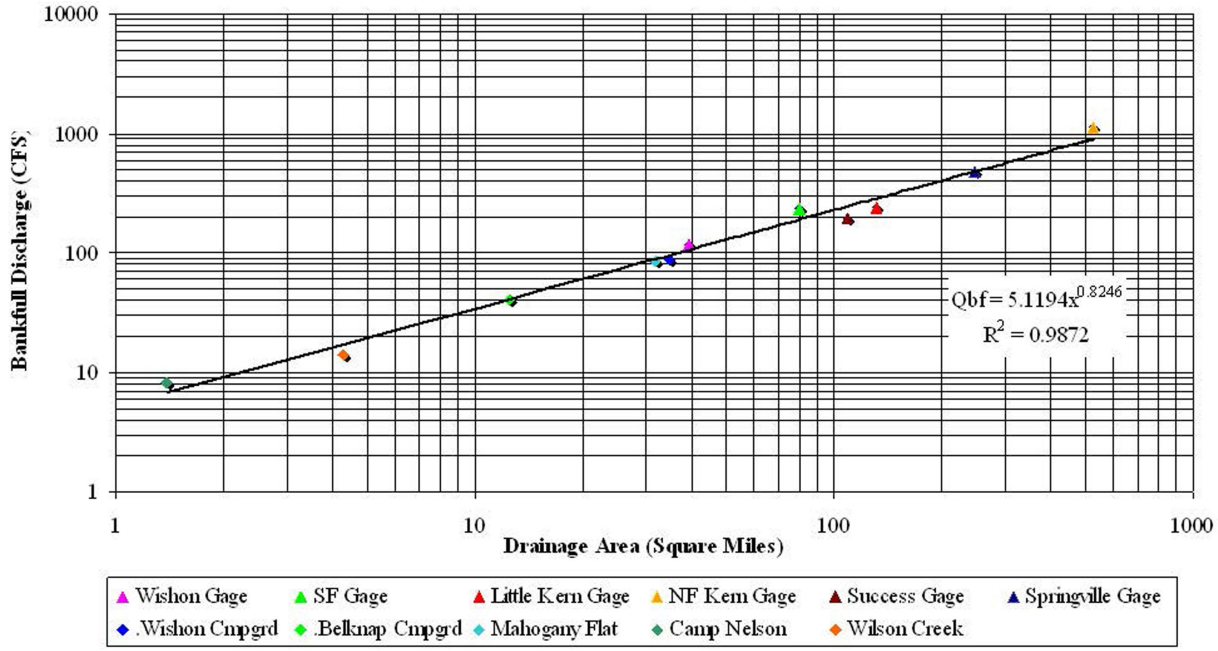
The Tule River basin is located in Tulare and Kings counties in the southeast portion of the San Joaquin Valley. The Tule River flows from the Sierra Nevada westward toward the Tulare lakebed. Hydrologically, the basin is a closed system with the river terminating in the lakebed. Lake Success is located on the main branch of the Tule River about six miles east of Porterville. The river is located within Tulare County, bounded on the north by the Kaweah basin and on the south by the White River-Deer Creek basin. The dam at Lake Success, with construction completed in 1961 by the U.S. Army Corps of Engineers, provides flood protection and storage for irrigation water. The earth-fill dam is 156 feet high, 3,490 feet long, and has a crest 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.

The North, Middle, and South Forks of the Tule River have similar climate with annual precipitation from 21 to 61 inches. The highest runoff period for the Middle Fork Tule River occurs in March, April, and May. For the period of record 1978-1993, average daily flows during the October-May period recorded at a gage station adjacent to Lower Coffee Camp have ranged from 16 cfs (October) to 217 cfs (May). Average daily flow during the June-September period has ranged from 17 cfs (September) to 148 cfs (June). Maximum flows are as high as 6,120 cfs. Peak flows for the North Fork Tule River occur in March, April, and May, with historic flows being highest in April. Peak flows for the South Fork Tule River occur in February, March, and April, with historic flows highest in

March. Substantial rain-on-snow events occur on a 15-20-year cycle. Ambient summer temperatures recorded at RAWS stations range from 60 to 90+ degrees F, with winter temperatures ranging from 35 to 70 degrees F. Evaluations of regional physiographic relationships have been evaluated from 2001 to present. Discharge relationships for the Tule River (Stewart 2006) are provided in the following figure. These discharge relationships are updated as new data become available.

Figure 11 Bankfull Discharge Relationships Tule River, CA



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 tributary of the Kaweah River), and continues toward the Tulare lakebed. A few miles upstream of Porterville is a natural tributary called Porter Slough that is used to convey irrigation water. In addition to Porter Slough, numerous irrigation diversions are 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 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.

Channel characteristics were developed from past surveys and recent SCI data collected in the Upper Tule River basin. The ranges were created from the SCI sites located within the basin's watersheds. More detailed information is provided in the Hydrology Report.

Table 92 Range in Channel Attributes for Upper Tule River Basin

Upper Tule River Basin	
Large woody debris (m^3/m)	0.00-1.17
Percent shading	0-100
Temperature (Celsius)	11-16
pH (ppm)	6.5-7.5
Alkalinity ($CaCO_3$)	30-180
Mean particle size in mm (D50)	0.05-222.22
Width-to-depth ratio	11.03-293.71
Hilsenhoff biotic index–rating	0.90-4.00–excellent to very good
Riparian impact rating	Minimal–moderate
Rosgen channel type	B and C

Aquatic insect data for the Upper Tule River basin indicate waters sampled have aquatic MIS site conditions that range from excellent to very good using the Hilsenhoff biotic rating. Riparian ecotype impact ratings fall in the low range.

Stream surface shade measurements were taken both in non-meadow and meadow environments. The percent stream surface shade ranges from 0 to 100 percent.

Large woody material shows a range from 0.00 to 1.40 cubic meters per meter of stream evaluated. The lowest levels of woody debris were measured in Boulder Creek, and the highest levels of woody debris were measured in Tule River at Belknap.

Values for the Upper Tule River basin for width-to-depth ratios have been separated by channel type. Measurements taken in naturally-stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements.

Water chemistry measurements for pH values range from 6.5 to 7.5 in this watershed basin. Temperature ranges from data that were taken at a point during summer months are from 11 to 16 degrees C. Alkalinity values range from 30 to 180 ppm.

Flooding on the Tule River has occurred from winter and spring rains 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, with runoff occurring from April through June.

Tule River waters are classified as rich in calcium carbonate. Salinity concentrations are low; electrical conductivity ranges from 112 to 365 micro-ohms per centimeter. Occasionally, inflow levels of iron, lead, and zinc have exceeded EPA standards for freshwater aquatic life. At the South Fork Tule River inflow, total and dissolved iron levels exceeded the federal drinking water standards in the summers of 1995 and 1996. Total iron values exceeded the drinking water standard at the North Fork inflow in the spring of 1995. Both copper and mercury have exceeded federal standards in past years. In the spring of 1995, copper exceeded standards at the North Fork Tule River inflow, and mercury exceeded the standard at the South Fork inflow. 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.

The Upper Tule River basin was rated as a priority category I in the Unified Watershed Assessment. A 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.

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. The total acreage within the watershed is 70,480 acres and drains approximately 99 linear miles of perennial streams. National Forest System lands occupy approximately 67,210 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 basin is concave in nature with a dendritic 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 Lake Success.

Elevation ranges from 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 spring.

The Middle Fork Tule River watershed contains relatively low road density with approximately 1.01 miles per square mile of road (USDA Forest Service 2001c). Of this, approximately 0.35 miles per square mile occur within 300 feet of streams, 0.16 miles per square mile occur on steep slopes, and 0.60 miles per square mile occur in the lower one-third slope (USDA Forest Service 2001c). A portion of the Moses Roadless Area (approximately 2,500 acres) and all of the Black Mountain Roadless Area (2,120 acres) lie within this watershed.

Dense urbanization affects water quality in the lower reaches of the watershed as sites cluster around main drainages, such as the North Fork Middle Fork Tule River. Highway 190 parallels the stream for the entire length of the basin. There are 62.18 miles of trails in the watershed.

Stream channel characteristics were developed from past surveys and recent SCI investigations in the Middle Fork Tule River watershed (see the following table). The next table contains a summary of these ranges by channel type.

Table 93 SCI Sites in Middle Fork Tule River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Middle Fork Tule River	1803000601	SFMF Tule River	Belknap Campground	Western Divide	2001, 2006	B3a	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Boulder Creek	Deep Meadow	Western Divide	2001, 2006	C6	Stable-sensitive	Moderate
Middle Fork Tule River	1803000601	NFMF Tule River	Camp Wishon	Western Divide	2001, 2006	B3a	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Moorehouse Creek	Above old fish hatchery, at Mahogany Flat	Western Divide	2005	B4a	Stable-sensitive	Moderate
Middle Fork Tule River	1803000601	Tributary to SFMF Tule River	Camp Nelson	Western Divide	2005	B3	Naturally-stable	Low
Middle Fork Tule River	1803000601	Bear Creek	Near tributary to Coy Creek	Western Divide	2008	B3a	Naturally-stable	Low
Middle Fork Tule River	180300601	SFMF Tule River	Southeast of Mahogany Flat	Western Divide	2001	B3c	Naturally-stable	Minimal
Middle Fork Tule River	1803000601	Wilson Creek	Below Black Mountain Grove	Western Divide	2006	B3a	Naturally-stable	Low

Table 94 Range in Channel Attributes for Streams in Middle Fork Tule River Watershed

Parameter	Channel Type	
	A and B Channels	C Channels
Large wood debris (m^3/m)	0.01-1.40	0.01-1.17
Percent shading	26-100	0-39
Temperature (Celsius)	11-14	14
pH (ppm)	6.5-7.5	6.5
Alkalinity ($CaCO_3$)	30-180	30
Mean particle size in mm (D50)	5.39-222.22	0.05-0.12
Width-to-depth ratio	12-26	11.43-293.71
Hilsenhoff biotic index–rating	0.90-2.95–excellent	4.00–very good
Riparian impact rating	Low–moderate	Moderate

Numerous wells, spring developments, and diversions are located in this watershed on National Forest System lands. Camp Nelson Water Company has a diversion from Belknap Creek; Alpine Village has a community spring box development; Cedar Slope community has a diversion from Marshall Creek; Slate Mountain Homeowners have a well and filter basin; and 11 spring developments or diversions provide water to individual cabins. Quaker Meadow Camp has a well, and wells supply water to Quaking Aspen, Belknap, and Coy Flat campgrounds; Upper Coffee Camp; and Boulder Camp administrative area. A spring development and well provide water to Wishon Campground. On private land there are two known community water systems, one serving the Pierpoint Springs area and one at Cedar Slope. Water chemistry, specifically water pH, is naturally high and is the result of soda springsthroughout the watershed.

Two hydroelectric power plants are located in this watershed. One plant is owned by Pacific Gas and Electric Company (PG&E) and is located on the North Fork of the Middle Fork Tule River. The other is owned by Southern California Edison (SCE) and is located on the Middle Fork Tule River. Both PG&E and SCE divert waters from the channel to produce electricity. PG&E diverts water near Wishon Campground by lift pump, while SCE diverts water near the powerhouse at highway 190. These plants operate on unregulated flow of the Middle Fork Tule River. Both of these projects are run-of-the-river and return all water for downstream uses.

Earthen type dams impound four lakes/ponds within the watershed. Two lakes are in Quaker Meadow Camp on National Forest System lands, and two small ponds are in the Sequoia Crest and Alpine Village areas on private land. These lakes are man-made features and were constructed prior to designation of the Monument.

Camping, hiking, hunting, mountain biking, equestrian use, cross-country skiing, and snowmobile activities are popular in this watershed. Mountain Home State Forest has 2,450 acres in this watershed, including two campgrounds with a total of 29 campsites and one group campsite.

Two day use areas, Upper and Lower Coffee Camps, lie in this basin. Upper and Lower Coffee Camp day use areas are heavily used in the summer months. The upper and lower stream banks in these areas are heavily affected by recreational use. Stream bank vegetation is sparse, and sedimentation is present in pools. Human refuse and graffiti are also associated with these areas and are a source of pollution to the waterway. A parking and access area at the Stairs is located near the upper extent of the drainage and receives similar effects from recreation use.

The Black Mountain, Cow Mountain, and Middle Tule grazing allotments, and approximately 20 percent of the Little Kern allotment, are found in the watershed, along with an abandoned copper mine.

North Fork Tule River Watershed (1803000602)

The watershed encompasses approximately 62,360 acres. Of these, about 30,480 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 6,000 acres of the watershed constitute 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 draining these two basins include 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.

Stream channel characteristics were developed from past surveys and recent SCI investigations in the North Fork Tule River watershed (see the following table). The next table displays the ranges of channel attributes for the North Fork Tule River watershed.

Table 95 SCI Sites in North Fork Tule River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
North Fork Tule River	1803000602	Bear Creek	Bear Creek at SCICON	Western Divide	2001, 2006	B4c	Stable-sensitive	Moderate
North Fork Tule River	1803000602	Bear Creek	Bear Creek by CCC camp	Western Divide	2007	B5a	Stable-sensitive	Moderate

Table 96 Range in Channel Attributes for North Fork Tule River Watershed

Parameter	Channel Type
	A and B Channels
Large wood debris (m^3/m)	0.00-0.03
Percent shading	58-78
Temperature (Celsius)	12-16
pH (ppm)	7.1-7.5
Alkalinity ($CaCO_3$)	72-140
Mean particle size in mm (D50)	2.00-163.45
Width-to-depth ratio	11.03-25.98
Hilsenhoff biotic index–rating	2.99-3.39–excellent to very good
Riparian impact rating	Moderate

The elevation ranges from approximately 2,200 to 9,300 feet. Approximately 60 percent of the watershed in 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.

Human-related disturbances include roads, residences, recreation, grazing, and vegetation management. No watersheds cause concern from any of these past disturbances.

South Fork Tule River Watershed (1803000603)

The South Fork Tule River and its tributaries, including Cedar Creek, Kessing Creek, Windy Creek, and Crawford Creek, drain west through the Tule River Indian Reservation into Lake Success and eventually into the Tulare lakebed. The watershed encompasses approximately 64,580 acres. Of these, about 10,520 acres are National Forest System lands within the Monument, and approximately 160 acres are private land. The remaining 53,890 acres are the Tule River Indian Reservation.

Elevation ranges from approximately 5,000 feet at the Monument boundary to 9,000 feet at Slate Mountain.

Human-related disturbances within National Forest System lands include roads, residences, recreation, grazing, and vegetation management. Past disturbances have the potential to affect water quality. No watersheds cause concern from any of these past disturbances.

Upper Deer, White, and Poso River Basins

Upper White–Upper Deer River Basin

Most of the Upper White–Upper Deer River basin is located outside of National Forest System lands. Headwaters begin along Greenhorn Summit, which separates 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. Deer Creek and White River become intermittent drainages once they hit the valley floor. Historically, these drainages flowed directly into the old Tulare lakebed. Both drainages have little flow for several months in most years; however, high flows have reached 2,720 cfs and 5,330 cfs for White River and Deer Creek, respectively.

Stream channel characteristics were developed from past surveys and recent SCI data within the Upper White-Upper Deer River basin (see the following table). The ranges are shown for large woody debris, stream shading, water temperature, alkalinity, and other parameters. More detailed information is provided in the Hydrology Report.

Aquatic insect data for the Upper Deer–Upper White River basin aquatic MIS site condition ranges from excellent to very good using Hilsenhoff biotic rating. Riparian ecotype impact ratings fall in the low riparian impact range.

Stream surface shade measurements were taken along sites in non-meadow environments. The percent stream surface shade ranges from 37 to 97 percent.

Large woody material in the Upper White–Upper Deer River basin shows a range from 0.04 to 0.58 cubic meters per meter of stream evaluated. The lowest levels of woody debris were in Capinero Creek, and the highest levels were in White River.

Table 97 Ranges in Channel Attributes for Upper White–Upper Deer River Basin

Upper Deer–Upper White River Basin	
Large woody debris (m^3/m)	0.04-0.58
Percent shading	37-97
Temperature (Celsius)	15-18
pH (ppm)	7.0-7.5
Alkalinity ($CaCO_3$)	65-175
Mean particle size in mm (D50)	1.28-87.11
Width-to-depth ratio	13.22-35
Hilsenhoff biotic index–rating	2.97-3.57–excellent to very good
Riparian impact rating	Low–moderate
Rosgen channel type	B

Values for the Upper White–Upper Deer River basin for width-to-depth ratios have been separated by channel type. Measurements taken in naturally stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements.

Water chemistry measurements for pH values range from 7.0 to 7.5 in this watershed basin. Temperature ranges taken during the summer months are from 15 to 18 degrees Celsius. Alkalinity values range from 65 to 175 ppm.

Upper Deer, White, and Poso River basins were 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.

Upper White River Watershed (1803000501)

The White River and its tributaries are located on the west slope of the Sierra Nevada 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 6,540 acres are National Forest System lands that fall within the Monument, about 350 acres are private land, and 50,600 acres lie outside the national forest. 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 several minor springs and seeps occur in the watershed. No giant sequoia groves are located in this watershed, and no known dams are in the Monument in this watershed.

Stream channel characteristics were developed from past surveys and recent SCI data in the Upper White River watershed (see the following table).

Table 98 SCI Sites in Upper White River Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper White River	1803000501	White River	Near Betty Waller Meadow	Western Divide	2001, 2006	B3	Naturally-stable	Low

Upper Deer Creek Watershed (1803000502)

Deer Creek and its tributaries are located on the western slope of the Sierra Nevada 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 25,970 acres are National Forest System lands that fall within the Monument, approximately 2,370 acres are private land, and 37,000 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 in the watershed and moderate gradient cobble channels in the more moderate terrain. Two meadows occur in the upper portions of the watershed: Pup Meadow and Dead Horse Meadow. The Upper Deer Creek watershed is composed of four watershed basins: Gordon Creek, Rube Creek, Tyler Creek, and Deer Creek. Several minor springs and seeps occur within the watershed.

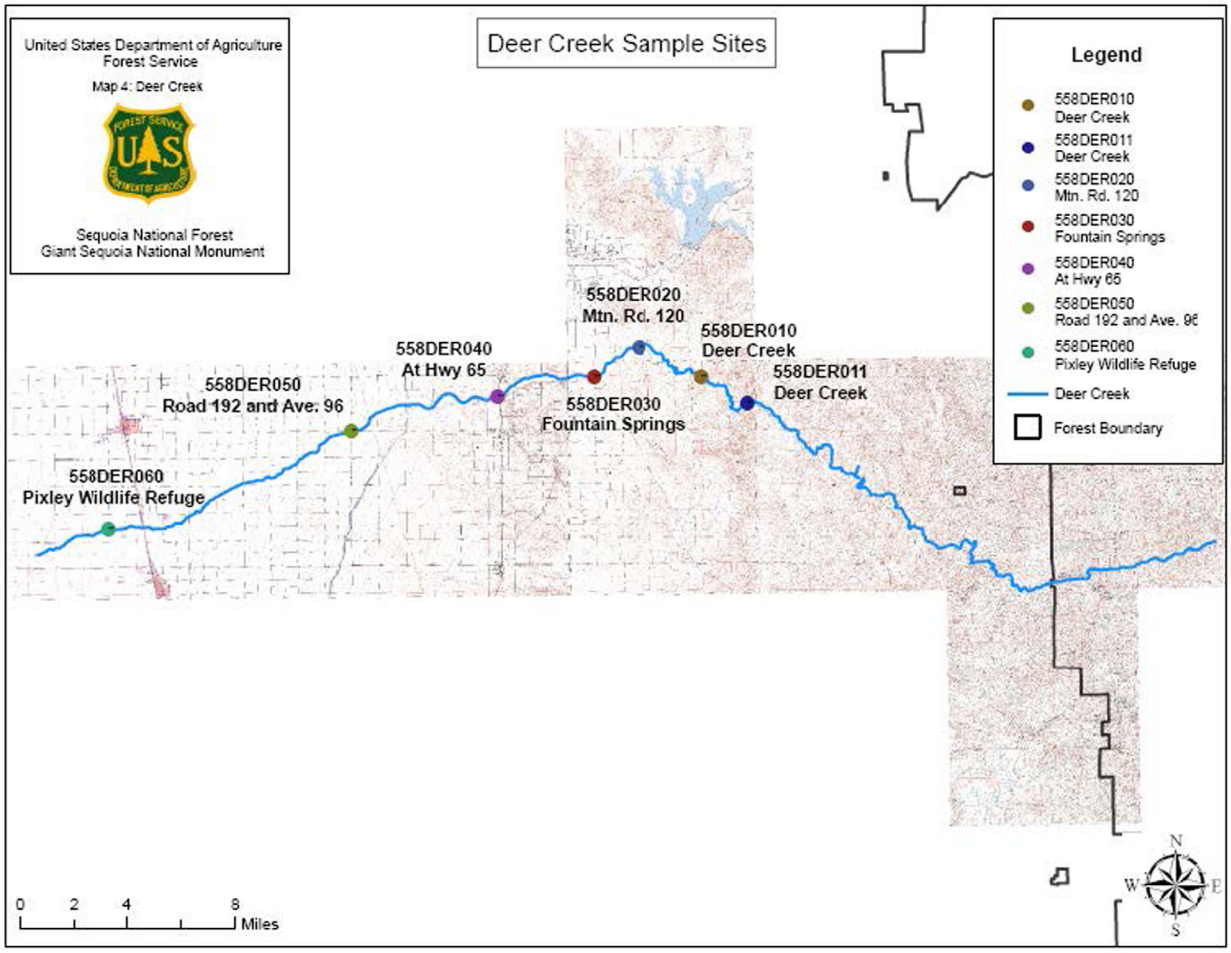
California Hot Springs Water Company has a water bottling plant on private land in this watershed. Pine Flat Water Company has a water system, and cabin owners get their water supply from National Forest System land. A well provides water to the Uhl administrative site, the Deer Creek administrative site, and Leavis Flat Campground. This watershed contains the foothill communities of California Hot Springs and Pine Flat.

Human-related disturbances include roads, residences, recreation, grazing, and vegetation management. Past disturbances have the potential to affect water quality such as natural and prescribed fires, slope stability, and floods. 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.

Deer Creek is listed as a potential 303(d) impaired water body by the Central Valley Water Quality Control Board (CVWQCB) in June 2009. This water segment, as identified by the board, started somewhere around Pixley, California, and proceeded to the headwaters in the Sequoia National Forest. Sampling that placed Deer Creek for consideration on the 303(d) list was done at seven sites along the

reach. None of these sites are on National Forest System lands, and the nearest sample site is 17 miles downstream of the national forest boundary. Deer Creek is crossed by highway 65, highway 99, and highway 43, and flows through agricultural lands, range lands, and communities once it leaves the forest. The Deer Creek sample sites are shown in the following map and table, with sampling data provided by the Regional State Water Quality Control Board.

Map 18 Deer Creek Sample Sites



Deer Creek Sampling Sites/Station Code	Sampling Date	Data Range (pH)	Deer Creek Sampling Sites/ Station Code	Sampling Date	Data Range (pH)	Deer Creek Sampling Sites/Station Code	Sampling Date	Data Range (pH)
Deer Creek 558DER011	6/24/2003	8.2	Deer Creek 558DER011	6/24/2003	8.2	Deer Creek 558DER011	6/24/2003	8.2
	5/19/2004	8		5/19/2004	8		5/19/2004	8
	6/16/2004	7.37		6/16/2004	7.37		6/16/2004	7.37
Deer Creek 558DER010	2/3/2005	7.37	Deer Creek 558DER010	2/3/2005	7.37	Deer Creek 558DER010	2/3/2005	7.37
	5/10/2005	7.84		5/10/2005	7.84		5/10/2005	7.84
	6/28/2005	8.28		6/28/2005	8.28		6/28/2005	8.28
	7/26/2005	7.83		7/26/2005	7.83		7/26/2005	7.83
	8/30/2005	7.6		8/30/2005	7.6		8/30/2005	7.6
	10/19/2005	7.57		10/19/2005	7.57		10/19/2005	7.57

Deer Creek Sampling Sites/Station Code	Sampling Date	Data Range (pH)	Deer Creek Sampling Sites/ Station Code	Sampling Date	Data Range (pH)	Deer Creek Sampling Sites/Station Code	Sampling Date	Data Range (pH)
	1/3/2006	7.96		1/3/2006	7.96		1/3/2006	7.96
	2/14/2006	8.51		2/14/2006	8.51		2/14/2006	8.51
	3/13/2006	8.72		3/13/2006	8.72		3/13/2006	8.72
	4/25/2006	8.2		4/25/2006	8.2		4/25/2006	8.2
	6/26/2006	7.82		6/26/2006	7.82		6/26/2006	7.82
	7/24/2006	7.56		7/24/2006	7.56		7/24/2006	7.56
	8/21/2006	7.72		8/21/2006	7.72		8/21/2006	7.72
	10/23/2006	8.15		10/23/2006	8.15		10/23/2006	8.15
Deer Creek–Mtn Rd 120 558DER020	6/24/2003	8.4	Deer Creek–Mtn Rd 120 558DER020	6/24/2003	8.4	Deer Creek–Mtn Rd 120 558DER020	6/24/2003	8.4
	5/19/2004	8.3		5/19/2004	8.3		5/19/2004	8.3
Deer Creek–Fountain Springs 558DER030	6/24/2003	8.6	Deer Creek–Fountain Springs 558DER030	6/24/2003	8.6	Deer Creek–Fountain Springs 558DER030	6/24/2003	8.6
Deer Creek at Hwy 65 558DER040	2/3/2005	8.14	Deer Creek at Hwy 65 558DER040	2/3/2005	8.14	Deer Creek at Hwy 65 558DER040	2/3/2005	8.14
	5/10/2005	7.76		5/10/2005	7.76		5/10/2005	7.76
	6/28/2005	8.26		6/28/2005	8.26		6/28/2005	8.26
	1/3/2006	8.2		1/3/2006	8.2		1/3/2006	8.2
	2/14/2006	8.71		2/14/2006	8.71		2/14/2006	8.71
	3/13/2006	8.55		3/13/2006	8.55		3/13/2006	8.55
	4/25/2006	8.15		4/25/2006	8.15		4/25/2006	8.15
Deer Creek; Road 192 and Ave. 96 558DER050	6/28/2005	8.19	Deer Creek; Road 192 and Ave. 96 558DER050	6/28/2005	8.19	Deer Creek; Road 192 and Ave. 96 558DER050	6/28/2005	8.19
	7/26/2005	7.48		7/26/2005	7.48		7/26/2005	7.48
	8/30/2005	8.08		8/30/2005	8.08		8/30/2005	8.08
	2/14/2006	8.36		2/14/2006	8.36		2/14/2006	8.36
	3/13/2006	8.79		3/13/2006	8.79		3/13/2006	8.79
	4/25/2006	8.35		4/25/2006	8.35		4/25/2006	8.35
	6/26/2006	7.92		6/26/2006	7.92		6/26/2006	7.92
	7/24/2006	7.2		7/24/2006	7.2		7/24/2006	7.2
	8/21/2006	7.66		8/21/2006	7.66		8/21/2006	7.66
Deer Creek at Pixley Wildlife Refuge 558DER060	6/28/2005	8.79	Deer Creek at Pixley Wildlife Refuge 558DER060	6/28/2005	8.79	Deer Creek at Pixley Wildlife Refuge 558DER060	6/28/2005	8.79
	7/26/2005	6.85		7/26/2005	6.85		7/26/2005	6.85
	8/30/2005	8.05		8/30/2005	8.05		8/30/2005	8.05
	2/14/2006	8.06		2/14/2006	8.06		2/14/2006	8.06
	3/13/2006	8.53		3/13/2006	8.53		3/13/2006	8.53
	4/25/2006	8.35		4/25/2006	8.35		4/25/2006	8.35
	6/26/2006	8.2		6/26/2006	8.2		6/26/2006	8.2
	7/24/2006	7.6		7/24/2006	7.6		7/24/2006	7.6
	8/21/2006	7.71		8/21/2006	7.71		8/21/2006	7.71

The source of the pH is stated as unknown. Findings of the sampling indicate pH values range from 6.85 to 8.79. Toxicity data were not included in the documents provided for public review. The source of the toxicity is stated as unknown. The forest has gone on record and documented that the sampling stations are so far downstream of the Sequoia National Forest boundary and conditions are so different that information provided in the state's data set is not applicable to the forest. Acceptable pH ranges are 6.5 to 8.3. Beneficial use for Deer Creek is stated as warm freshwater habitat in Appendix F, Supporting Information, Draft 2008 California 303(d)/305(b) Integrated Report, Deer Creek, Decision ID 13090, Unknown Toxicity and ID 13088, pH.

The national forest has been monitoring water quality on National Forest System lands for years. The forest has fisheries inventories and channel stability data that go back to the early 1970s. Policy directs the forest to investigate macro-invertebrate and stream condition inventories prior to any ground-disturbing activity (USDA Forest Service 2001c, 2004e). Roughly 33 miles of stream tributary to and including Deer Creek have been surveyed for fisheries habitat and stream stability since 1971. Stream surveys for the Deer Creek drainage follow stream condition inventory protocol. These surveys provide chemical, physical, and biological data. Evaluations of pH provided a value of 7.5 in 2006 and 7.3 in 2007. Aquatic insect data collected in 2006 indicate no apparent organic pollution. The following table provides a summary of data collected at Leavis Flat Campground located on Deer Creek.

Table 99 SCI Sites in Upper Deer Creek Watershed

Name	Location	pH	Hilsenhoff Aquatic Insects	Date Collected	UTM
Deer Creek	Leavis Flat Campground	7.5	3.49 no apparent organic pollution	7/19/2006	11S 0348884 3971701
Deer Creek	Leavis Flat Campground	7.3	None collected	12/03/07	11S 0348884 3971701

The most recent investigation of Deer Creek was on November 6-7, 2007, for renewal of recreation residence authorizations. During field investigations, the following water chemistry measurements were taken in Deer Creek, South Fork of the Middle Fork (SFMF) of the Tule River, and White River. All of the sampled rivers are within state water quality standards. The following table displays results of that water quality sampling.

Table 100 Water Quality Sampling for Recreation Residence Permits 2007

Water Quality Sample	Deer Creek	Tule River (SFMF)	White River
Alkalinity	64 ppm of $CaCO_3$	62 ppm of $CaC0_3$	40 ppm of $CaCO_3$
Dissolved oxygen	9.1 ppm	10 ppm	9.2 ppm
pH	7.3	7.5	7.3
Nitrates	0 ppm	0 ppm	0 ppm
Nitrites	0 ppm	0 ppm	0 ppm

Based on forest fisheries data, Deer Creek is a class I stream that supports a population of rainbow trout and would be considered a cold water fishery.

Final determinations as to the listing of Deer Creek as an impaired water body are expected to be evaluated in 2010 by the California State Water Quality Control Board. Currently, this water body remains unlisted.

Channel characteristics were developed from past surveys and SCI investigations within the Upper Deer Creek watershed (see the following table). The next table contains the ranges of channel attributes derived from the survey sites within the Upper Deer Creek watershed.

Table 101 SCI Sites for Upper Deer Creek Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper Deer Creek	1803000502	Capinero Creek	Near Capinero dispersed camping area	Western Divide	2001, 2006	B5c	Stable-sensitive	Moderate
Upper Deer Creek	1803000502	Deer Creek	Near Leavis Flat	Western Divide	2001, 2006	B4	Stable-sensitive	Minimal
Upper Deer Creek	1803000502	Starvation Creek	Section 21 on Starvation Creek	Western Divide	2001, 2006	B5c	Stable-sensitive	Minimal
Upper Deer Creek	1803000502	Merry Creek	Tributary to Tyler Creek	Western Divide	2006	B4a/1	Stable-sensitive	Low

Table 102 Range in Channel Attributes for Upper Deer Creek Watershed

Parameter	Channel Type
	A and B Channels
Large wood debris (m^3/m)	0.04-0.38
Percent shading	37-95
Temperature (Celsius)	18
pH (ppm)	7.5
Alkalinity ($CaCO_3$)	64-175
Mean particle size in mm (D50)	1.28-22.6
Width-to-depth ratio	14-35
Hilsenhoff biotic index–rating	2.93-4.09–excellent to very good
Riparian impact rating	Low–moderate

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 Tulare lakebed. The basin covers more than 250,000 acres. Precipitation ranges from 6 to 30 inches. The morphology 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, which is located just south of the historic Tulare Lake in the San Joaquin Valley. Poso Creek is an intermittent stream, which spills floodwaters onto the Kern National Wildlife Refuge only during wet years. 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.

Monthly stream flow ranges from 0.86 to 33 cubic feet per second with a mean annual flow of 6.85 cubic feet per second. Peak flow, similiar to Deer Creek, occurs in March, April, and May, with historic flows being highest in April. Rain-on-snow events are cyclic and may have short-term effects depending on severity. Ambient summer temperatures recorded at

district weather stations range from 50 to 102 degrees F and winter temperatures from 35 to 60 degrees F.

Stream channel characteristics were developed from past surveys and recent SCI investigations in the Upper Poso River basin. The following table summarizes the ranges of channel attributes for the Upper Poso River basin. More detailed information is provided in the Hydrology Report.

Table 103 Ranges in Channel Attributes for Upper Poso River Basin

Upper Deer–Upper White River Basin	
Large woody debris (m^3/m)	0.03-1.32
Percent shading	48-93
Temperature (Celsius)	8-18
pH (ppm)	6.5-7.5
Alkalinity ($CaCO_3$)	65-175
Mean particle size in mm (D50)	0.2-299.65
Width-to-depth ratio	12.17-30.26
Hilsenhoff biotic index–rating	3.39–very good
Riparian impact rating	Low–moderate-high

Aquatic insect data for the Upper Poso River basin indicate aquatic MIS site conditions range from excellent to very good using the Hilsenhoff biotic rating. Riparian ecotype impact ratings fall in the moderate impact range.

Stream surface shade may be associated with stream temperatures. Surveys were taken along sites in non-meadow environments. The percentage stream surface shade ranges within the 48 to 93 percent range.

Large woody material is an important component of stream stability and aquatic habitat. Measurements taken in the Upper Poso River basin show a range of large woody material from 0.03 to 1.32 cubic meters per meter of stream evaluated. The lowest levels of woody debris were measured in Little Poso Creek, and the highest levels of woody debris were measured in Spear Creek (lower).

Values for the Upper Poso River basin for width-to-depth ratios have been separated by channel type. Measurements taken in naturally-stable or stable-sensitive riparian environments are in stable condition as suggested by width-to-depth measurements at those locations.

Water chemistry measurements for pH values range from 6.5 to 7.5 in this watershed basin. Temperature ranges from data that were taken at a point during summer months are from 8 to 18 degrees C. Alkalinity values range from 65 to 175 ppm.

Upper Poso Creek Watershed (1803000401)

The Poso Creek watershed encompasses approximately 136,090 acres. Of these, approximately 37,170 acres are National Forest System lands, and approximately 7,880 of those acres are within the Monument. The remaining acres consist of approximately 2,430 acres of private land, and 96,490 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).

The Upper Poso Creek watershed contains the watersheds of Poso Creek, Fulton Creek, Cedar Creek, Lumreau Creek, and Little Poso Creek. Only a portion of the Poso Creek drainage is in the Monument.

Stream channel characteristics were developed from past surveys and recent SCI investigations in the Upper Poso Creek watershed (see the following table). Attribute ranges were developed from all of the watersheds within the Upper Poso Creek watershed. Surveys include Cedar Creek at Cedar Creek Campground, Cedar Creek at Alder

Creek Campground, Little Poso Creek, and Bear Creek in the Kern River District. The next table summarizes the SCI data by channel type for the Upper Poso Creek watershed.

Table 104 SCI Sites in Upper Poso Creek Watershed

Watershed (HUC 6)	Watershed Number	Stream Name	Location	District	Years Surveyed	Channel Type	Riparian Ecotype	Impact Rating
Upper Poso Creek	1803000401	Lower Spears Creek	Spear Creek below Poso Park	Western Divide	2002, 2006	B4	Stable-sensitive	Moderate-high
Upper Poso Creek	1803000401	Upper Spears Creek	Spear Creek above Poso Park	Western Divide	2002, 2006	B4	Stable-sensitive	Moderate-high

Groundwater

Groundwater is a key component of the water resources in the Monument. Groundwater is fundamental to sustain the health, productivity and diversity of aquatic wildlife, terrestrial wildlife and the human populations within and downstream of the Monument. Groundwater is critical to maintain ground dependent ecosystems and is part of the total water system that moves water from the high elevation, snow regions to the lower elevation, groundwater discharge zones. The programmatic activities and management strategies proposed in the alternatives of this FEIS have been evaluated for their potential effect to groundwater resources.

Groundwater in the Monument is located within weathered, fractured bedrock and unconsolidated alluvial and glacial deposits. Carbonate (marble and meta-limestone) geology exists in the Windy Gulch Area and in the Tule River Basin. The carbonate geology has components of a karst landscape and ground water systems may be considered karst groundwater systems. Karst groundwater systems may have flat water tables, enlarged fractures from solution cavities, sink hole springs and karst springs, swallows and sinks in the middle of channels that capture surface water, and flowing subsurface streams in cave passages. Groundwater systems have not been studied in these karst landscapes, and site-specific groundwater conditions are unknown. Unconsolidated alluvial and glacial deposits are unconfined aquifers. Most alluvial deposits are wet meadows that often contain springs.

Three types of groundwater flow systems have been identified in the scientific literature (Toth 1962, 1963, Freeze 1969, Freeze and Witherspoon 1966, 1967, 1968, Freeze and Cherry 1979). Local groundwater flow systems are recharged at a topographic high and discharge at the adjacent topographic low. Intermediate groundwater flow systems have a topographic high between the flow system recharge and discharge areas. Regional groundwater flow systems are recharged at the topographic high of a groundwater basin and discharge to the hydrologic sink of the groundwater basin. Local groundwater flow systems respond immediately to a recharge event. There is generally a time lag between the response of groundwater levels to a recharge event within an intermediate groundwater flow system. Groundwater levels in a regional flow system respond more slowly to recharge events than intermediate and local groundwater flow systems. Groundwater is transported down gradient recharge areas from recharge areas to discharge areas. Springs provide an exit point for a groundwater flow system. Springs and wet meadows are considered groundwater dependent ecosystems.

Several wells are located in the Monument at sites including campgrounds, fire stations, and state and private land holdings. Well sites are located in the Western Divide Ranger District at California Hot Springs and at Johnsondale and at Mountain Home State Forest.

The Monument is located in three California groundwater administrative basins, including the Kings River basin, the Upper Kern River basin, and the Upper Tulare basin. Groundwater within these basins originates and discharges in these basins with some unknown interaction between the basins. Several ecosystems in these basins, including giant sequoia, springs, meadows, fens, and caves, are dependent on groundwater.

Hydrologic processes, including groundwater, deliver subsurface water (or groundwater) to giant sequoia groves. The connection of groundwater to giant sequoia groves is not well studied or understood. Borcher (2001) produced a manuscript entitled *An Ecological Zone of Influence for Giant Sequoia: Subsurface Water Considerations*. This manuscript summarizes the current understanding of giant sequoia subsurface water relations and describes subsurface flow systems that might provide water to groves. Borcher describes the relation of giant sequoia groves to direct precipitation, soil moisture, movement of water down hill slopes, unsaturated groundwater, shallow groundwater flow systems, and deep groundwater flow systems. Borcher's assessment can be summarized with the following points:

1. Water balance studies suggest precipitation directly on groves areas may be adequate to sustain some giant sequoia ecosystems.
2. Movement of water down hill, within the unsaturated zone water and as surface runoff, possibly provides soil moisture used in giant sequoia groves.
3. During periods of extended drought, recharge to shallow, seasonally-saturated groundwater systems on hill slopes might not provide adequate water to sustain healthy giant sequoia ecosystems. Healthy giant sequoia ecosystems might persist during times of drought where groundwater moves to the root zone from perennially saturated groundwater flow systems.
4. Shallow groundwater flow systems are nested overlying, intermediate, and regional groundwater flow systems. The relationship between shallow groundwater flow systems and intermediate and regional groundwater flow systems is unclear. Shallow groundwater can move downward to deeper groundwater flow systems in recharge areas where vertical hydraulic gradients exist.
5. Detailed hydrologic and hydrogeologic characterization of giant sequoia groves does not exist, and the sources and flow paths of subsurface water available to giant sequoia groves cannot currently be described quantitatively.

In a 1972 study, completed by Philip W. Rundel, high levels of soil moisture appear to be maintained within giant sequoia groves during the dry summer months through groundwater originating from summer thunderstorms in the high Sierra. Groundwater percolates down to lower elevations where it appears in the soil profile. Percolation of high elevation groundwater into groves during the dry summer months may be key to the continued existence of giant sequoia groves.

There are approximately 65 springs[24] in the Monument. Spring locations are dependent upon the presence of rock layers of differing hydraulic conductivity, groundwater flow system, the level of the water table, and local topography (Bachman 1997). Springs are distributed throughout the Monument with most springs clustered in the southwest part of the Monument near California Hot Springs; near Nobe Young and Dry Meadow Creeks; around Freeman Creek grove; in the Camp Nelson and Camp Wishon areas; and in the northern Monument south of the Kings River canyon. Most springs are perennial and have little information on site-specific flow rates or water quality. However, an inventory of aquatic insects suggests that overall water quality is excellent to very good, and flow rates can be determined through the use of regional discharge relationships on Monument lands (see the hydrology report for more detailed information). Spring ecosystems are dependent on groundwater to maintain their flow rates and ecosystem function. Springs can have phreatophyte vegetation, which are deep-rooted plants that obtain their water needs from just above the water table. These species are a key component of most riparian ecosystems.

There are approximately 268 meadows, including 112 wet meadows in the Monument. A wet meadow is considered a wetland and can include fens. Fens

24. A spring is a location where groundwater flows from rock or soil onto the land surface or into a surface water body.

are peat-forming wetlands that receive recharge and nutrients almost exclusively from groundwater. The average size of wet meadows is approximately 5.5 acres, with the largest being about 50 acres and the smallest being 0.5 acres. Meadows are productive and diverse ecosystems scattered throughout the Monument, except in the Kings Canyon inner gorge and between the Tule River Indian Reservation, north to the boundary of Sequoia National Park. Meadow ecosystems and phreatophyte vegetation are groundwater-dependent and rely on shallow groundwater during the growing season.

Loheide et al. (2009) concluded that meadows throughout the Sierra Nevada have experienced important changes in vegetation and hydrology since the 1850s. Because of the connection between vegetation and the groundwater systems, the lowering of the water table, resulting from changes in hydrologic patterns and processes, typically results in a shift from native wet meadow vegetation to more xeric vegetation. These changes could be associated with logging, road and railroad construction, ditching/channelization, grazing, and climate change. One of the most apparent issues in meadows is the encroachment of lodgepole pine, which is reducing meadow vegetation around the perimeter. It is unknown how much meadows have changed in the Monument area since the 1850s and in the last 70 years.

There are 15 known caves and possibly as many as 100 caves, located in the Monument. Most of these caves are located in proximity to Boyden Cave. Caves are a type of groundwater-dependent ecosystem, and their formation and continuing formation is due to groundwater percolating through fractures and dissolving carbonate rocks located in the Monument. A comprehensive inventory of the caves has not been conducted, and there is high potential that groundwater dependent fauna and microorganisms exist in the cave systems.

There are 26 wells located in the Monument that draw groundwater for domestic use at campgrounds and administrative sites, including fire stations. Some of these wells are located near giant sequoia groves within the groves' ecological zones of influence (see the following table). It is unknown how much water these wells draw or if they are affecting groundwater dependent resources.

Table 106 Wells within Groves' Ecological Zones of Influence

Well Name	Groundwater-dependent Ecosystem
Boulder Creek well	Belknap Complex sequoia groves
Belknap well	Belknap Complex sequoia groves
Coy Flat well	Belknap Complex sequoia groves
Quaking Aspen well	Belknap Complex sequoia groves
Jerkey well	Small meadow
Princess Campground well	Indian Basin sequoia grove
Redwood Meadow well	Long Meadow sequoia grove
Eshom Campground well	Redwood Mountain sequoia grove
Fir Cove Campground well	3 meadows
Mountain Home Guard State Recreation Rental well	Mountain Home sequoia grove

Geological Resources

The Monument is located in the Sierra Nevada geomorphic province and includes two areas. The northern area of the Monument is located along the Kings Canyon which has the distinction of being considered deeper than the Grand Canyon. The southern area of the Monument is located along the Kern Canyon, where the Kern Canyon fault is exposed on the east side of the canyon walls. The Little Kern River and the Great Western Divide are located northeast of the junction of the Monument

boundary and the Kern Canyon. This area offers spectacular views of the Kern Plateau, Little Kern volcanic field, and the Needles. These areas offer unique areas for geologic interpretation.

The geology in the Monument consists of four major geologic groups: (1) Mesozoic granitic rocks; (2) late Paleozoic-Mesozoic Kings River metamorphic roof pendants; 3) Tertiary volcanic deposits; and (4) Quaternary glacial deposits and recent alluvial and colluvial deposits. Mesozoic granitic rocks are the dominant rock types inside the Monument boundary and consist of several plutons that are approximately 100 million years old (Moore and Nokleberg 1992). The metamorphic rocks are known as the Kings terrain and the most extensive of these areas is the Lower Kings River roof pendant and the Kaweah River and Tule River roof pendants (Nokleberg 1983). The Lower Kings River roof pendant includes the Boyden Cave roof pendant, and it is located in the north end of the Monument in the Windy Gulch area. Several caves including Boyden Cave and Church Cave are located in marbles of the Boyden Cave roof pendant. Tertiary volcanic rocks are located throughout the Monument with the most extensive outcrops located in the north end of the Monument: near Hume Lake; Indian Creek; on both sides of McKenzie Ridge; and in the southern portion of the Monument between Pyles Camp and Capital Rock. Quaternary glacial deposits are located in the north end of the Monument in Windy Gulch Grove, Evans Grove and Kennedy Grove. The glacial deposits are mostly in the form of ground moraines and lateral moraines.

Caves

The Monument contains several caves that are located primarily 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, Nokleberg 1983). 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 dissolves in Sierra Nevada waters, and if a marble outcrop is subjected to stream flow a cave can result.

The location of 15 caves is known. These include Boyden Cave, Church Cave, and several named and unnamed caves (USDA Forest Service 2004). Most of the known caves are located in the Windy Gulch Area. There are possibly 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 in Church Cave, and there are still many openings to explore and survey. Current management of Church Cave allows for limited access into the cave by authorized leaders and pre-approved parties. Each trip has to be approved with an access permit. Church Cave, Boyden Cave and several of the other caves in the Windy Gulch area are part of complex cave system that is not fully understood. A complete inventory of caves and further study needs to be conducted to fully understand the interrelationship of individual caves with each other.

Several gates are located at cave passage entrances in the Windy Gulch area. These gates control access to Church Cave, Boyden Cave and Saturday Cave. Access to Hummel Cave and Windy Cave has been blocked with gates to protect cave features. Forest Service and National Park Service personnel know of several other caves, but their locations have not been formally documented.

Some caves in the Monument are unique in that they 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. Boyden Cave has some bat habitat and bats have been observed in Boyden Cave. Boyden Cave has perennial water flowing through the cave passages and is an important source for seasonal springs in the area.

Caves in the Monument could have habitat for aquatic species. Several endemic aquatic species have been found in the adjacent Sequoia and Kings Canyon National Parks, including subterranean asellids. It is possible that similar aquatic species may be found in caves in the Monument.

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

Monitoring of caves has been minimal and has included assessments to determine direct visitor effects to Boyden Cave and Church Cave. The results of this monitoring have found damage to gates, discarding of bagged human waste left in passages, and some damage to speleothemes in Church Cave.

Domes and Spires

Several domes and spires are located throughout the Monument. These domes and spires are landforms that have developed from speroidal weathering and exfoliation of layers of rock along sheet joints, similar to layers of an onion. Spires have developed in a similar way, except spires have formed from rocks falling and collapsing along vertical joints. This process has resulted in domes and spires. These domes and spires are popular rock climbing areas and are spectacular geologic features. The most popular domes and spires are located in the southern portion of the Monument, and they include the Needles, Buck Rock, Dome Rock, Chimney Rock, Sentinel Peak, and Elephant Knob. There are many domes and spires in the Monument, too numerous to list here.

Soda and Hot Springs

Several soda springs and hot springs are located inside the Monument. There are approximately 65 springs included in the Monument GIS Database. Some of these springs may be influenced by geothermal activity and may be hot or warm. Spring inventory data has not been conducted to make this determination. There are five soda springs associated with tufa deposits, located in the Middle Fork Tule River and South Fork Tule River.

Paleontological Resources

Paleontological resources have not been identified or inventoried within the Monument, other than invertebrate fossils (crinoids and ammonites) found within metamorphic rocks in the Monument. These fossils have been used to date the age of the metamorphic rocks in the Monument. There have been no inventoried fossils in meadow sediments or caves in the Monument.

Soil Resources

The Monument has a great variety of soil types. Primarily these soils differ in their parent material, climate, topography, vegetation, and degree of development.

The soils in the Monument are primarily derived from solid bedrock, mostly igneous granite with smaller areas of metamorphic roof pendants. Topography varies widely across the Monument. The lower elevations have steep slopes and are more highly dissected into drainages and ridgelines. The higher elevations tend to have more subdued topography with gentle basins and moderate slopes. Vegetation types range from blue oak savanna at lower elevations up through chaparral and hardwood forest to expansive conifer forests at the higher elevations

(5,000 to 12,000 feet). Warmer temperatures, sufficient precipitation, and gentle topography create great conditions for soil development at the middle elevations (5,000 to 7,500 feet) within the Monument. Soils are less well developed at higher elevations (>7,500 feet) because of lower temperatures and a consequent shorter growing season. At lower elevations (<5,000 feet) a lack of precipitation and a pronounced summer drought are what limit soil development.

These differences result in a broad range of soil productivity across the Monument. In general, the most productive soils are found at middle elevations on the west side of the Great Western Divide and the main crest of the Sierra Nevada. These soils are concentrated in an elevation belt (5,000 to 7,000 feet), where favorable temperature and precipitation support ponderosa pine, west side mixed conifer, and giant sequoia vegetation types. Soils tend to be shallower, less well developed, and more coarse textured at higher elevations (7,000 to 12,000 feet) within the Monument. Soil information detailed within this section comes from the Sequoia National Forest Soil Survey (1996) unless otherwise attributed.

Soil Characteristics and Classification

Soils are generally drier in the western portions of the Monument or where they are shallow due to steep slopes. High runoff is common in these portions of the Monument 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 found in these lower 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.

At the middle elevations, especially in flatter terrain along the meadow areas and basins, soil infiltration and depth is moderate to good due to generally moderate to deep soils on granite bedrock. Where soils are deeper the water holding capacity of the soil is generally good. Soils are shallowest in the ridges from 7,000 feet and above and deepen as one descends into the foothills on the west side of the Monument. Soil infiltration and depth is poor to moderate at the higher elevations around areas of exposed bedrock monoliths and outcrops.

Soils in the northern portion of the Monument, generally in the Kings River watershed, are predominantly comprised of coarse sandy loam and sandy clay loam derived from granitic rock of the Chawanakee-Chaix and Dome-Chaix series. In the areas of caves and marble roof pendants, the soil is derived from metamorphic rock in the Hotaw-Brownlee-Rock outcrop series. The higher acidity soils are found in the region of caves in the northern portion of the Monument. This is from the formation of carbonic acid as groundwater flows through marble roof pendants. Rainwater and snowmelt disappear into fissures and later flow into underground rivers, eventually flowing into the Kings River downstream of the marble bearing formations.

Soils in the southern portion of the Monument, generally in the Tule River and Kern River watersheds, 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.

Soil Erosion Hazard Ratings

The specific soil associations with high and very high erosion potential within the Monument are shown in the following tables. The soil associations are shown with their percent in the Monument area, erosion hazard rating (EHR), predominant soil texture, and slope range. A high or very high rating means accelerated erosion can occur, and the need for erosion control measures should be evaluated during project level analysis. Soil associations with very high EHRs account for approximately five percent of the Monument.

Soil associations with very high EHRs account for approximately five percent of the Monument.

Table 107 Soil Associations with Very High Erosion Hazard within the Monument

Soil Association	Chawanakee-Chaix-Outcrop Complex	Outcrop-Cieneba-Chawanakee Complex	Toem-Outcrop-Cagwin Complex	Rock Outcrop
Soil texture	Sandy loam	Sandy loam	Sandy loam	Sandy
Slope percent	30-75	30-75	30-50	30-75

Soil associations with high EHRs account for approximately 40 percent of the Monument.

Table 108 Soil Associations with High Erosion Hazard within the Monument

Soil Association	Hotaw-Brownlee-Outcrop Complex	Chaix-Dome-Outcrop Complex	Shaver Chaix Association	Holland-Bohna Association
Erosion hazard rating	High	High	High	High
Soil texture	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Slope percent	30-75	30-75	30-50	30-50

Soils and Invasive Nonnative Species

Invasive nonnative species are often early invaders after soil disturbance. While some of these species may stabilize nutrients and soil cover, most tend to out compete and replace native vegetation. Different soil organisms predominate under different kinds of vegetation. Replacement of native plant communities with invasive nonnative species can be expected to change soil microbial populations and thus nutrient cycling processes. Many of these annuals have shallow root systems that make them poor candidates for stabilizing soil surfaces and providing erosion protection. Some invasive exotic plants such as salt cedar (*Tamarisk chinensis*, *Tamarisk spp*.) affect soil moisture and salt balance (Neill 1983).

Invasive nonnative species are controlled using chemical, biological, mechanical, and cultural methods. Chemical and biological treatment methods generally result in lower effects to soil properties because these treatments do not physically disturb the soil. This presumes that these methods have negligible effects on soil microorganisms.

Soil Conservation Practices

The correlation between management effects on soil properties and changes in long-term soil productivity has not been completely determined. However, current soil science points to three basic soil conservation practices for maintaining long-term soil productivity.

- During land management activities maintain adequate cover to protect the soil from erosion. Soil cover can include litter, duff, limbs, and other vegetative material, rock fragments, living vegetation, or applied mulches, such as straw or wood chips.
- During land management activities limit the amount of area where detrimental compaction or movement of soil occurs. This can be accomplished by:
  1. Identifying soil characteristics in the area being managed;
  2. Selecting a management method including the type of equipment appropriate to soil capabilities and limitations;

3. Timing activities appropriately; and
4. Limiting the area where the activity is allowed to occur. This practice may include repairing areas of detrimental compaction by deferring management activities or subsoiling (loosening soil layers from below with minimal mixing of surface layers).

- Maintain levels of organic matter on the soil surface and within the soil that are sufficient for the nutrient cycling and maintaining soil microorganisms. Woody material, litter, and duff are sources of soil nutrients. Woody material provides habitat for small animals, microorganisms, and insects. Many of these organisms convert nutrients in woody material, litter, and duff to forms usable by vegetation. Soil arthropods, microbes, and fungi work in concert to regulate the decomposition rates and nutrient cycling (Moldenke 1993).

Human Use, including Recreation, Scenery, and Socioeconomics

Recreation

The Sequoia National Forest and the 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. More than 28 million people live within a half-day's drive of this forest and the Monument. More than 2 million people live within an hour's drive from the forest (USDA Forest Service 2004a, 2006a, 2008a, 2008c). While all these people are potential visitors to the Monument, numerous other recreation opportunities in these areas may also attract this population base.

The Monument is located both north and south of Sequoia and Kings Canyon National Parks. Visitors to the Hume Lake District of the Sequoia National Forest and Monument must drive through the national parks, in order to access much of the district and Monument. People frequently do not recognize whether they are in the park or the forest and are confused when confronted with the different policies and types of facilities found in each place. Some people are attracted to the national park, but camp in the national forest because they prefer the forest's facilities (USDA Forest Service 2008a).

The forest/Monument sees a great deal of diversity in its visitors, although the majority of users continue to be from White/Euro-American cultures. Use by other culturally diverse user groups is prevalent and growing (although still underrepresented, compared to the overall population) (USDA Forest Service 2006a, 2008c). The forest's large numbers of visitors are multicultural, especially Hispanic and Southeast Asian, many of whom are locally based. International visitors, who are drawn to the giant sequoia groves, frequently tour the forest. Recent school studies found that people in this area speak more than 26 languages. A few of the cultures within the forest's area of influence (see the socioeconomic affected environment section in this chapter) include Native American, Hmong, Laotian, Filipino, Japanese, Chinese, and numerous cultures related to Spanish-speaking countries, ranging from Mexico to South America (USDA Forest Service 2004a, 2008a). Each of these cultures has unique demands for and values toward the use and management of the forest and Monument (USDA Forest Service 2004a).

Managers have observed that visitor use patterns vary tremendously from the north end of the forest to the south. More people from the San Francisco bay area and international visitors tend to visit the Hume Lake District than other parts of the forest. People from the Los Angeles basin visit the forest's southern portions, especially the Kern Canyon, Lake Isabella, and the Kern Plateau. The Kern Valley is marketing itself as a gateway to the Monument, which will increase the likelihood of more Monument visitation from the Los Angeles basin. Local residents tend to visit portions of the forest and Monument that are closest to their residences.

The Monument offers a rich and varied range of recreation, interpretation, and education opportunities, much of which 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 Clinton proclamation that established the Monument. As of December 31, 2000, the use of motorized vehicles was restricted to designated roads (except in the Kings River Special Management Area), and the use of non-motorized mechanized vehicles (mountain bikes) was restricted to designated roads and trails.

The Clinton proclamation also placed limitations on when land exchanges can be pursued; disposing of public land can occur only to further the protective purposes of the Monument. In addition, Monument lands have been withdrawn from new mineral extraction in accordance with the proclamation:

All Federal lands and interests in lands within the boundaries of this monument are hereby appropriated and withdrawn from entry, location, selection, sale, leasing, or other disposition under the public land laws including, but not limited to, withdrawal from locating, entry, and patent under the mining laws and from disposition under all laws relating to mineral and geothermal leasing, other than by exchange that furthers the protective purposes of the monument (Clinton 2000, page 24097).

The Small Tracts Act of 1983 (16 USC 521c-521i) is precluded from use in national monuments. This law authorizes the disposal of small parcels of land under certain circumstances. The law is useful to resolve innocent encroachments, where a private landowner places improvements on National Forest System land, but in good faith relied on an erroneous survey, title search, or other land description that indicated an encroachment would not occur. In that circumstance, the law allows the small parcel of land with the improvement to be sold to the private landowner. Without that law, the only resolution for such a situation is to remove the improvement that is encroaching on National Forest System land within the Monument.

Sustainable Recreation

Providing for the long-term sustainability of National Forest System lands and resources is essential to maintaining the quality of the recreation experience for all users. A sustainable recreation program aligns recreation opportunities with visitors' desires, expectations, and use. Sustainability recognizes that the interconnections between the environmental, economic, and social conditions underlie all program decisions. In order to sustain the benefits of outdoor recreation for present and future generations, the recreation program must address and work within all three of those areas.

Monument management needs to provide for protection of resources, through consistency with protecting the objects of interest, restoration, and developing stewardship, so that people care about the land and its resources. Conservation education is an important part of addressing this need. All project planning must consider resource sustainability; the resource legacy that will be left to the next generation needs to be considered. Recreation use needs to be integrated so as to harmonize with, protect, enhance, and sustain natural and cultural resources, including the objects of interest. Potential environmental effects need to be minimized and mitigated. Recreation facilities, including campgrounds, day use facilities, and trails, need to have minimal effect on the surrounding ecosystem, including the objects of interest (NARRP 2009).

Conservation Education and Interpretation

Interpretation, by definition, is recreational and voluntary, having the goal of enhancing the audience's experience of the subject. Traditionally, the interpretive audience consists of the recreating public visiting the forest. With the internet and new digital media, the interpretive program may be expanded to reach new, underrepresented groups and virtual visitors that will never set foot in the forest (USDA Forest Service 2008a).

Most people who benefit from resources originating in the forest and Monument, such as water and electrical power, may never visit. All are potential advocates, however. Interpretive products and services that outreach to these audiences need to be developed, in order to reveal the connection between their lives, their personal decisions, and the forest's natural resources. Especially important is the need to reach children in urban areas, to create future advocates for national forest resources (USDA Forest Service 2008a).

Some recent studies document that children are gravitating away from outdoor experiences and

toward a virtual indoor reality. Interpretive products and services need to be researched and developed to rebuild the connection between children and the Sequoia's natural and cultural resources (USDA Forest Service 2008a).

Visitors to the Sequoia are more active than the regional average, which suggests that visitors stay long enough and are likely to seek out and participate in interpretive experiences, such as guided and self-guided interpretive tours, programs, and interpretive trails (USDA Forest Service 2006a, 2008a).

Investments in interpretive products and services geared toward the activity-oriented adventure seekers (see user group descriptions in the following Connection to Place section) could be most effective in developing lifelong advocates. Some of their activities have a higher potential for affecting resources; conservation and low-impact use messages could be especially effective delivered through interpretive products (USDA Forest Service 2008a).

Partnerships with long-term community residents and agencies, in order to provide information-rich interpretive programs and materials, could help residents become aware of important resource conservation issues. Agency neighbors include the Tule River Indian Reservation, Bureau of Land Management, Mountain Home State Demonstration Forest, and Sequoia-Kings Canyon National Parks (USDA Forest Service 2008a).

A large number of children under the age of 16 visit the Sequoia with parents and grandparents. Interpretive products and services designed for children need to be incorporated into the overall program. Activity oriented interpretation that provides for adult interaction could be especially effective (USDA Forest Service 2006a, 2008a).

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 conservation education for more than a decade. Through a partnership with the National Park Service, Forest Service employees work at the Kings Canyon Visitor Center each summer. Boyden Cavern, operated under special use permit, offers guided tours through the cave. Montecito Lake 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 more than 40,000 visitors each year.

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

Interpreters are trained each summer to provide traditional campfire interpretive programs, as well as guided hikes, children's activities, and living histories. Forest Service programs directly reach an average of 7,000 visitors each year. Forest Service personnel also offer conservation education programs to schools and service organizations at local schools, fairs, and other gatherings in surrounding communities.

In the southern part of the Monument, ongoing education and interpretation opportunities include trails at Wishon Campground and the Trail of 100 Giants and programs at Quaking Aspen Campground. Beginning in 2010, the Giant Sequoia National Monument Association has been providing docent tours at Trail of 100 Giants.

All Forest Service offices offer written guides to the public at no cost, covering a wide range of topics, such as hiking and camping opportunities, safety messages, ecological education, outdoor ethics, visiting giant sequoia groves, hunting and fishing rules, and fire safety. A Sequoia visitor guide, which provides information on campgrounds, popular activities, and safety messages, regarding the entire forest, is produced in partnership with the Three Forests Interpretive Association (3FIA).

The *Interpretive Plan for the Sequoia National Forest and Giant Sequoia National Monument* (USDA Forest Service 2008a) establishes a strategy and makes recommendations for the forest's interpretive program. The interpretive plan proposes actions for a coordinated forestwide program, interpretive opportunities for visitors, and program expansion to new audiences. According to that document, the mission statement is:

> The Sequoia interpretive program will provide customer-focused products and services that build public appreciation of forest resources and support

for management within the Sequoia National Forest and Giant Sequoia National Monument.

The interpretive plan establishes forestwide interpretive goals (USDA Forest Service 2008a). The Sequoia program will provide interpretive products and services that:

- Promote public understanding of their responsibility in protecting forest ecosystems, cultural resources, and public facilities while visiting the forest;
- Stimulate local economies of communities that depend on tourism, through increased visitation, return visits, and longer visitor stays in or near the Sequoia;
- Increase public support for forest stewardship of all forest resources;
- Inform and interpret to the public the objects of interest within and the management of the Giant Sequoia National Monument;
- Reach out to underrepresented populations and youth to reestablish the relevance of national forests and grasslands to all Americans, especially urban populations, so that the Forest Service can continue "to provide great memories to this and future generations."

This interpretive plan establishes management objectives (USDA Forest Service 2008a), by outlining a coordinated forest program and interpretive strategy to:

- Incorporate current agency messages and emerging emphasis areas into interpretive products and services;
- Ensure the delivery of Forest Service messages to target markets through a variety of high quality venues and products;
- Identify priorities to ensure that limited funds for interpretation are used in the most cost-effective way;
- Build a forestwide, interdisciplinary team to support the development of high quality interpretive services and products.

According to the interpretive objectives (USDA Forest Service 2008a), visitors/the public will understand:

- The living things and elements of the forest ecosystem are interconnected;
- Humans are members of the ecosystem, and they have personal responsibility for conservation of natural resources;
- Disturbances, such as fire and flood, are essential to forest ecosystem health;
- Many valid demands for forest resources exist;
- Landscape management practices are based on scientific study, congressional perception of people's needs and desires, and judicial rulings, and, therefore, change over time.

Visitors/the public will feel:

- Inspired by the power, beauty, and complexity of natural ecosystems;
- Appreciation and respect for the Sequoia's resources and its ecosystems;
- Support and trust for Forest Service management of resources and ecosystems;
- Responsible for contributing to the conservation of public lands.

Visitors/the public will:

- Behave in an environmentally responsible manner while visiting the forest;
- Return to the forest for another visit and participate in other interpretive programs;
- Share with their family, friends, and neighbors the importance of conservation of natural resources and stewardship of public lands;
- Contribute time and support funding opportunities for forest projects and/or participate in forest activities and programs.

The interpretive plan (USDA Forest Service 2008a) establishes a central forest theme and sub-themes, around which all interpretive efforts should be structured.

Theme:The Sequoia National Forest, a public treasure, cared for and enjoyed by people, sustains and enriches lives today and in the future. A magnificent landscape, the Sequoia is a beautiful, living tapestry, woven with high mountain peaks

and meadows, cut by steep river canyons, carved from roaring whitewater, glaciers, and earthquakes, and accented by granite monoliths and forests rich in diverse and unique species.

Sub-theme:Giant sequoias are a world renowned, public treasure to be protected and enjoyed. The giant sequoia rise above the rest of the forest as one of the largest and most ancient living things on this planet, providing witness and record to ecological and cultural change, continually evoking public emotion, opinion, and action.

Sub-theme: Water is a valued resource enjoyed by the public through recreation opportunities and then collected and harnessed to provide drinking water, irrigation, and power to the central valley and desert communities. Rivers run wild from high mountains, ripple and tumble through mid-elevation conifer forests and meadows, rage through steep-walled canyons, and are contained and diverted at lower elevations.

Sub-theme: A remarkable mix of habitats supports a wide variety of plants, animals, and people, creating interwoven communities of life. Multiple bioregions from alpine to desert converge within the boundaries, making the Sequoia unique.

Sub-theme: Ecosystems in the Sequoia are dynamic and shaped by disturbance processes, such as fire, flood, and geologic forces. Landforms, fossils, fire scars, and tree rings provide clues to the story of ecological and cultural change.

The interpretive plan will help focus interpretation efforts, and implementation of this plan (USDA Forest Service 2008a) is just beginning. The interpretive plan recommends projects. Site-specific environmental analysis would need to be completed, as appropriate, before project implementation. The interpretive plan is expected to evolve over time and be supplemented, as circumstances change.

Connection to Place

People have a strong connection to place (Cordell 1999, Hill et al. 2009). This connection may come from a person's experience. Use of particular areas may be multi-generational. For example, a person may have visited a place for years, perhaps with their parents or grandparents, and want to pass along that tradition of use to their children and grandchildren. The connection may be vicarious. A person might have seen a picture of a location or read about it and consequently formed a strong attachment to that place, even though they might never actually visit it. A connection to place may be shared by cultures. For example, Native Americans often have strong attachment to particular areas for practical purposes, such as gathering basketry materials, or for spiritual reasons.

Whatever the reason, places have particular meaning for individuals, and each person can have that attachment for a different place or multiple locations. What places those are may vary with the activity, such as a favorite camping spot, or a favorite trail, or a favorite vista point. No one place can satisfy that connection for all people. The place and the reason for the attachment are as individual as the person (Cordell 1999, Hill et al. 2009).

The Monument is a unique place, highly valued by its neighbors, visitors, and distant admirers. Giant sequoias are a symbolic vestige of the wild Sierra, evoking a deep emotional response, even from people who have never experienced their grandeur firsthand (USDA Forest Service 2008a, 2008c).

Recreation Niche

The Sequoia National Forest is best known for particular attributes or settings, which is the forest's niche (NARRP 2009) for recreation (USDA Forest Service 2008c). Giant sequoias are a key attribute of this forest and Monument. Indeed the Sequoia is the only national forest in the nation that is named for a tree.

The Sequoia's landscape is as spectacular as its trees. Soaring granite monoliths, glacier-carved canyons, caves, roaring world-class whitewater, and scenic lakes and reservoirs await visitors' discovery at the Sierra Nevada's southern reach. Elevations range from about 1,000 feet in the lower canyons to peaks over 10,000 feet in the Monument, with views to higher peaks on the Sierra crest, providing visitors with spectacular views in a dramatic range of settings. These mountains stand in contrast to California's San Joaquin Valley, providing cool relief for families

from the scorching heat of summer and welcome blue skies and sun during the cold fog of winter. From the dramatic Kings Canyon, through the ancient giant sequoias, down to the mighty Kern River, the Sequoia National Forest, including the Giant Sequoia National Monument, features diverse settings and special places (USDA Forest Service 2008a, 2008c).

How well those settings fit with what the forest is known for is called niche conformance. However, just because a setting is noted as having low or moderate niche conformance does not mean that those settings are not important to individuals; their own connection to place may be strongest for some of those locations.

The following settings (USDA Forest Service 2008c) can be found within the Giant Sequoia National Monument:

- **Rivers and Lakes:** Water is the magnet, featuring world-class whitewater and attracting family use at Hume Lake and the Kern, Kings, and Tule rivers (high niche conformance);
- **Scenic Routes:** These routes offer great views through a range of life zones, providing access to adventure and discovery (high niche conformance);
- **Great Western Divide:** Giant sequoias and dispersed recreation (high niche conformance);
- **Lloyd Meadow:** Spectacular Kern Canyon views; rock climbing on granite formations; dispersed recreation; giant sequoias (high niche conformance);
- **Hume High Elevation:** Overnight destination with giant sequoia logging history; wilderness access; intertwined with national parks (high niche conformance);
- **Wildlands:** Includes parts of two wildernesses in the Monument and a few other areas, offering solitude and scenic backdrop (moderate niche conformance);
- **Front Country:** Year-round access; desirable in spring (wildflowers) and fall (hunting); very hot in summer; chaparral, oak to mixed conifer (low niche conformance);
- **Kings River Special Management Area OHV:** Off-highway vehicle (OHV) use in the Monument, authorized by law; this steep canyon offers motorized trails with solitude (low niche conformance).

The following settings are not within the Monument: Kern Plateau, Greenhorn, Breckenridge, and Piutes. The settings are displayed on the following maps.

The diverse settings offer a wide range of opportunities for visitors year-round. Water is a magnet, attracting people to recreate; areas with water attract more visitors than areas without it. This forest is an overnight destination for visitors, whether they come from nearby or far away. Family-oriented overnight activities are most popular and in highest demand, with higher than average participation by children and elderly people. During their stays, visitors pursue a variety of activities; viewing scenery and driving for pleasure, hiking, hunting, group camping and picnicking, boating, fishing, and whitewater rafting are popular (USDA Forest Service 2006a, 2008a, 2008b, 2008c).

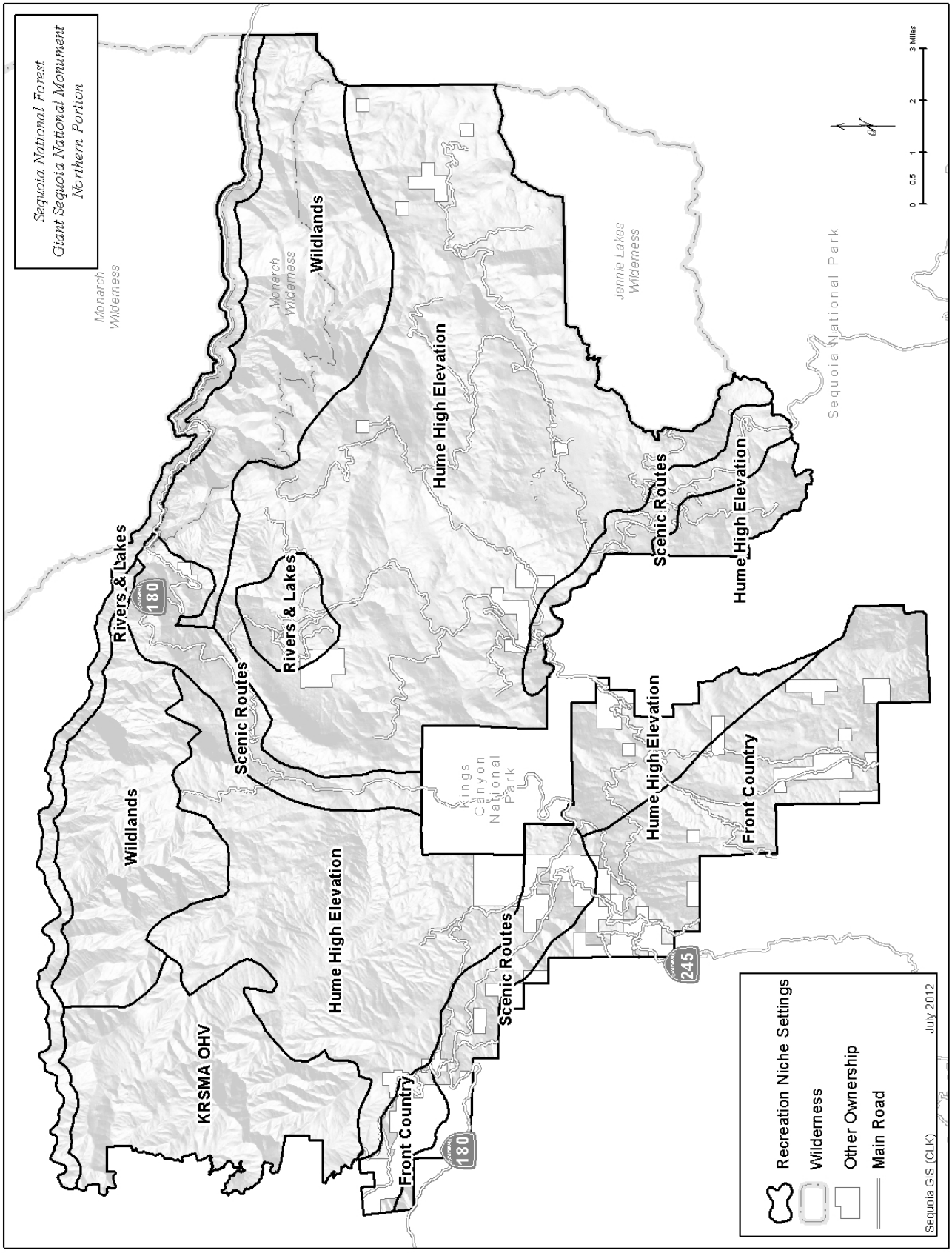
The following table contains more information about each of the settings that are located within the Monument.

In developing the niche, each of the forest's 12 settings was evaluated by forest personnel against a combination of criteria, reflecting physical characteristics, visitor use, and market data (USDA Forest Service 2006a). These criteria were viewed by forest personnel as the essence of what makes the Sequoia the special place that it is. Each setting was examined to see how well it met the following five criteria:

- Whether or not giant sequoias exist;
- Whether or not water exists (streams or lakes);
- Whether or not the setting is popular or attractive for family use;
- Whether or not the setting offers opportunities for overnight use; and
- Whether or not viewing scenery is a reason people visit the setting.

These settings are further divided into places, which are described in the scenery resources affected environment section in this chapter.

Map 19 Recreation Niche Settings for the Northern Portion of the Monument



Map 20 Recreation Niche Settings for the Southern Portion of the Monument

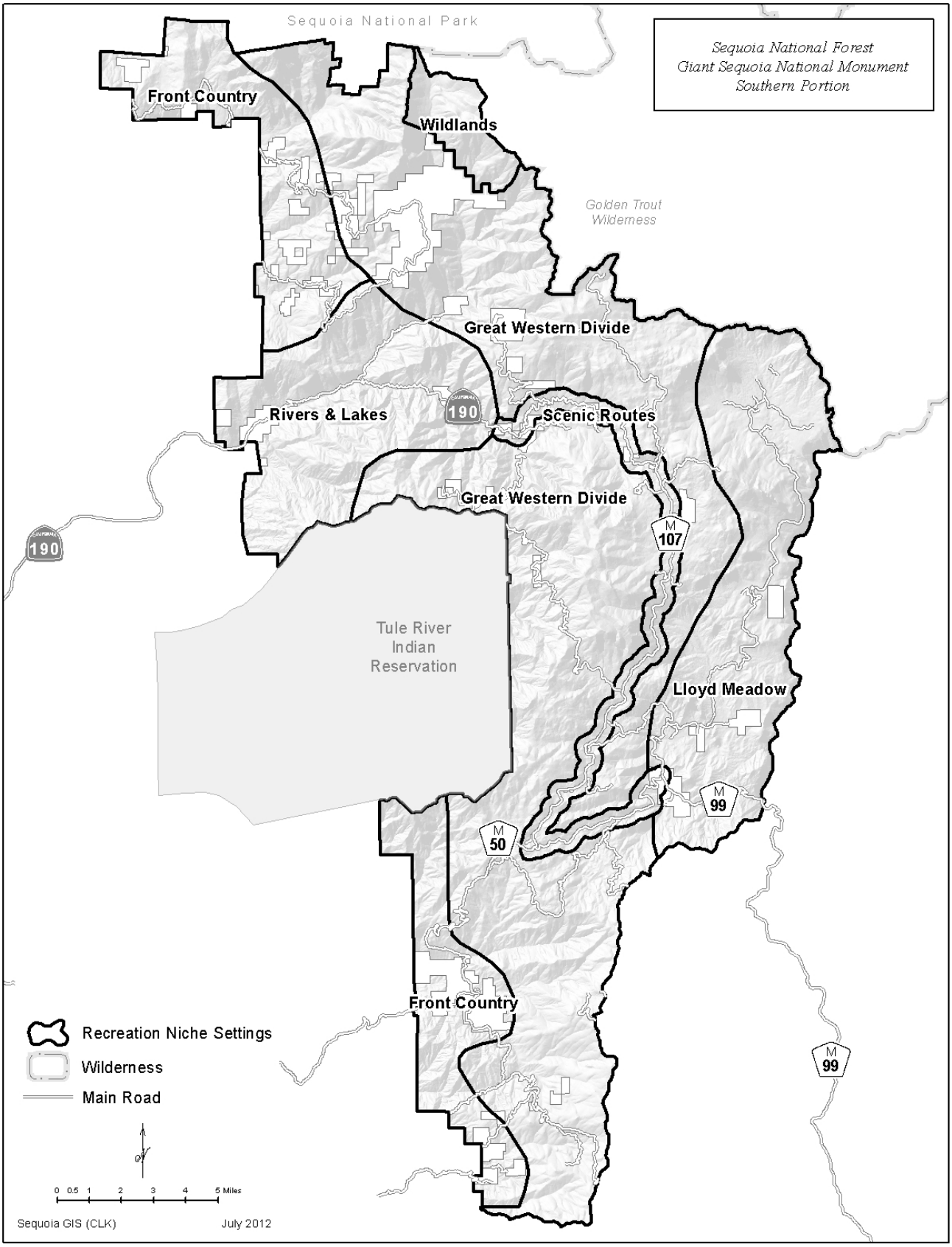


Table 109 Recreation Niche Settings

Name of Setting	Niche Conformance[1]	Function/Theme	Key Example Activities	Example Site Types
Rivers and Lakes	High	Water is the magnet. Escape the heat.	Sustainable water related activities	Water access, campgrounds, day use, rental cabins.
Scenic Routes	High	Access, touring, great views with range of life zones	Driving for pleasure, scenery, hiking, viewing giant sequoia.	Observation, campgrounds, day use, trailheads (includes winter).
Great Western Divide	High	Giant sequoia and heat escape.	Hands-on giant sequoia experience; dispersed use.	Trailheads, rental cabins, campgrounds.
Lloyd Meadow	High	Spectacular Kern Canyon views.	Rock climbing, dispersed use.	Campgrounds, trailheads.
Hume High Elevation	High	Giant sequoia story, national park connection.	Overnight destination.	Campgrounds, horse camps, trailheads, rental cabins.
Wildlands	Moderate	Wilderness and other remote, isolated areas; some giant sequoia.	Hiking, backpacking, stock use.	No developed sites.
Front Country	Low	Year-round access; wildflower viewing.	Overnight camping, dog running, backyard access.	Campgrounds, day use, rental cabins.
Kings River Special Management Area OHV	Low	OHV routes with steep canyon views; remote, isolated.	Sustain/protect Native American values.	No developed sites.

1. Niche conformance indicates which settings best support the recreation niche.

User Groups

One way that visitors pick their destinations is according to the activities they prefer. The Sequoia National Forest's prevalent user groups could be classified according to the following descriptions (USDA Forest Service 2008a).

Water players: This user group crosses a wide variety of ethnic, age, income groups, and skill levels, sharing their attraction to water. They are drawn to the Rivers and Lakes recreation niche setting. Their toys (equipment) or preferred activity dictate which water body they visit.

Forest experience seekers: Generally attracted to the higher elevations to escape the heat of summer, the congestion of the city, or the complexities of daily life, this user group is looking for a forest setting to relax and unwind. They are attracted to developed sites, as well as dispersed camping areas.

Sightseeing tourists: Kings Canyon, the giant sequoia groves, scenery, and wildlife associated with natural areas attract this user group. These visitors are often overflow from the national parks and come with higher expectations for services and facilities.

Activity oriented adventure seekers: These adventuresome recreationists include mountaineers, backpackers, stock users, OHV users, over snow vehicle (OSV) users, rock climbers, whitewater rafters, kayakers, cross-country skiers, snow trekkers, and geocachers looking for new and challenging experiences. These visitors usually have higher disposable incomes, are well-educated, and tend to value and be in good health and physical condition. Outfitters and guides provide services to many of these visitors for backcountry pack trips, whitewater rafting, fishing, and hunting excursions.

These experiences can be once or twice in a lifetime adventures and are potentially life or attitude changing.

Most wilderness use is overnight by either stock users or backpackers. Backpackers are generally physically fit, younger, have enough income to acquire equipment, and are fairly well-educated. Wilderness stock users generally have high disposable incomes. Some may ride horses as their preferred mode of travel. Others may have been backpackers in their youth, but as they age, are no longer able or willing to access their favorite wilderness destinations on foot. Although the Sequoia has six designated wilderness areas (portions of two, the Monarch and Golden Trout, are in the Monument), visitor demand is not high (compared to recreation at developed sites) and not a large focus of the recreation program.

Social gatherers: Attracted to areas and facilities large enough to support group activity, many are attracted to the Rivers and Lakes setting, with developed group sites that are easily accessible from the highway or dispersed camping opportunities. These people visit the forest to have a good time with friends or family. Church groups, fraternities, family reunions, informal social groups, and clubs are among this user group. Some of these groups have a long tradition of using particular sites and a strong attachment to them.

Hunter/gatherers: This user group includes anglers, hunters, and those visiting to collect forest products, such as berries, foliage, rocks, or gold. Some of these groups have a long tradition of use at particular sites (e.g., traditional hunting camps) and a strong attachment to them.

Students/enthusiasts: When visiting the forest, they often come in groups from elder hostels, special interest organizations, and schools. These groups are looking for information and education rich experiences.

Virtual visitor: As the Sequoia is steward of the largest concentration of giant sequoia groves in the world, the forest has a great number of committed admirers and interest groups, some of whom want to learn more about these awe-inspiring trees. Books, television, websites, and school programs are all avenues for these persons to experience the resources of the Sequoia. The internet introduces many persons to the Sequoia, turning many non-visitors into virtual visitors. Many of these people may visit the forest after viewing the forest website, and others use the website to get information to plan their visits.

Neighbors: Neighbors include residents of small communities, such as Kernville, Lake Isabella, Pinehurst, and Camp Nelson, who live within or adjacent to the forest boundary. Some depend on the national forest for their livelihoods. These communities are increasing in size, as retirees escape urban life and seek lower costs of living by moving into these rural areas. Many of these new residents have little or no experience with more natural landscapes.

Traditional users: This user group includes people who belong to groups or families with a long history of using a particular area of the forest. Some of these uses began prior to the establishment of the Forest Service. These people care deeply about the area and about maintaining access rights to continue their use of these areas. Many are older and request vehicle access to areas they may have previously accessed by foot. This group includes generational use by Native Americans, ranchers with grazing allotments, recreation residence permittees, and people with family traditions in hunting, fishing, and other activities.

Underrepresented populations: Only a small portion of the population within a 2½-hour drive of the Sequoia visits the forest each year. The portion that does visit is not really representative of the diverse population in that area. Underrepresented ethnic groups are Hispanic, African American, and Asian, with the greatest disparity in the groups claiming to be Hispanic or Latino and African American. Lower income groups, especially children from inner city or urban populations, are also underrepresented among forest visitors. Barriers to visiting the Sequoia for underrepresented groups include:

No tradition of use: Populations new to the United States or lacking social traditions in wildland settings are less likely to be aware of the recreation opportunities and benefits offered on national forest lands.

Language and communication styles: The Forest Service traditionally uses static, written formats to communicate with the public, in the form of brochures and signs. In many homes, English is not the primary language. However, most groups traveling to the forest will have at least one child or member who speaks English and serves as interpreter for the group. In the case of the Hmong culture, their language has not been a written language until recently.

Travel distances: Travel costs for lower income groups limit their ability to visit the forest. Most trips to the Sequoia involve at least one overnight stay, because of the time needed to travel to a forest destination. Developed recreation sites and dispersed recreation areas, especially those with a source of water (lake or stream) close to population centers, are popular with lower income groups.

Facilities and services outdated/designed for traditional visitors/in poor repair: Areas that provide an opportunity for larger social gatherings for extended families are in demand with many culturally diverse, nontraditional forest users. The typical family campground that was developed in the 1960s, with individual campsites designed to accommodate six people in tents or small camper trailers, no longer suits the style of recreation that many people seek to experience.

Recreation Opportunities

This section describes existing recreation opportunities (supply) and attractions in both the northern and southern portions of the Monument.

The Forest Plan assigned recreation opportunity spectrum (ROS) classes to all lands within the Sequoia National Forest. In the Monument, 11 percent (35,860 acres) is in the semi-primitive non-motorized class; 12 percent (39,570 acres) is in the semi-primitive motorized class; 76 percent (249,830 acres) is in the roaded natural class; and 1 percent (3,060 acres) is in the rural class. No areas in the primitive or urban classes are located in the Monument.

In the Monument, many developed campgrounds and areas with little development, known as concentrated use areas or dispersed areas, provide the full range of camping experiences. Trails offer hiking, backpacking, horseback riding, and mountain biking. The rivers, lakes, and reservoirs offer boating, fishing, swimming, whitewater rafting, and kayaking. In the winter, high elevations accommodate snow play, cross-country skiing, snowshoeing, and snowmobiling.

Developed recreation facilities in the Monument encompass 660 acres and provide a variety of opportunities for the recreating public. The Monument has 21 family campgrounds, with approximately 500 campsites, and seven group campgrounds. The total capacity (also called persons at one time, or PAOT) of the family sites is 2,806, while the group sites have a PAOT of 565. Six picnic areas have 53 sites.

A number of recreation facilities are located within the current administrative boundaries of giant sequoia groves. These include four family campgrounds (Belknap, Redwood Meadow, Eshom, and Princess) with 144 campsites; two interpretive trails, Indian Basin Trail and Trail of 100 Giants (with five picnic sites and 15 parking spaces); and about 23 miles of trail. Also located in groves are seven trailheads (Chicago Stump, Boole Tree, Cherry Gap, Evans, Little Boulder, Freeman Creek, and Needles); two recreation residence tracts (McIntyre and Soda Springs); one organizational camp (Quaker Meadow Camp); and one recreation rental cabin (Mountain Home). One old 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. The northern portion of the Monument has 43 concentrated use areas, with an estimated 8,900 use days. The southern portion has 80 concentrated use areas, with about 17,700 use days.

Within the Monument, 196 miles of system trails, including 12 miles of the Summit National Recreation Trail, are available for trail users. Twelve developed trailheads offer parking, information, and restrooms; 10 other trailheads only have parking for trail users. Two pack stations provide outfitter-guide services.

Trails in the Kings River Special Management Area and designated roads in the rest of the Monument offer OHV riding experiences. A total of approximately 265 miles of road are designated for OHV use in the northern portion of the Monument, including 3.8 miles of motorcycle routes, 25 miles of challenging 4-wheel drive road that are also available for motorcycles and all-terrain vehicles, and high-clearance unpaved roads. The southern portion has OHV recreation opportunities that offer approximately 250 miles of high-clearance unpaved, designated roads.

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.

Part or all of three giant sequoia groves are in the Monarch Wilderness and Agnew Roadless Area: Agnew, Monarch, and Evans Complex. The Golden Trout Wilderness contains part or all of three other groves: Maggie Mountain, Upper Tule, and Middle Tule.

Typically, recreation facilities within the Monument were built 40 to 50 years ago. Many are outdated and are not equipped to handle today's visitors or their equipment. Although an effort is being made to upgrade facilities, reconstruction has been limited, due to funding availability. 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.

Group and family campground occupancy rates (percent of sites occupied) average 75 percent to 85 percent on peak weekends and about 25 percent to 30 percent on summer weekdays. For day use sites, percentages range from about 30 percent to 85 percent. For the northern portion of the Monument, most facilities have 100 percent occupancy on peak use days, which is partially a reflection of their proximity to Sequoia and Kings Canyon National Parks. Once occupancy reaches 60 percent, campers are likely to find that adjacent campsites are occupied, and some people will begin to feel crowded.

Within the Monument, three resorts and nine organizational camps, authorized under special use permits, offer additional opportunities for visitors. One hundred forty-eight 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 Native American gatherings. Five recreation rental cabins, owned by the Forest Service, are available for use by the public; three additional cabins, recently acquired by the Forest Service, will also soon be available for rent. Sequoia and Kings Canyon National Parks border the northern portion of the Monument, and visitors to these parks often use Monument facilities.

Northern Portion

The Hume Lake Ranger District forms the northern portion of the Monument. The entire district is very heavily used, with most campsites being fully occupied during the heavy use season from mid-June through early September. Users come from many parts of the country, with a substantial number of them interested in visiting the adjacent Sequoia and Kings Canyon National Parks. However, the majority of visitors come from central and southern California. Eshom Campground, in particular, has an established clientele that has used the area for decades.

In the Stony Creek and Big Meadows areas at the higher elevations in the Hume Lake District, activities include fishing, hiking, horseback riding, and sightseeing. Trailheads lead into the Jennie Lakes Wilderness and Monarch Wilderness, as well as the backcountry of Kings Canyon National Park. A portion of the Monarch Wilderness is located in the Monument.

Activities in the Hume Lake area include camping, picnicking, sightseeing, fishing, swimming, and boating. The major attractions for this area are giant sequoia groves and Hume Lake, which is an 90-acre lake that is heavily used by swimmers, anglers, and boaters. Hume Lake Christian Conference is privately

owned, adjacent to Hume Lake, and is the largest Christian camp in the United States. The Christian Conference rents canoes, paddleboats, and rowboats to the general public.

The greatest amount of water-oriented recreation occurs at Hume Lake. Non-motorized boating, fishing, and swimming are the primary uses. Recreation development around the lake includes 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 Ten Mile, Landslide, and Logger Flat campgrounds along Tenmile Creek; Eshom Campground along Eshom Creek; Upper Stony Creek and 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. Cedarbrook Picnic Area is along Mill Creek near Pinehurst.

About 24,000 acres of the Kings River Special Management Area (KRSMA) 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, archaeological, 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 Clinton proclamation that created the Monument which 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 3.8 miles of trails.

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 forest) and is an eligible state scenic highway. The scenic byway nomination report states that this travel corridor is internationally significant with two extraordinary features: towering giant sequoia trees and Kings Canyon.

Winter recreation activities are primarily snowmobiling, cross-country skiing, snow play, and some snowshoeing. In the northern portion of the Monument, 39 miles of marked roads are available for over-snow vehicles, 21 of which are groomed, and an additional 50 miles of unmarked roadbeds are open to snowmobiles. These roads 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 it 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 both snowmobilers and skiers. Montecito Lake Resort, authorized under special use permit, offers 20 miles of groomed trails used exclusively by cross-country skiers. Snow play typically occurs near winter trailheads and road turnouts opened by plows.

Southern Portion

The Western Divide Ranger District forms the southern portion of the Giant Sequoia National Monument. The Middle Fork Tule River and North Fork Middle Fork Tule River are major attractions with year-round flow. The river draws recreationists interested in many activities during the high use season and primarily sightseers, hikers, and anglers during the remainder of the year. Visual observation indicates that a very large percentage of visitors to the Tule River Canyon are Hispanic and Southeast Asian.

The major attractions within the Western Divide District include giant sequoia groves, the Needles, Dome Rock, trails, including the Trail of 100 Giants in the Long Meadow Grove of giant sequoias, and Tobias and Mule Peak lookouts. The Middle Fork Tule River, Peppermint Creek, White River, and

the other small streams in the area are stocked by the California Department of Fish and Game during the spring and early summer months, depending on stream conditions and temperatures. Major attractions near this area include the privately owned California Hot Springs Resort, the North Fork of the Kern Wild and Scenic River, and the Golden Trout Wilderness, a small portion of which is located in the Monument.

Major activities within the Western Divide District include camping, hiking, viewing scenery and wildlife, driving for pleasure, mountain biking, rock climbing, nature study, fishing, and hunting in the fall. Winter activities include snow play, snowmobiling, and cross-country skiing.

Many campgrounds and picnic sites are located near streams 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. As proposed through the recreation facility analysis process, Redwood Meadow Campground is proposed to be converted to day use to accommodate the need for more parking and access to the Trail of 100 Giants, and Leavis Flat Campground is proposed to be decommissioned.

Winter recreation in the southern portion of the Monument features 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 state highway 190 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 four miles of ungroomed ski trails in the Quaking Aspen/Ponderosa area and the Parker Pass area. Snow play typically occurs wherever winter trailheads are located and road turnouts are opened by plows.

Partnerships

The national forest and Monument maintain numerous and diverse partnerships for the mutual benefit of the forest and its partners and will work to expand these partnerships and to develop new ones. The Forest Service is extremely grateful to all its partners, without whom the forest would not be able to function. Not all of these partnerships involve money. Some provide in-kind contributions, such as labor, equipment, supplies, or services; others involve collaboration toward a mutual goal. Without partnerships, the forest would not be able to provide nearly the variety or quality of recreation opportunities that these partnerships enable (USDA Forest Service 2004a).

Recreation Demand Analysis Summary

A recreation demand analysis was prepared for the Monument for use in this planning process and is included as Appendix D; the surveys and references cited are noted in that appendix. Various sources of information (listed in the literature cited section and further described in the appendix) are examined in that analysis. Useful information includes lifestyle, demographic, and economic trends, all of which can affect how or if people recreate, as well as where and when (Cordell 1999, Sheffield 2005, USDA Forest Service 2006a); race, ethnicity, and gender also affect recreation participation (Cordell 1999). Recreation activity and participation trends are examined. Studies at various scales, covering the nation, California, or portions of the state, are reviewed for their applicability to the Monument. Some survey information is specific to the Sequoia National Forest, as a whole, and others provide insight to particular aspects of the Monument, such as visitor information. No one information source provides recreation participation information for the entire Monument (although research [Chavez] was recently completed, which provides information on six day use sites in the Monument; research on a seventh site is being conducted in summer 2011). Consequently, information must be extrapolated from these other sources and applied to the Monument; the results are inherently uncertain.

The various surveys cited provide a snapshot in time. The results are not directly comparable, because the surveys were conducted at different times, different sampling techniques were used, and different questions were asked. Yet, even though the surveys yield different results, they do provide insight to help determine future recreation demand in the Monument. Despite what the science indicates, predicting the future is uncertain.

This recreation demand analysis is not a needs assessment that compares recreation demand with the existing Monument supply of recreation opportunities and use patterns. A gap analysis (demand minus supply equals needs) was not performed, because such an analysis yields simplistic results that are not reflective of the complexities inherent in predicting human behavior or the uncertainties associated with predicting changing circumstances in the future. A summary of the recreation demand analysis appears here.

The Monument is an overnight destination, rather than a day use destination. Even visitors from local origins tend to stay overnight (Tierney et al. 2002). For many visitors (except for those who live in communities within or adjacent to the forest), the Monument does not provide a quick, out-the-back-door day use experience. Overnight visitors are camping more in developed sites than they are primitive camping (USDA Forest Service 2006a, 2008a, 2008b, 2008c) (although dispersed camping in concentrated use areas, which is not really primitive, is also popular, based on visual observation).

With the Monument's spectacular scenery, viewing it is very popular, resulting in a higher percentage of visitors participating in this activity in the forest than the regional average. Escape from the heat is a primary motivation of many visitors to the Monument, so that higher elevations are popular. Water is a magnet, attracting people to recreate; areas with water attract more visitors than areas without it. In the Monument, water provides an additional escape from the heat, and water-related activities are popular (USDA Forest Service 2006a, 2008a, 2008b, 2008c).

The Sequoia is a very family-oriented forest, with a higher percentage of use by both young people and persons over the age of 61 than the regional average. Use by culturally diverse user groups, especially Hispanics and Asian, is prevalent and growing, although not well represented compared to the population base (USDA Forest Service 2006a, 2008a, 2008b, 2008c).

In the next 25 years, the population in the Sequoia's market area is projected to increase 38 percent, and this increase will place more demands on the Monument's resources. Conservation and resource stewardship will be increasingly important for sustainable recreation, especially for more environmentally sensitive areas. Unmanaged recreation has the potential to damage forest resources when careless or uninformed visitors do not follow regulations for responsible use. Effective interpretive techniques and public information services can help to inform and motivate the public, both visitors and non-visitors, into becoming stewards of the forest (California State Parks 2002, NARRP 2009, USDA Forest Service 2006a, 2008a, 2008c).

Future changes in the state's population will affect outdoor recreation more than anything else. The population is growing rapidly, becoming more culturally and racially diverse, and aging (Cordell 1999, Sheffield 2005). Even if outdoor recreation participation rates are static or decline, the sheer numbers of people participating will increase, due to the increase in population (Sheffield 2005). Families with children, youth, and seniors are large markets for outdoor recreation and will grow (Sheffield 2005, USDA Forest Service 2006a, 2008c), particularly in southern and central California urban areas (Sheffield 2005). This area of the Sierra Nevada will experience the largest population growth in nearby urban areas, particularly Bakersfield and Fresno, during the next few decades (Duane 1996). Most Californians believe that outdoor recreation areas and facilities are "important" or "very important" to their quality of life (California State Parks 1998, 2003). The result will be increasing recreation demand.

The diversity of recreationists will continue to increase, as the American population becomes more diverse and international visitors increase (Cordell 1999). The greatest growth is projected to be in Hispanic and Asian populations (California State Parks 2009, Sheffield 2005), and their use is projected to increase dramatically in the next 25 years. Interpretation methods designed to reach these culturally diverse users need to communicate

important resource issues, solicit commitment to conservation, and encourage appropriate behaviors (APPL 2004, California State Parks 2009, USDA Forest Service 2008a).

Hispanic recreation participation patterns are somewhat different from predominantly Anglo populations (California State Parks 1998, 2003, Sheffield 2005). One example is in picnicking; Hispanics tend to participate with larger groups, arrive earlier in the day, and spend quite a bit of time in food preparation (Sheffield 2005).

Group facilities for both camping and day use are important and will become even more important in the future, as larger "families" want to recreate together (California State Parks 1998, 2003, 2009, Sheffield 2005, USDA Forest Service 2006a). What constitutes a family has changed over the years because of changing demographics. Where, in the past, a family was viewed as a mother, father, and their children, today a family may be multi-generational and may or may not be related by blood or marriage (Sheffield 2005). Research (California State Parks 1998, 2003, 2009, Sheffield 2005, USDA Forest Service 2006a) has shown that people often want to recreate in groups (one study showed an average of 11 people).

As the baby boom generation ages, the proportion of the population that is elderly will increase. The attitude is generally that leisure time is not a privilege, but a right earned by years of hard work, and seniors have more free time available for activities. Improved health care, greater emphasis on maintaining lifelong physical fitness, and a changing image of what "old" people can or cannot do are also factors that contribute to greater participation in outdoor recreation and leisure activities than previous generations (California State Parks 2002, 2009, Cordell 1999, USDA Forest Service 2006a).

Baby boomers are a diverse group. Some people are interested in continuing education and have a strong desire to learn about nature, wildlife viewing, and history and culture, for example. They will also be drawn to be active in conservation and heritage causes. Some are interested in high-risk activities, and a number of people over the age of 40 are beginning such activities as rock climbing (California State Parks 1998, 2002, Sheffield 2005, USDA Forest Service 2006a). Not all older people will increase their recreation participation, however, as health concerns and mobility problems will affect their ability and desire to participate.

Baby boomers and older adults want more amenities and improved access, while younger adults want more immediate and lively information and access, drawn by opportunities for excitement, such as extreme sports and adventure recreation (Sheffield 2005). People expect instantaneous information, thanks to the internet, so that they can customize their recreation experiences, as well as have virtual experiences (APPL 2004, Cordell 1999, Sheffield 2005, USDA Forest Service 2008a).

People have a continuing desire to get away from the stress of everyday life and to enjoy the outdoors (California State Parks 1998, 2002, 2003, 2009). Being able to relax is the most important motivation for outdoor recreation participation for most people. Viewing scenic beauty is important to people's enjoyment of their favorite activities. Americans see outdoor recreation as a potent tool in attacking societal problems. Most people feel that recreation helps improve people's health, helps reduce crime and juvenile delinquency, and creates jobs and helps the economy. Those who participate in outdoor recreation are markedly more content with their lives, in general, their families, their jobs, and their physical well-being (California State Parks 1998, 2002, 2003, 2009, Cordell 1999, Hill et al. 2009, Sheffield 2005, 2008).

People will continue to have an increasing number of choices on how to spend their leisure time. The Monument faces competition from a myriad of leisure opportunities, both at home and away. At the same time, the public is developing higher expectations for quality and service. Convenient products and services that give people more time will continue to proliferate. The importance of convenience will extend to all areas of life, even recreation, as close-to-home recreation will increase in importance. Visitors will be interested in a diversity of activities and conveniences/amenities (APPL 2004, Hill et al. 2009, Sheffield 2005).

Income can affect participation (California State Parks 2009, Cordell 1999). An example is activities that have a high cost investment in recreation equipment. Some researchers have also noticed that participation is lower in households with very low or very high

incomes (California State Parks 1998). Economic recession or prosperity also affects participation patterns, as equipment sales, travel distance, travel frequency, and activity choices can all be affected by the amount of disposable income available (Cordell et al. 2009b). Whether by choice or economic necessity, two income households with or without children have become the rule, although with the current recession, many people are unemployed.

The recession in the economy is a prime driver of what is currently occurring (Cordell et al. 2009b). High rates of unemployment continue. Personal income is down. Although the cost of gasoline has gone down significantly since 2008 (the price has been creeping up again), the unprecedented high gas prices of 2008 drastically affected the way that people drove. Gasoline costs may have negative or positive effects on Monument visitation; some people visit as a closer-to-home travel option than what they would normally choose, while others choose not to visit or visit less often. Gas prices also affect the activities that people choose. Although people are not driving more miles, overall, the average time spent in transit has increased, indicating an increase in congestion.

Crowding can affect how and when people visit an area (Cordell 1999). 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 recreation 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 (California State Parks 1998, 2002, 2003). Within the Monument, some areas are filled to capacity, at times, especially on holiday weekends.

Recreation is a prime lure for attracting visitors from overseas, and it is a growing factor in travel and residency patterns (California State Parks 2002, Hill et al. 2009). Natural resources and outdoor recreation play an important role in tourism, as they provide the settings for travel activities and experiences (California State Parks 2002, Cordell 1999, Hill et al. 2009). The availability and proximity of recreation opportunities affect how much people recreate, as well as their choice of activities. The multinational forest users have different expectations for their recreation experiences than those of the traditional forest user. Multinational visitors also provide a challenge in effective communications (Cordell 1999). The Monument already sees a substantial number of international visitors (USDA Forest Service 2008a), and they are expected to increase in the future.

Participation in some already popular activities will continue to increase, along with the state's population. The number of people at the lower end of the income scale is increasing disproportionately as the state's population grows. People with lower income rely more on public recreation facilities (California State Parks 2009). Many of these popular activities can be done without much equipment, are relatively low cost, and can be enjoyed by people with a variety of skill levels, without a great deal of physical exertion (California State Parks 1998, 2003, 2009, Sheffield 2005). Most of these activity types remain popular with Americans past the age of 60 (California State Parks 1998, Cordell 1999, Cordell and Betz 2005 [cited in Sheffield 2008]). Many activities have a strong social component, drawing families to participate (Sheffield 2005), and are especially fitting for the Monument with its family orientation (USDA Forest Service 2006a, 2008c).

Many activities with the largest growth rates (although participation is quite small, compared to the most popular activities) are physically demanding and may require specialized equipment and/or skills, such as kayaking, snowboarding, backpacking, and mountain climbing. These growth rates indicate a shift in the mix of activities that may be occurring (Cordell 2004, Cordell et al. 2009b, Sheffield 2005). The variety of activities is expected to continue to grow (Cordell 1999, Sheffield 2005). Some will be determined to be appropriate for the Monument, and some will not. As more recreation uses occur, they must compete with existing uses for a limited land base (Cordell 1999, NARRP 2009, Sheffield 2005).

People have a continuing interest in adventure activities, such as mountain biking, backpacking, rock climbing, and hang gliding. High-tech activities, such as geocaching, are continuing, and technological advances continue to be made in recreation equipment for various activities, such as skiing, snow shoeing, and mountain biking (California State Parks 2002, 2009, Sheffield 2005).

Climate change is evident, as the number of frost-free days is increasing (Cordell et al. 2009b). The snow pack is expected to melt earlier in the season, particularly affecting where and when winter recreation activities occur (Morris and Walls 2009). (For a more detailed description of climate change, see the Effects on Air Resources section in Chapter 4 of the final EIS.)

Recreation facilities and services need to be made more relevant for the state's rapidly changing population segments, including the elderly, youth, single-parent families, ethnic groups, new immigrants, and persons with disabilities (California State Parks 2002). To meet these needs, more group picnic areas and camping opportunities are needed (California State Parks 1998, 2003, 2009, USDA Forest Service 2006a). In addition, camping alternatives, such as cabins, tent cabins, yurts, and other affordable lodging should be provided (California State Parks 2009).

The following activities are expected to be primary in the next 10 years for the Monument (not in priority order): relaxing/escaping heat; hiking; viewing/photographing natural features/wildlife; driving for pleasure/sightseeing/driving through natural scenery; fishing and hunting (although many studies show the demand for hunting to be decreasing [California State Parks 1998, 2002, Cordell 1999]); snowmobiling; biking; family gatherings; picnicking/group picnicking; developed camping/group developed camping; motorized and non-motorized water travel; swimming/water play; horseback riding; rock climbing; walking; nature center/nature study; and visiting historic/prehistoric sites. A range of camping opportunities is desired, from more developed campgrounds with flush toilets, hot showers, and food lockers, to more basic campgrounds with picnic tables, cold water, and vault toilets. The list of activities was primarily drawn from Sequoia National Forest market data (USDA Forest Service 2006a), supplemented by other sources examined in the recreation demand analysis (California State Parks 1998, 2002, 2003, 2009, Cordell 1999, 2004, Cordell et al. 2004, 2009b, 2009c, Kocis et al. 2004, Sheffield 2005, 2008).

Various studies have found that recreationists are generally satisfied with their available recreation opportunities (California State Parks 1998, 2002, 2003, 2009, Kocis et al. 2004, USDA Forest Service 2006a). However, they continue to be concerned with the availability of clean restrooms, safe drinking water, and information (directional signs, information on conditions and hazards, and interpretive information). Safety and security are of more concern in some areas and among some populations (Cordell 1999, Sheffield 2005).

Just as people have a variety of reasons for visiting, they also have numerous reasons for not visiting. Time constraints, lack of interest, lack of transportation, health or physical limitations, family needs, no one to go with, distance, and lack of money, as well as fear of the unknown or perceived crowding, are some of the factors that could affect a person's recreation participation (California State Parks 1998, 2002, 2003, 2009, Cordell 1999, Crano et al. n.d., Sheffield 2005). A lack of information about recreation opportunities has often been cited as one of the reasons, more frequently by people of color. Using media that are more likely to be effective with particular groups and emphasizing activities that are more likely to be of interest to those groups may more effectively reach culturally diverse people (Crano et al. n.d.). Many recent immigrants have limited outdoor recreation experience on public lands (Sheffield 2005).

New methods of interpretation, including multilingual materials, and efforts to outreach to underrepresented groups need to be developed with careful attention to their special needs. In many cases, developing products and services to reach out into the communities where underrepresented groups live, in order to raise their awareness of opportunities available (Crano et al. n.d.) or to bring the resource to them, may be needed. In other cases, for those who do visit, services need to be developed that meet their needs (USDA Forest Service 2008a).

Regarding ways to receive information about recreation areas, the majority of people seem to prefer word of mouth from family and friends, the internet, and brochures (California State Parks 2003). Family and friends and computers/the internet were most frequently reported as the most trusted information sources across all ethnic groups, according to one study (Crano et al. n.d.). Whites seem to rely more on newspapers for recreation information than members of other ethnic groups. Asians may rely more frequently on computers than other groups. Both

Latinos and African Americans seem to rely most on television for recreation information (Crano et al. n.d.).

Public Involvement

The recreation demand analysis includes information gathered through the public involvement conducted for this Monument planning process. People involved in this process were people who are interested in the Monument; they were not selected through a scientific sampling process that would yield statistically valid results through analysis. During this process, the public helped to develop and refine a decision framework using the Multi-Criteria Decision Support (MCDS) model (for more information on MCDS, see the socioeconomic affected environment section in this chapter). A portion of that MCDS framework addressed recreation in "Increase Enjoyment of the Monument." The public identified what is important to them for recreation in the Monument that should be addressed in the Monument management plan, as described below.

Increasing enjoyment of the Monument is an overarching goal. The plan needs to balance diverse users, a wide variety of uses, accommodate uses through the variety of seasons, and minimize conflicts. The plan needs to provide for access; people cannot play if they cannot get to their destination, and for some, use of those access routes is their desired form of recreation. Road access, trail access, good signage, and permission to use the roads/trails are needed for people to enjoy the Monument. The plan needs to address connections: connection of people to place, peoples to peoples, developing stewardship to foster that connection to the land, and education. The plan needs to provide for protection of people. The plan needs to be practical, in providing for opportunities that are easy to maintain and can be funded. The plan needs to provide for protection of resources, through consistency with protecting the objects of interest, restoration, and developing stewardship, so that people care about the land and its resources.

In addition to MCDS, in order to satisfy the requirements of the Clinton proclamation (Clinton 2000) and to create a healthy balance for both the Monument ecosystems and recreationists, the public emphasized the following considerations (submitted during scoping) as important in developing the Monument management plan.

Tourism: Provide and maintain good front country roads with pull-outs for sightseeing. Provide information and educational opportunities, such as information kiosks, brochures, visitor centers, museums, and self-guided nature and history trails. Provide adequate parking and comfort stations at major attractions. Partner with local and statewide organizations to promote tourism.

Day use: Provide picnic facilities in areas that create minimal effect on surrounding ecosystems. Place facilities where a range of recreation opportunities exist (such as near rivers, ponds, climbing rocks, views, giant sequoias). Provide and maintain adequate restroom facilities. Create informational and educational kiosks on the specific area's natural and social history, objects of interest, and need for respect and care of these areas.

Camping: Provide and maintain campgrounds that create a sense of space, safety, privacy, and immersion in the forest experience with minimal effect on the surrounding ecosystem. Design camping spaces for small individual use, large family gatherings, and larger organizational groups. Monitor ecosystem and human effects and the safety of the recreation users and wild animals. Situate the campground facilities where recreation activities can be enjoyed close at hand. Provide and maintain adequate water, restroom, food storage, and garbage disposal facilities. Provide interpretive programs that impart historic and environmental information. Develop kiosks and bulletin boards that provide information regarding regulations, appropriate user practices, and maps of the surrounding area. In addition, provide and maintain backcountry camping areas with toilet facilities and food storage for use in popular wilderness areas.

Roads: Designate and maintain existing roads that are appropriate for ATV, four-wheel drive vehicles, and snowmobiles, providing for user safety and minimum effect on the environment. Post maps, regulations, and safety considerations, regarding front country usage, wood gathering, etc., on bulletin boards at the roadheads. Partner with state and local agencies to maintain roads for four season use.

Parking and toilets: Provide for appropriate toilet and parking facilities.

Trails: Design and maintain all trails and trail systems for user safety and minimum effect on the environment. Design trail systems for specific uses, such as biking, foot traffic, and pack and riding stock or other non-vehicular uses. Emphasize loop trails and other trail systems, so that users move from one place to another, as opposed to "out and back." Plan trail systems for four season use.

Signage: Provide and maintain dependable and accurate signage at roadheads, trailheads, road and trail junctions, lakes, and other points of interest. Provide food storage at roadheads, trailheads, and stock staging areas. Provide and maintain bulletin boards and/or kiosks that provide information on backpacking, hiking, biking, boating, fishing, hunting, and horseback riding; trail and permit regulations; safety rules; trail etiquette; historical information; and maps of the area.

Concessionaires and private resorts: Provide for, regulate, and cooperate with concessions, resorts, and private organizations that enhance the recreation experience. These opportunity providers may include summer and winter backcountry guides, stock packing outfits, commercial tours, lodges, campgrounds, restaurants, health spas, and other commercial recreation providers.

Permittees, organizational camps, and private communities in and adjacent to the Monument: Develop cooperative programs that enhance the Monument experience, while protecting its objects, history, and health. Address the current needs of private and public interests through understanding of past and future concerns. Create cooperative management structures to encourage dialogue, transparency, and trust. Educate private interests to the needs of ecological balance and stewardship.

Public outreach programs: Provide for public and permittee input throughout the development and implementation of the Monument management plan. Create memoranda of understanding with outside agencies, organizations, and inholders. Develop cooperative interpretation and stewardship programs involving communities within and adjacent to the Monument. Develop partnerships with Monument advocacy groups to acquire marketing, financial, and public resources. Involve gateway communities in decision making forums and marketing of Monument opportunities.

Education programs: Develop programs in schools, communities, and in the Monument to promote a strong sense of public and personal ownership and responsibility for the Monument. Promote responsible usage, conservation practices for environmental and human resources, fire safety, and social and environmental safety. Create awareness through the media and Monument publications of the importance of wildland systems, the importance of human actions to wildland health and welfare, and the importance of historical perspectives to help guide us to a balanced future.

The analysis in the effects on recreation section of Chapter 4 is based on how well the alternatives would meet future recreation demand and protect the objects of interest. The discussion addresses both a portion of the MCDS framework and these considerations which the public identified as important to them.

Scenery Resources

The creation of the Monument focused greater national and international attention on the natural beauty and scenery resources in this portion of the southern Sierra Nevada. The Clinton proclamation that established the Monument increased the emphasis on recreation and public enjoyment and protection of the objects of interest.

Scenic quality is a fundamental element of the recreation experience. Viewing scenery is the single most popular recreation activity nationwide (USDA Forest Service 2008f). The report and recommendations to the president of the United States (President's Commission on Americans Outdoors 1986) states that America's most important attribute for a recreation area is natural beauty. Driving to enjoy the scenery has been the top national recreation activity for over a decade.

Viewing scenery has always been a highly valued activity for visitors to the Sequoia National Forest and the Monument. In the 2003 National Visitor Use Monitoring (NVUM) survey, Sequoia National Forest

visitors identified viewing natural features as the second leading recreation activity following relaxing (66.38 percent participation) (Kocis et al. 2004).

Scenery is the valued visual expressions (sights) people enjoy within places. Many landscape preference studies have shown striking uniformity in the type and composition of landscapes that people find visually appealing. The four common aspects of visually preferred settings are:

- Large trees
- Herbaceous, smooth groundcover
- Open midstory canopy with high visual penetration
- Vistas with distant views and high topographic relief

"Landscapes usually considered less visually appealing are wide-open areas with uniform or monotonous vegetation" (Ryan 2005, p. 13). All landscapes have a definable character and those with the greatest variety or diversity have the greatest potential for high scenic value (USDA Forest Service 1974). Visitors to the Sequoia National Forest expect to see and value natural appearing landscapes.

Important management objectives include sustaining ecological function and achieving a fire-safe landscape for human populations, while meeting and exceeding scenic integrity objectives and maintaining or restoring valued attributes of landscape character.

The Forest Plan used the visual management system (VMS) developed in 1973 to inventory, analyze, and set objectives for scenery resources. In December 1995, the scenery management system (SMS) replaced VMS. VMS and SMS are both structured to emphasize "natural appearing" scenery, but SMS more broadly recognizes scenery as the visible expression of dynamic ecosystems functioning within "places" that have unique aesthetic and social values.

The 2001 SNFPA replaced VMS with SMS. All national forests are directed to convert to SMS as part of forest plan revision. The Sequoia National Forest initiated the Monument planning effort before forest plan revision. To use the best science available for scenery resources, the Sequoia National Forest converted to SMS with the new scenery inventory and analysis completed for this planning effort, incorporating the direction described in the 1990 MSA, Clinton proclamation (2000), and the 2001 SNFPA.

Identifying places and describing the landscape character of these "places" is the initial step of an SMS inventory. Places for the Sequoia National Forest were first identified in the forest interpretive plan (USDA Forest Service 2008a). In the SMS analysis, the unique physical, biological, and cultural images, a listing of valued scenic attributes, and the ecosystem context for each "place" is described in the landscape character description. Desired conditions and desired landscape character are developed from an analysis of the landscape character description.

Overview of Scenery Management System

The scenery management system process involves identifying scenic components, mapping these components, and assigning a value for aesthetics. These maps are useful to relate scenery as part of ecosystems for site-specific project level environmental analysis and in determining the trade-offs related to forest plan management scenarios.

The primary units for the Region 5 SMS inventory are **places** based on people's commonly shared image of specific geographic areas. Places focus on the aesthetic, recreation, and social values reflecting the history, culture, social meaning, and human attachments to the land, as well as the biophysical attributes of an area. Places are approximately 75,000-100,000 acres in size, with roughly 7-25 places occurring in each forest (USDA Forest Service 1995d).

Each place is described in the **landscape character description** section. The description includes the valued attributes of the landscape, important elements of the social environment, environmental regimes, and disturbance regimes creating a "sense of place." By protecting the existing or enhancing the valued scenic attributes described in that section, scenery is expected to be protected or improved. An objective description of the biological and physical elements is drawn from data available for ecological or planning units, which provides the frame of reference for defining the scenic attractiveness classes.

The landscape character description is used as a reference for the **existing scenic integrity** of all lands. Existing scenic integrity (ESI) indicates the degree of intactness and wholeness of the landscape character. Conversely, ESI is a measure of the degree of visible disruption of the landscape character. A landscape with very minimal visual disruption is considered to have high ESI. Those landscapes having increasingly discordant relationships among scenic attributes are viewed as having diminished ESI. Existing scenic integrity is expressed and mapped as very high, high, moderate, low, very low, and unacceptably low.

Scenic attractiveness classes are developed to determine the relative scenic value of lands within a particular landscape character. The three scenic attractiveness classes are class A—distinctive; class B—typical; and class C—indistinctive. The landscape elements of landform, vegetation, rocks, cultural features, and water features are considered when determining each of these classes.

Landscape visibility is composed of two parts: the relative importance to the public of various scenes and the relative sensitivity of scenes based on distance from an observer. Human values that affect landscape perceptions are derived from constituent analysis. Constituent analysis also helps to identify special places and helps to define the meaning people give to the landscape. Constituent analysis leads to a determination of the relative importance of aesthetics to the public. This importance is expressed as a concern level. Sites, travelways, special places, and other areas are assigned a concern level value of 1, 2, or 3 to reflect the relative high, medium, or low importance.

Seen areas and distance zones are mapped from these concern level 1, 2, or 3 areas to determine the relative sensitivity of scenes based on their distance from an observer. These distance zones are identified as:

- Foreground—up to one-half mile from observer
- Middleground—one-half to 4 miles from the observer
- Background—4 miles from the observer to the horizon

Seldom seen areas are areas not seen from travel routes or identified use points. These areas are assigned a concern level of 1, 2, or 3, based on concern for a specific area, and may occur in any distance zone or scenic attractiveness class.

Scenic classes use the data gathered and mapped for scenic attractiveness and landscape visibility (seen areas/distance zones) to assign a numerical scenic class value to forest lands. The ratings 1-7 indicate the scenic value of landscape areas irrespective of existing scenic integrity. Mapped scenic class values are used during forest planning and project planning to compare the value of scenery with the value of other resources.

Scenic integrity is a measure of the degree to which a landscape is visually perceived to be "complete." The highest scenic integrity ratings are given to those landscapes that have little or no deviation from the character valued by constituents for its aesthetic appeal. Scenic integrity objectives are defined by minimally acceptable levels and the direct intent to achieve the highest scenic integrity possible.[25]

Landscape character goals and **scenic integrity objectives** are described for each forest plan management area. The goals describe the actions necessary to achieve and perpetuate desired landscape character and desired condition in each "place."

Places

Identifying "places" is the initial step of an SMS inventory. The values that create a "sense of place" and make each place important and unique" are described in the **landscape character description** section.

Recreation niche settings were first identified for the Sequoia National Forest during the recreation facility analysis process and are described in the recreation affected environment section in this chapter. In the forest interpretive plan (USDA Forest Service 2008a), the recreation niche settings are subdivided into "places." Based on people's commonly shared image of specific geographic areas these places serve as the primary unit for Region 5's scenery management system inventory policy and establish the physical context of recreation niche settings. The following table identifies the "places" within each recreation

25. For more information on SMS, see Landscape Aesthetics: A Handbook for Scenery Management 1995.

niche setting in the Monument. These "places" are displayed on the maps following the table.

Table 110 Places within Recreation Settings

Recreation Setting	Places
Rivers and Lakes	Tule River Kings River Hume Lake
Great Western Divide	Great Western Divide
Scenic Routes	Kings Canyon Scenic Byway Generals Highway Western Divide Highway
Lloyd Meadow	Lloyd Meadow
Wildlands	Golden Trout Wilderness Kings River Special Management Area (KRSMA) Monarch Wilderness and Agnew Roadless Area
Hume High Elevation	Hume High Elevation
KRSMA OHV	KRSMA OHV
Front Country	Front Country

Landscape Character Descriptions

This section describes the places identified in the forest interpretive plan (USDA Forest Service 2008a). Each place has a brief description of the social values and human attachments to the area including the scenic attributes and recreation opportunities. The landscape character includes each place's visual and cultural image, as well as the ecological context.

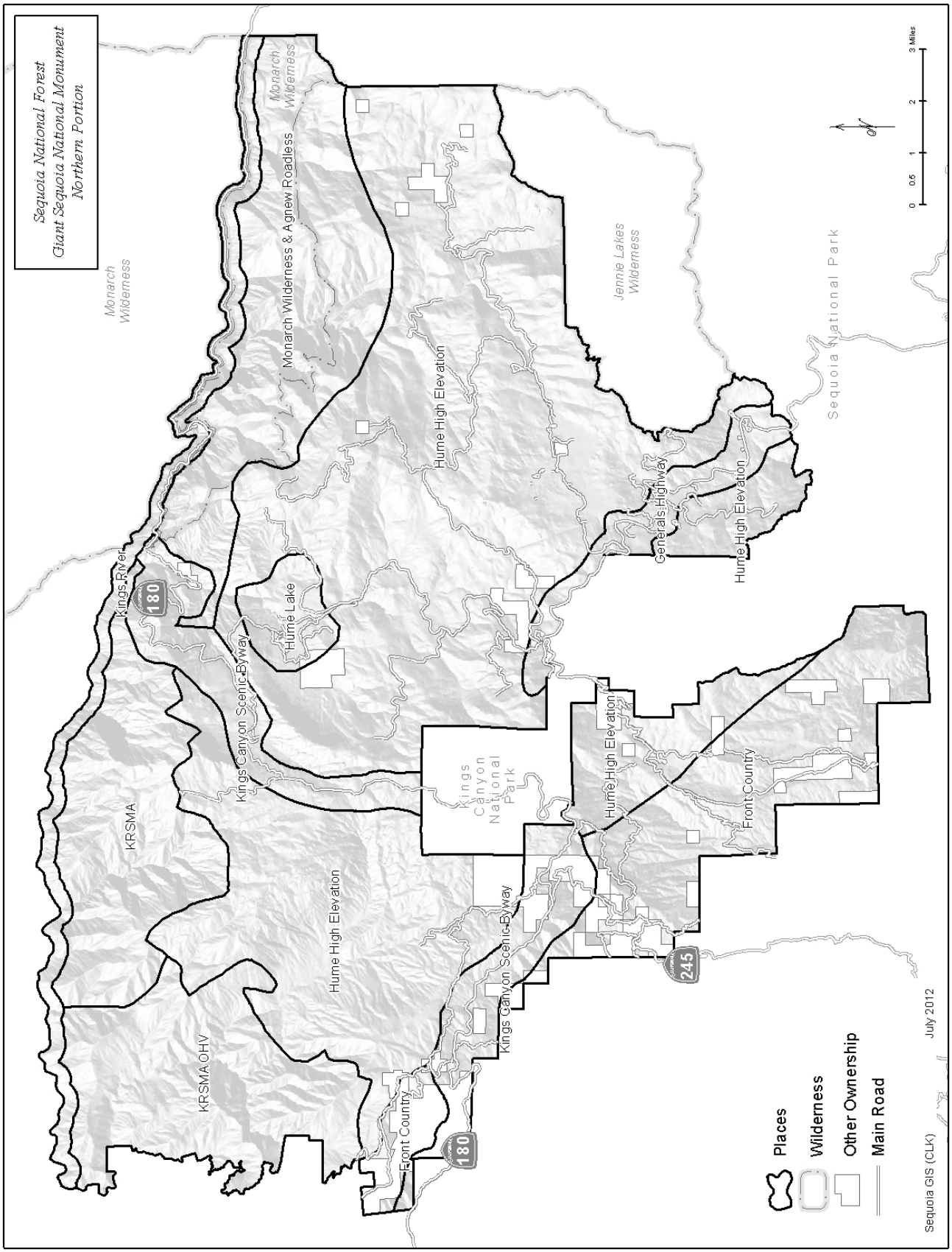
The desired landscape character for the Monument includes a wide variety of visually appealing landscapes from oak woodlands, chaparral, a large variety of mixed conifer forests, and giant sequoia groves. Chaparral is represented by a mosaic of age classes, and woodlands are dominated by open, park-like conditions with large trees, a variety of age classes, and species with a mid-story canopy that is open with high visual penetration. Scenic routes and areas that are often seen are expected to offer vistas with distant views of distinctive ridge lines, river canyons, and outstanding geologic features. These landscapes display minimal visual disruption resulting from large-scale disturbance events. The landscape character description is an objective description of the biological and physical elements drawn from data available for ecological or planning units, combined with identified landscape character attributes and the human elements of the landscape. Landscape character creates a "sense of place" and describes the image of an area. The landscape character description provides the frame of reference for defining the scenic attractiveness classes.

Rivers and Lakes

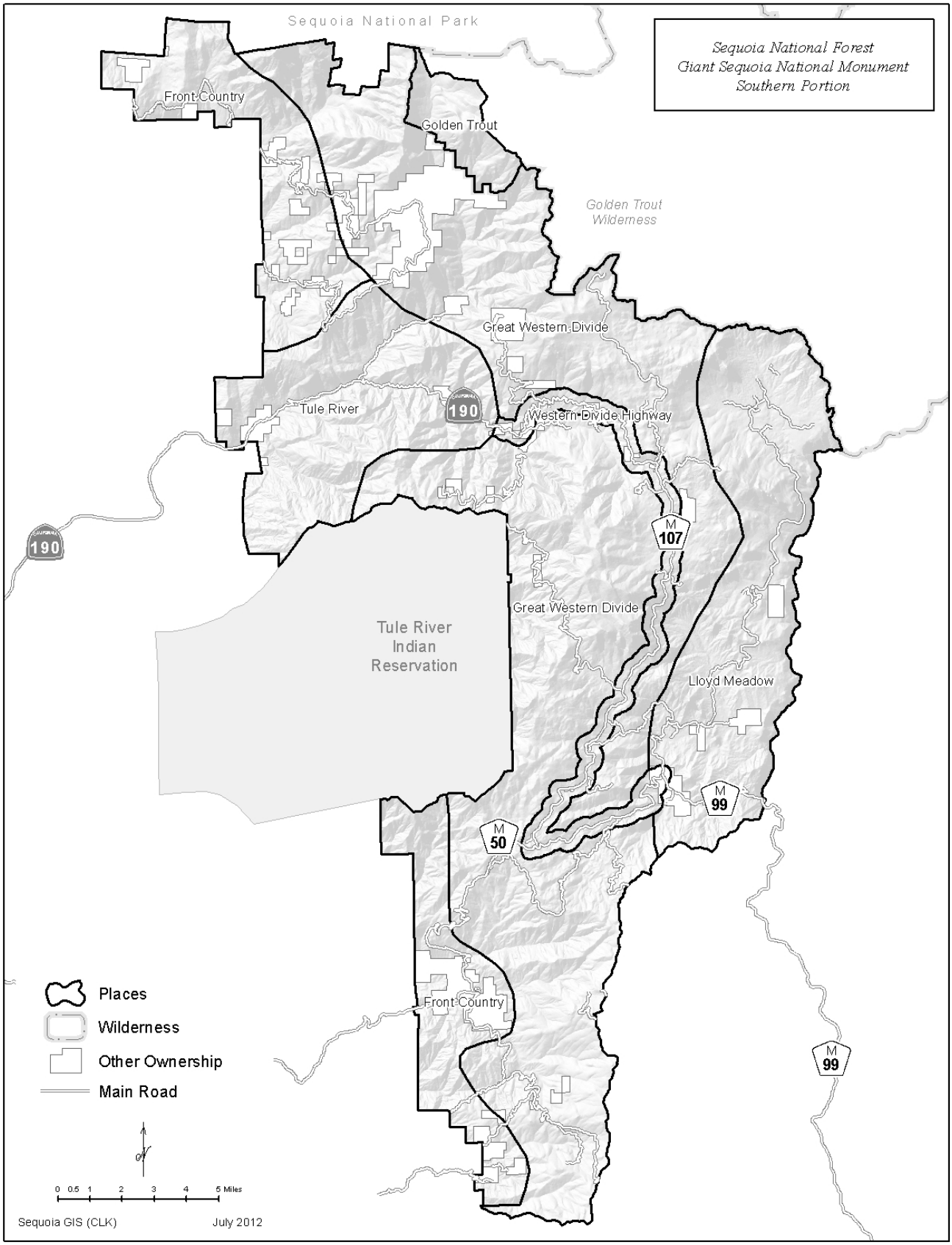
Tule River

The Middle Fork of the Tule River descends steep canyons through a wide variety of fire evolved life zones. The Tule River Canyon is comprised of foothills covered with oak woodlands, impressive granite features, and steep chaparral covered slopes with conifer covered ridge lines. The riverbed is granite based with beautiful, deep pools carved from large slabs of smooth granite and boulder-strewn stream beds interspersed with beautiful water cascades. Riparian vegetation includes sycamores, cottonwoods, and willows at lower elevations.

Map 21 Places within Recreation Niche Settings in the Northern Portion of the Monument



Map 22 Places within Recreation Niche Settings in the Southern Portion of the Monument



Management challenges include fire, hydroelectric power projects, Native American values, tribal relations, wildland urban intermix, crowd and traffic control, litter, graffiti, and gang related problems. In most years, all of the water in this river is used and reused before it can reach its historic destination in Tulare Lake. Water from the river provides hydroelectric power, irrigation, and drinking water. Central valley residents are attracted to the river during the hot summer months for social gatherings, water play, and fishing.

Scenic attributes are the Middle Fork of the Tule River with deep pools carved from large slabs of smooth granite; views to distinctive ridge lines including Slate Mountain, Jordan Peak, and large rock outcrops; riparian vegetation; wildflower displays in the spring; conifer forests on ridge lines; and waterfalls.

Recreation opportunities include day use at Upper and Lower Coffee Camps, the Stairs, fishing, water play; developed camping at Wishon Campground; Wishon cabin rental; trails include 30E14, 30E16; no dispersed camping along the Tule River.

Ecological units are predominantly blue oak and interior live oak, chaparral and live oak, limited montane hardwood and montane hardwood-conifer, and mixed conifer dominated by ponderosa pine.

Kings River

This wild and scenic river travels through the world-renowned Kings Canyon, one of the deepest canyons in the world at over 8,000 feet deep separating the Sierra and Sequoia national forests and dividing the Monarch Wilderness. Both the Middle and South Forks begin in the backcountry of Kings Canyon National Park. Highway 180 which is the Kings Canyon Scenic Byway drops into the Kings River gorge along the South Fork and provides the only vehicle access to this section of the river and Cedar Grove in Kings Canyon National Park.

Management challenges include the interface with Kings Canyon and Sequoia National Parks and unmanaged or concentrated recreation activity that could lower scenic integrity in areas that do not provide facilities. All access is limited, with only the Kings Canyon Scenic Byway for passenger vehicle access along the South Fork of the Kings River. Downstream is Forest Road 12S01 for approximately 4 miles at the western end and the Kings River National Recreation Trail for part of the middle length of the river.

Scenic attributes are the U-shaped valley carved by glaciers; whitewater; outstanding geologic features including marble pendants, folded rocks, and limestone caves; Monarch Wilderness; riparian habitat with cottonwoods, sycamores, and willows lining the banks where the river widens and slows; and numerous streams and waterfalls that flow into the Kings River.

Recreation opportunities include fishing; driving for pleasure at Kings Canyon Scenic Byway; developed day use at Grizzly Falls and Boyden Cavern; Deer Cove trailhead to Monarch Wilderness; Kings River National Recreation Trail; other opportunities outside the Monument include Mill Flat, Kirch Flat, Green Cabin Flat, and Camp 4.5 campgrounds, Camp 4.5 cabin rental, and whitewater rafting.

Ecological units are chaparral and live oak, montane hardwood, and montane hardwood with conifer.

Hume Lake

At 5,200 feet in elevation, the 90-acre reservoir is located in mixed conifer forest in the Tenmile Creek watershed. The Hume Lake Dam has been nominated as a National Historic Landmark. The reservoir was built in the early 1900s to support historic logging operations in the area and was the beginning of the longest log flume that transported logs down Tenmile Creek to the Kings River and then on to the mill in Sanger. Today the lake is a popular recreation destination and provides riparian habitat for wildlife.

Management challenges include risks associated with wildfire and the interface with the Hume Lake Christian Camps and Kings Canyon and Sequoia National Parks; and unmanaged or concentrated recreation activity which has the potential to lower scenic integrity in areas that do not provide facilities. Visitors have higher expectations for scenery, and scenic integrity needs to be improved in overstocked forests, especially in areas that have missed burn cycles or in plantations.

Scenic attributes are Hume Lake, Hume Lake Dam, Tenmile Creek, mixed conifer forest, and vistas to distinctive ridge lines.

Recreation opportunities include developed camping at Hume Lake Campground and Aspen Hollow Group Campground; fishing; day use at Powder Can and Sandy Cove, Hume Lake Interpretive Trail; recreation residences; Hume Lake Christian Camps (private).

Ecological units are predominantly mixed conifer forest, dominated by ponderosa pine, and limited mixed conifer including giant sequoia.

Great Western Divide

The Great Western Divide is the high elevation ridge line that breaks the Sierra Nevada range into two watersheds. This area has 19 recorded giant sequoia groves. Old growth forests provide habitat for rare wildlife species such as the Pacific fisher. Meadows, some lined with aspen groves, creeks with waterfalls, and distant vistas are abundant. Needles and Dome Rock are spectacular, high profile granite monoliths. Slate Mountain is an unusual and prominent landmark with a botanical area hosting rare plants. Jordan and Mule Peak are still in operation as fire lookouts, and they are open to the public.

Management challenges include risks associated with wildfire and urban intermix, which includes improving scenic integrity in overstocked forests, especially in areas that have missed burn cycles or in plantations, especially in areas visited by the public. Unmanaged or concentrated recreation activity has the potential to lower scenic integrity in areas that do not provide facilities.

Scenic attributes are a wide variety of habitats including old growth forests with rare wildlife species, giant sequoia groves, meadows, aspen groves, creeks with waterfalls, views to distinctive ridge lines at Slate Mountain, Jordon Peak, Mule Peak; and geological features of Needles and Dome Rock.

Recreation opportunities include driving for pleasure on back roads with off-highway vehicle (OHV) opportunities; stream fishing at the Middle Fork of the Tule River, Peppermint Creek, Nobe Young Creek; points of interest at Slate Mountain Botanical Area, multiple giant sequoia groves, fire lookouts (Jordan Peak, Mule Peak); rock climbing at Dome Rock, Needles; extensive dispersed camping opportunities; rental cabins at Frog Meadow and Mountain Home; developed camping at Frog Meadow; trails; trailheads for Nelson, Lewis Camp, Summit, Clicks Creek trails, and the Summit National Recreation Trail.

Ecological units are mixed conifer dominated by white fir and sugar pine, upper mixed conifer dominated by Jeffrey pine, red fir, and lodgepole with meadow, red fir, and Jeffrey pine, mixed conifer and giant sequoia, montane hardwood and montane hardwood-conifer, limited chaparral and live oak.

Scenic Routes

Kings Canyon Scenic Byway

This scenic route is the only designated national forest scenic byway in the Sequoia National Forest and provides the only vehicle access into the world-renowned Kings Canyon. This area of the forest is strongly influenced by visitation at Sequoia and Kings Canyon National Parks. No communities are located along this route; however, in Kings Canyon National Park, Grant Grove has a visitor center, grocery store, post office, and restaurant.

Management challenges include risks associated with wildfire, urban/private property, and Sequoia and Kings Canyon National Parks interface. Maintaining high to very high scenic integrity associated with the Scenic Routes recreation niche setting includes improving scenic integrity in overstocked forests, especially in areas that have missed burn cycles, and maintaining or creating vista points closed off by encroaching vegetation. Visitation rates and visitor expectations for scenery are high because of the adjacent national parks.

Scenic attributes are views into the central valley, Cherry Gap, Converse Basin, and Indian Basin, giant sequoia groves, ancient stumps remaining from the historic logging period, mixed conifer forests, panoramic vistas of Kings Canyon, unusual displays of folded rocks and marble roof pendants in the Kings River gorge; along the Kings River the road splits the Monarch Wilderness in two.

Recreation opportunities include driving for pleasure: access to the Converse Basin giant sequoia grove, Indian Basin grove, Monarch Wilderness, the wild and scenic Kings River, Sequoia National Park at Grant Grove and Cedar Grove, developed day use at

Grizzly Falls and Boyden Cavern, interpretive vista points, Indian Basin Interpretive Trail, and developed camping at Princess and Convict Flat campgrounds.

Ecological units are mixed conifer dominated by ponderosa pine, montane hardwood and montane hardwood-conifer, mixed conifer including giant sequoia.

Generals Highway

This route travels through National Forest System lands connecting Sequoia National Park with Kings Canyon National Park. The road is high elevation that is closed periodically during the winter when travel becomes questionable for passenger vehicles. Routes that go to Jennie Lakes Wilderness, Buck Rock, the Big Meadows area, and Ten Mile Road are accessed from this highway.

Management challenges include risks associated with wildfire, urban/private property, and Sequoia and Kings Canyon National Parks interface. Maintaining high to very high scenic integrity associated with the Scenic Routes recreation niche setting includes improving scenic integrity in overstocked forests, especially in areas that have missed burn cycles, and maintaining or creating vista points closed off by encroaching vegetation. Visitation rates and visitor expectations for scenery are high because of the adjacent national parks.

Scenic attributes are giant sequoia groves, red fir forests, views of distinctive ridge lines, vista points into Kings Canyon, the national park backcountry, and the central valley.

Recreation opportunities include driving for pleasure, access to the Big Meadows recreation area, Hume Lake, and the national parks; developed camping at Stony Creek and Upper Stony Creek campgrounds, Fir and Cove group campgrounds; Montecito Lake Resort, Stony Creek Resort; and trailheads at Stony Creek (Jennie Lakes Wilderness).

Ecological units are red fir and lodgepole with meadow inclusions, red fir, and Jeffrey pine.

Western Divide Highway

The Western Divide Highway as a "place" includes the Western Divide Highway (M107), a small portion of highway 190, and a small portion of SM50 to SM99. The scenic route starts at Camp Nelson on Highway 190 and becomes SM107 at Ponderosa. SM107 ends at the intersection of SM107 and SM50, and the scenic route continues on SM50 traveling east and becoming SM99 at the small community of Johnsondale. The route travels from mixed conifer woodlands of fir and pine intermixed with lush meadows down to drier gray pine scrublands with granite domes, rock outcrops, and views to the Kern Plateau. The scenic route ends at the Johnsondale Bridge where the route crosses the North Fork of the Kern Wild and Scenic River and continues south along the river to the community of Kernville. This route is a main travel artery through the southern portion of the Monument accessing developed and dispersed camping opportunities, multiple giant sequoia groves, fishing streams, and geologic features.

Management challenges include risks associated with wildfire and urban intermix. Maintaining high to very high scenic integrity associated with the Scenic Routes recreation niche setting includes improving scenic integrity in overstocked forests, especially in areas that have missed burn cycles, and maintaining or creating vista points closed off by encroaching vegetation.

Scenic attributes are meadows, diverse conifer forests, and giant sequoia groves; Needles and Dome Rock; views to distinctive ridgelines and features including Slate Mountain, Black Mountain Grove, Solo Peak, Kern Plateau, and Nelson Peak. Many of potential vista points are blocked by dense, overgrown forests or the brush-like character of multiple saplings and shade tolerant species that have colonized the road edges.

Recreation opportunities include driving for pleasure; Trail of 100 Giants; stream fishing the Middle Fork of the Tule River, Peppermint Creek, Nobe Young Creek; viewing the features of Dome Rock and Needles; developed camping at Coy Flat, Belknap, Quaking Aspen, Upper Peppermint, and Redwood Meadow campgrounds; developed group camping at Holey Meadow, Long Meadow, and Quaking Aspen.

Ecological units are mixed conifer dominated by white fir and sugar pine, upper mixed conifer dominated by Jeffrey pine, limited red fir and lodgepole with meadow, limited red fir and Jeffrey

pine, and limited montane hardwood and montane hardwood-conifer.

Lloyd Meadow

This high mountain shelf located between the Western Divide Highway and the Kern Plateau has an average elevation of 5,500 feet with spectacular views to the Kern River. Moist west side conifer forests give way to a drier, more east side conifer forest with some gray pine and shrubland. The southern third was burned in the McNally Fire of 2002. Granite formations and expansive vistas of the Kern River and Kern Plateau are enjoyed from many areas. The area includes the only access point for boaters starting the Forks of the Kern run and also provides early season access to the Golden Trout Wilderness.

Management challenges include risks associated with wildfire and some urban intermix with private property owners and recreation camps such as the R-Ranch. Scenic integrity could be improved in overstocked forests, especially in areas that have missed burn cycles, or in plantations. Dispersed recreation is popular in this area, and unmanaged or concentrated recreation activity has the potential to lower scenic integrity in areas that do not provide facilities.

Scenic attributes are views to the Kern River and Kern Plateau, Needles and Dome Rock, Freeman Creek Grove, conifer forests, and multiple streams.

Recreation opportunities include developed camping at Lower Peppermint Campground; extensive dispersed camping opportunities; Jerky and Forks of the Kern trailheads provide access to the Golden Trout Wilderness; multiple trails; organizational camps; water play at the "tubs and slides," rafting and kayaking the Forks of the Kern; hunting; fishing; rock climbing; hiking and and viewing the George Bush Tree in the Freeman Creek grove; mountain biking; equestrian use; and group use (non-commercial). Outfitter-guides provide services for some of these activities.

Ecological units are mixed conifer dominated by ponderosa pine (Freeman Creek Grove), chaparral and live oak, mixed conifer dominated by white fir and sugar pine, upper mixed conifer dominated by Jeffrey pine, montane hardwood and montane hardwood-conifer, red fir and lodgepole with meadow, red fir, and Jeffrey pine.

Wildlands

Golden Trout Wilderness

Designated in 1978, totaling 303,510 acres, the Inyo manages the eastern two-thirds, and the western third is managed by the Sequoia. Only a small section in the northwest corner of the Golden Trout Wilderness and adjacent to Mountain Home State Forest is in the Monument. Maggie Mountain and Moses Mountain are outstanding landmarks, along with the North Fork of the Middle Fork of the Tule River and the Maggie Mountain, Middle Tule, and Upper Tule River giant sequoia groves.

Management challenges include risks associated with wildfire aggravated by extremely steep slopes and protecting the wilderness character.

Scenic attributes are Moses and Maggie mountains, the North Fork of the Middle Fork of the Tule River, and giant sequoia groves.

Recreation opportunities include hiking, stock use, and dispersed camping.

Ecological units are red fir and Jeffrey pine and upper mixed conifer dominated by Jeffrey pine.

Kings River Special Management Area (KRSMA)

KRSMA begins at the junction of the South and Middle Forks of the Kings River where highway 180 climbs out of the canyon. KRSMA has little visitation because of the steep terrain. This area is visited mostly by anglers accessing the river. The main stem once provided the route for the longest lumber flume which carried lumber harvested during the historic logging period to Sanger. The Boole Tree is located on the southern boundary of this area and can be accessed by a two-mile loop trail. Plant communities range from riparian along the Kings River, forming the northern boundary, through grassland and chaparral to giant sequoia groves at the top of the drainage of Converse Creek. Prehistoric and historic use by Native Americans and ranchers occurred in this area.

Management challenges include risks associated with wildfire aggravated by extremely steep slopes. Visitation in these areas is very limited due to vegetation and terrain.

Scenic attributes are the Boole Tree, conifer forests, and the Kings River.

Recreation opportunities include fishing and the trail to the Boole Tree.

Ecological units are chaparral and live oak, montane hardwood and montane hardwood-conifer, mixed conifer including giant sequoia, and mixed conifer dominated by ponderosa pine.

Monarch Wilderness and Agnew Roadless Area

The Monarch Wilderness was designated in 1984, totaling 44,900 acres. The Sierra National Forest manages the northwest portion, and the rest is managed by the Sequoia. The only access is from the Sequoia side. The wilderness is adjacent to Kings Canyon National Park. From 2,000 feet in elevation at the South Fork of the Kings River to 11,077 feet on Hogback Peak, this land is steep and rugged with magnificent views from high ridges into deep canyons. Riparian areas to brush lands to conifer forests to meadows to giant sequoia groves, the Wild and Scenic South Fork of the Kings River and highway 180 bisect the area. The Kanawyer Trail traverses the Monarch and provides magnificent views into Kings Canyon. The Deer Cove Trail leads up to Grizzly Lakes and Wildman Meadow, popular only with the hardiest of hikers, hunters, and stock users. At the higher elevations are the Monarch, Deer Meadow, Agnew, and part of Evans giant sequoia groves. Agnew Roadless Area, like the adjacent Monarch Wilderness, is generally steep terrain, broken by rock outcrops and streams with mixed conifer forest. The proposed Windy Gulch Geologic Area (caves) is located in this area.

Management challenges include risks associated with wildfire aggravated by extremely steep slopes and protecting the wilderness character.

Scenic attributes are giant sequoia groves, views from high ridges into deep canyons, conifer forests, and meadows.

Recreation opportunities include the Kanawyer and Deer Cove trails, hiking and stock use, hunting, and dispersed camping.

Ecological units are montane hardwood and montane hardwood-conifer, mixed conifer including giant sequoia, mixed conifer dominated by ponderosa pine, limited red fir and lodgepole with meadow inclusions.

Hume High Elevation

Located in the northern section of the Monument, this area is strongly influenced by the national parks and the Hume Lake Christian Camps. Elevations range from 4,000 feet to 8,000 feet in mixed conifer forest with one of the largest concentrations of giant sequoia groves. Visitors have many opportunities to discover and explore these groves in their natural, wild condition while enjoying outstanding scenery including vistas of the Sierra high country and into Kings Canyon. Maintaining access to giant sequoias for "discovery" in a natural setting is important for this area. Thirteen giant sequoia groves are located in the district, including the two largest, with associated mixed conifer to red fir forests and granite and basalt outcrops. The historic logging of giant sequoias is a story unique to this area of the forest. Converse Basin, the largest grove, was host to the most extensive historic giant sequoia logging operation. Giant specimen stumps remain after 100 years, presenting the best opportunities in the forest to tell the historic logging story. Buck Rock Lookout, which is staffed with volunteers from the Buck Rock Foundation, functions as a fire lookout and is open to the public.

Management challenges include risks associated with wildfire and the interface with Kings Canyon and Sequoia National Parks. Scenic integrity and scenic stability in overstocked forests could be improved, especially in areas that have missed burn cycles or in plantations. Unmanaged or concentrated recreation activity has the potential to lower scenic integrity in areas that do not provide facilities.

Scenic attributes are giant sequoia groves, mixed conifer forests; vistas to Buck Rock, Kings Canyon, and the Sierra high country; giant sequoia specimen stumps; and Buck Rock Lookout.

Recreation opportunities include developed camping at Eshom, Big Meadows, Horse Camp, Landslide, Tenmile, and Buck Rock campgrounds; Logger

Flat Group Campground; Big Meadow rental cabin; extensive dispersed camping opportunities; giant sequoia groves, numerous trails, Chicago Stump, trail to Boole Tree; fishing at Big Meadows and numerous creeks.

Ecological units are mixed conifer including giant sequoias, mixed conifer dominated by ponderosa pine, montane hardwood and montane hardwood-conifer, red fir and lodgepole with meadow inclusions, red fir, and Jeffrey pine.

KRSMA Off-Highway Vehicle (OHV)

A portion of the Kings River Special Management Area, this area is bounded on the north by the Kings River and has the only OHV trails in the Monument, as authorized by the legislation that created KRSMA. The area is generally steep with brush and grass covered canyons, 1,000 feet to 5,000 feet in elevation, not very accessible, and provides great opportunities for solitude. Native American use and needs may preclude some interpretation. Millwood staging area and Mill Flat Campground are the access points to this area via the Davis Road (12S01). The existing OHV routes are currently impassable, even for a dirt bike. During the historic logging period, a flume was maintained along Mill Flat Creek to the Kings River originating at the town of Millwood.

Management challenges include risks associated with wildfire aggravated by extremely steep slopes. Visitation in these areas is very limited due to vegetation and terrain.

Scenic attributes are views to the Kings River and steep topography.

Recreation opportunities include OHV trails.

Ecological units are blue oak and interior live oak, chaparral and live oak, montane hardwood and montane hardwood-conifer, limited mixed conifer dominated by ponderosa pine, and very limited mixed conifer including giant sequoia.

Front Country

This setting is a desirable destination for visitors in spring and fall when temperatures are moderate and snow prevents access to higher elevations and is undesirable in the summer due to heat. During the spring the hillsides are dressed in spectacular displays of wildflowers. Often referred to as the foothills, the landscape progresses uphill from grasslands, chaparral, and oak woodland to mixed conifer forest. Elevations range from 1,000 feet to 4,500 feet with decomposed granite and erosive soils. These areas are the wildland urban intermix and are generally steep and prone to fire.

Management challenges include risks associated with wildfire in steep and fire prone vegetation types, Native American values, tribal relations, urban intermix, litter, graffiti, and gang-related problems. These areas are utilized mostly by residents; unmanaged or concentrated recreation activity has the potential to lower scenic integrity, and most of these areas do not provide facilities.

Scenic attributes are wildflowers, rock outcrops, and views to distinctive ridge lines such as Dennison Peak, Moses Mountain, and Maggie Mountain.

Recreation opportunities include developed camping at Leavis Flat and White River campgrounds; organizational camps; hiking and stock use on trails, fishing, hunting, and dispersed camping.

Ecological units are blue oak and interior live oak, mixed conifer dominated by ponderosa pine, chaparral and live oak, and very limited upper mixed conifer dominated by Jeffrey pine.

Scenic Integrity Level Definitions

Very high (unaltered) scenic integrity refers to landscapes where the valued landscape character is intact with only minute if any deviations. The existing landscape character and sense of place is expressed at the highest possible level.

High (appears unaltered) scenic integrity refers to landscapes where the valued landscape character appears intact. Deviations may be present, but must repeat the form, line, color, texture, and pattern common to the landscape character so completely and at such scale that they are not evident.

Moderate (slightly altered) scenic integrity refers to landscapes where the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.

Low (moderately altered) scenic integrity refers to landscapes where the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes, or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed, but be compatible or complementary to the character within.

Very low (heavily altered) scenic integrity refers to landscapes where the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such as size, shape, edge effect and pattern of natural openings, vegetative type changes, or architectural styles within or outside the landscape being viewed. However, deviations must be shaped and blended with the natural terrain (landforms) so that elements such as unnatural edges, roads, landings, and structures do not dominate the composition.

Existing Scenic Integrity

The existing scenic integrity (ESI) is a snapshot in time of the existing condition of scenery resources and will change over time. ESI is a result of the implementation of the current Forest Plan and indicates the degree of intactness and wholeness of the landscape character. Conversely, ESI is a measure of the degree of visible disruption of the natural landscape character. A landscape with very minimal visual disruption is considered to have high ESI. Those landscapes having increasingly incompatible relationships among scenic attributes are viewed as having diminished existing scenic integrity. National Forest System lands are not managed for unacceptably low scenic integrity. The unacceptably low level is used in the inventory process to identify lands that need rehabilitation. No lands were identified as unacceptably low during the ESI inventory for the Monument.

Existing scenic integrity (ESI) levels were determined for the Monument landscapes using elements and data available in GIS. Forest activities data from 1980 to present were used to determine areas that appear altered from vegetation management and other activities which alter the landscape, including developed and dispersed recreation, travel management, and livestock grazing. Other GIS data used to determine scenic integrity of the landscape includes designated wilderness, wild and scenic river corridors, inventoried roadless areas, special areas, research natural areas, the Kings River Special Management Area, and giant sequoia groves. National Agricultural Imagery Program (NAIP) aerial imagery from 2008 was used as a reference to identify changes in the landscape that may not be found in the GIS layers and may be noticeable from aerial views. Due to time constraints which limited field review, ESI levels were rated from an aerial view, which is the most revealing. During site-specific analysis for projects, the ESI inventory can be reviewed and updated based on views from concern level travelways and use areas, using typical on-the-ground observer points.

The Monarch and Golden Trout wildernesses and most wild and scenic river corridors appear unaltered, expressing the highest possible level of intactness with a primitive and natural sense of place and have an existing scenic integrity of very high. Lands with very high ESI make up about 5 percent of the Monument.

Inventoried roadless areas (IRAs), special areas, research natural areas, the Kings River Special Management Area, and giant sequoia groves are naturally appearing; the landscape appears intact, and deviations from the landscape character are not evident, giving these areas an ESI level of high. A portion of the Kings Wild and Scenic River corridor along state highway 180 near and east of Horseshoe Bend was rated high due to the presence of the highway. Lands with high ESI make up about 36 percent of the Monument.

The majority of the landscape, about 56 percent of the Monument, appears slightly altered due to the transportation system, developed recreation, special use permitted areas, and vegetation management activities, and has an ESI of moderate. The southern portion of Black Mountain Grove was rated moderate because of roads concentrated in this particular area. Additionally, some vegetation management activities caused lands originally rated as high to be rated as moderate because of fragmentation with small areas isolated from groves, IRAs, and the Kings River

Special Management Area. These small isolated areas were rated the same as adjacent lands until further field review can be completed.

Areas with vegetation treatments were rated as low ESI, as well as some dispersed camping areas. Most dispersed recreation sites and camping areas have reduced ground cover, litter, and extensive user-created trails being affected to the extent that they appear moderately altered. Vegetation treatments with naturally appearing edges and in areas with natural openings were also rated low. The above deviations may dominate the valued landscape character, but borrow from valued attributes such as shape, edge effect, and pattern of natural openings, resulting in a landscape which appears moderately altered. If treated areas are not noticeable and naturally appearing, some may be determined to meet high or moderate ESI during field review or site-specific project level analysis.

Two areas in the northern portion of the Monument were identified as having very low ESI. These areas adjacent to private land had extensive clearing, ground disturbing activities, or geometric shapes. These areas may strongly dominate the valued landscape character and borrow little from valued attributes such as size, shape, edge effect, and pattern of natural openings.

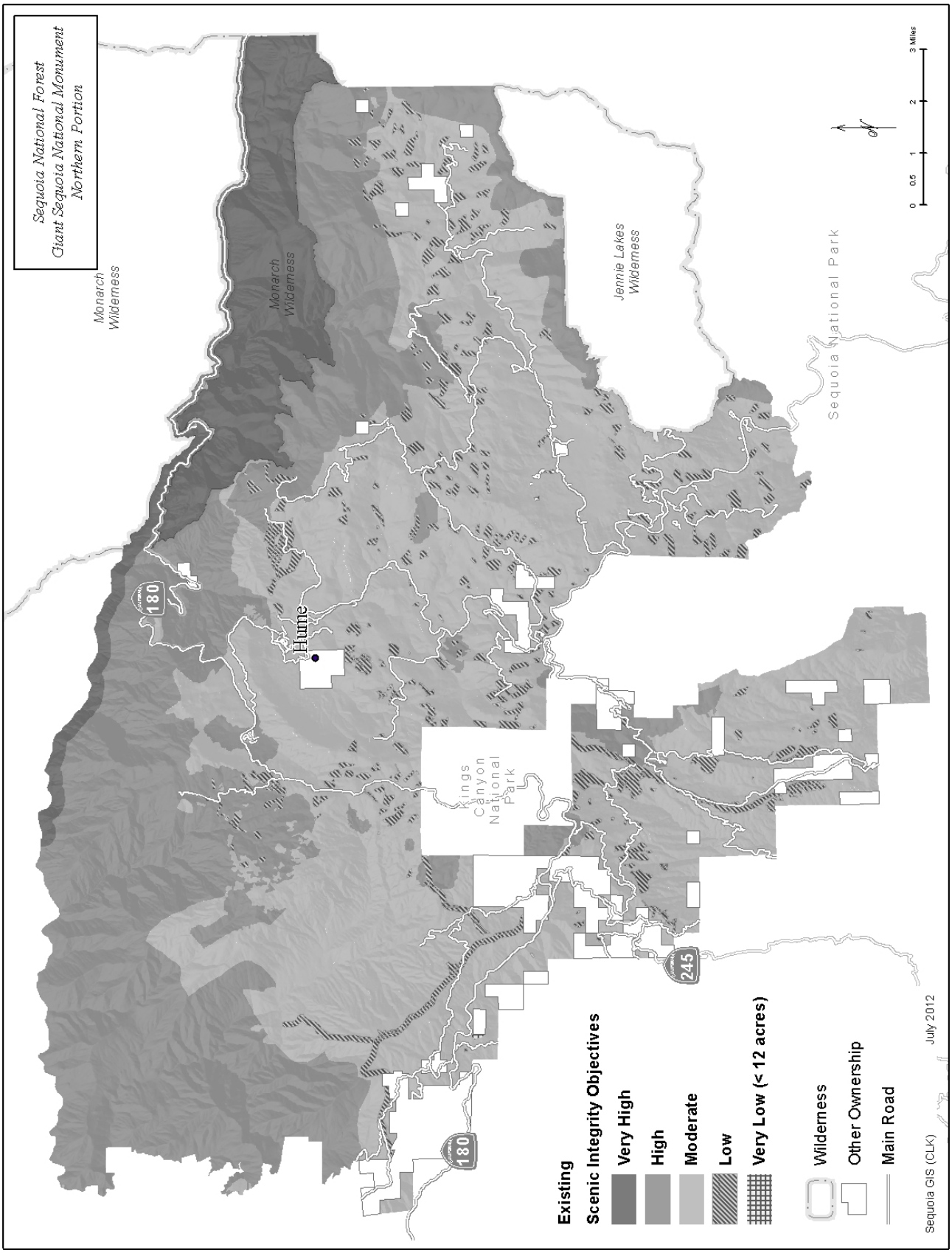
The following table displays the number of acres and the percentage of area in the Monument by existing scenic integrity level. The maps that follow the table display the existing scenic integrity.

Table 111 Existing Scenic Integrity Level Acres

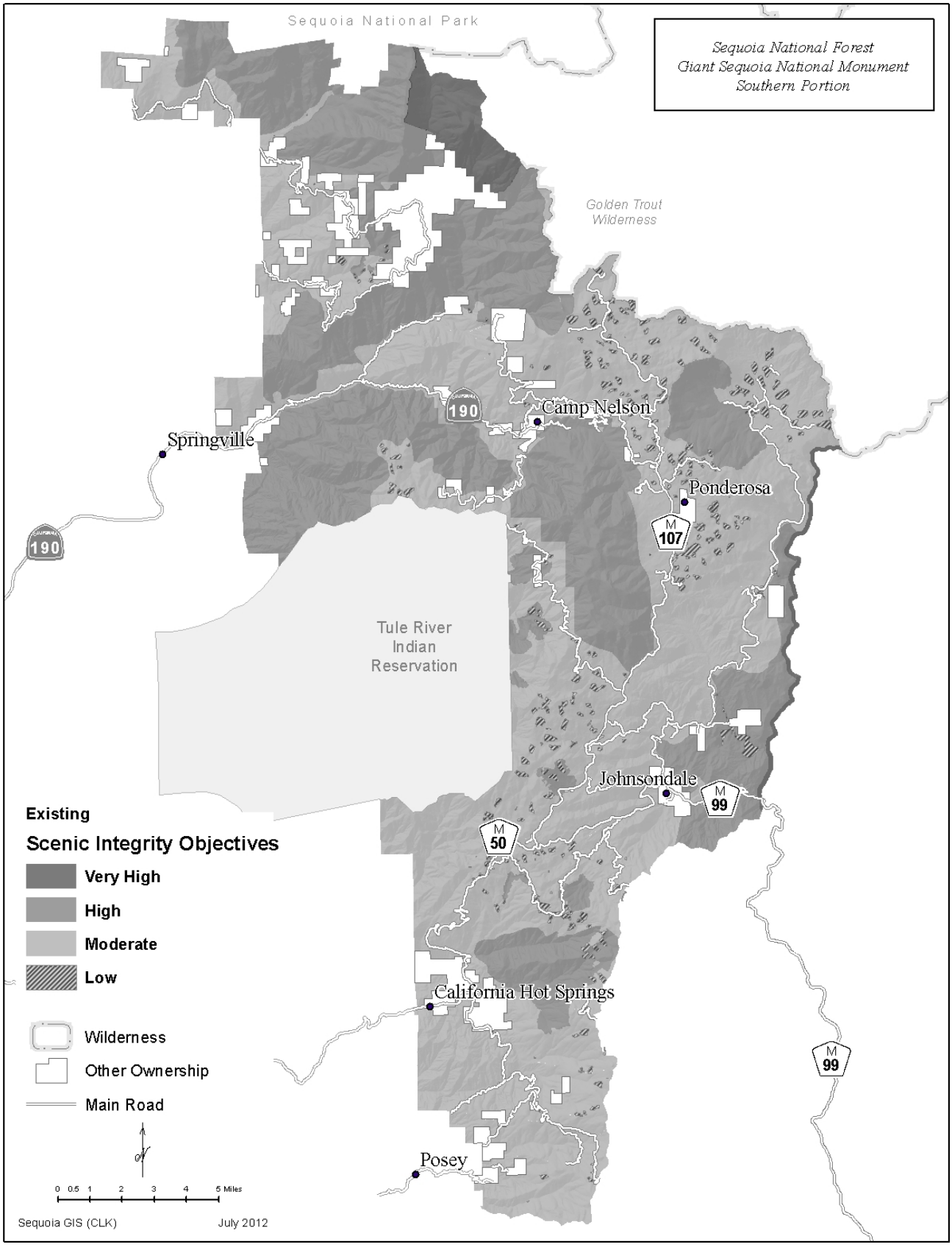
Existing Scenic Integrity Level	Acres[1]	Percent of Monument
Very high	16,050	5
High	118,130	36
Moderate	183,030	56
Low	11,100	3
Very low	10	0

1. The acre calculations only include National Forest System lands.

Map 23 Existing Scenic Integrity of the Northern Portion of the Monument



Map 24 Existing Scenic Integrity of the Southern Portion of the Monument



Proposed Scenic Integrity

A composite scenery base map was prepared, and the SMS values from that map were condensed to provide guidelines and a starting point for developing the proposed scenic integrity levels. The potential scenic integrity levels (SILs) were reviewed by forest personnel to fit the management needs of the Monument.

Table 112 Potential Scenic Integrity Level Acres Based on SMS Values

Potential Scenic Integrity Level	Acres[1]	Percent of Monument
Very high	15,590	5
High	252,780	77
Moderate	59,940	18
Low	10	0
Very low	0	0

1. The acre calculations only include National Forest System lands.

The following table displays the number of acres and the percentage of area in the Monument by proposed scenic integrity level. The maps that follow display the proposed scenic integrity levels.

Table 113 Proposed Scenic Integrity Level Acres

Proposed Scenic Integrity Level	Acres[1]	Percent of Monument
Very high	20,900	6
High	251,130	76
Moderate	56,280	17

1. The acre calculations only include National Forest System lands.

Proposed Scenic Integrity Objectives

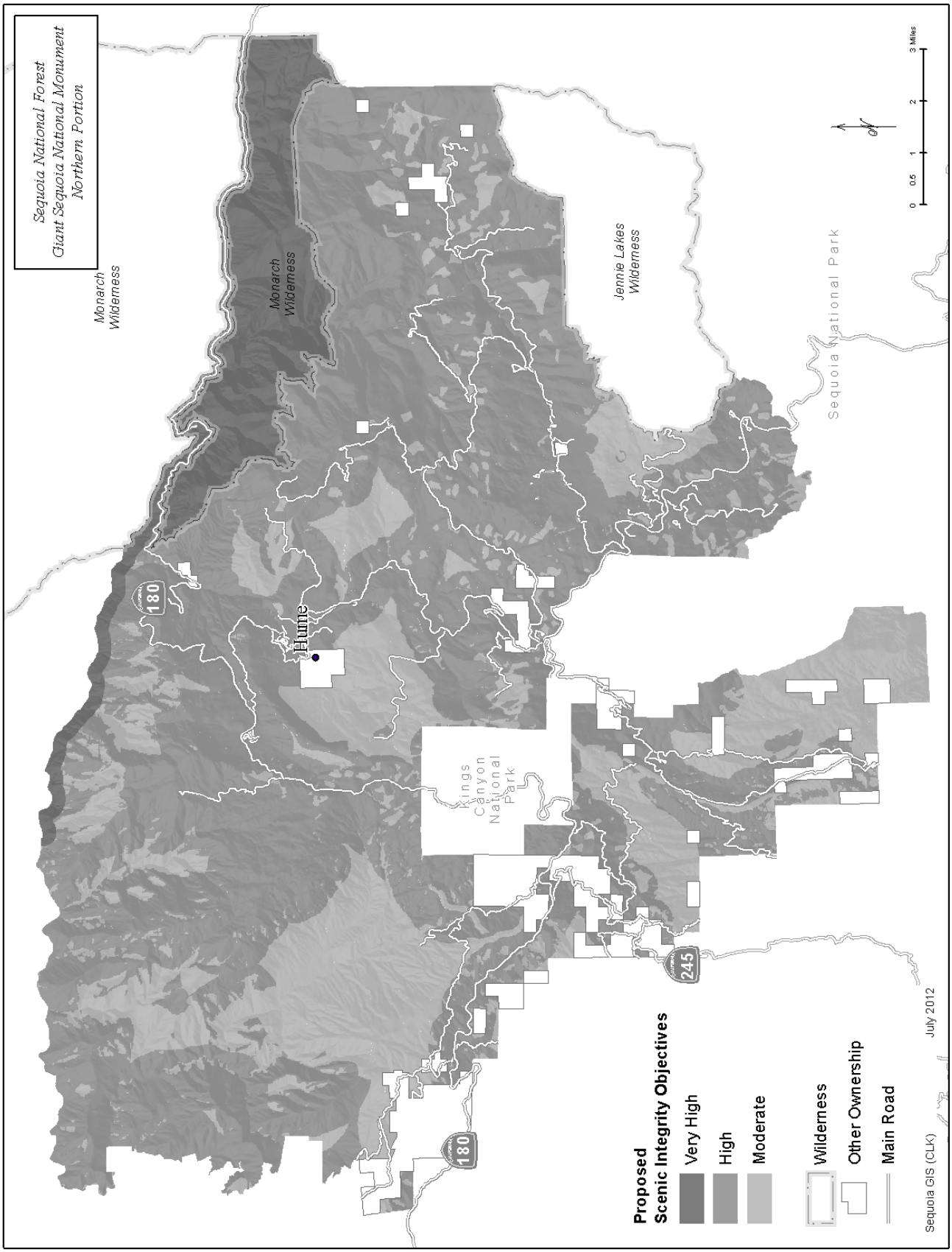
Once a final plan alternative is selected, the proposed scenic integrity objectives are expected to become the scenic integrity objectives (SIOs) for the management plan and will be used to manage the scenery resource. The SIOs reflect the management emphasis in the Clinton proclamation focusing on public enjoyment and protection of the objects of interest. Since the management emphasis remains the same for all the alternatives, the SIOs do not change by alternative.

The Forest Plan visual quality objectives (VQOs) equate to the proposed SIOs and are compared by acreage in the following table.

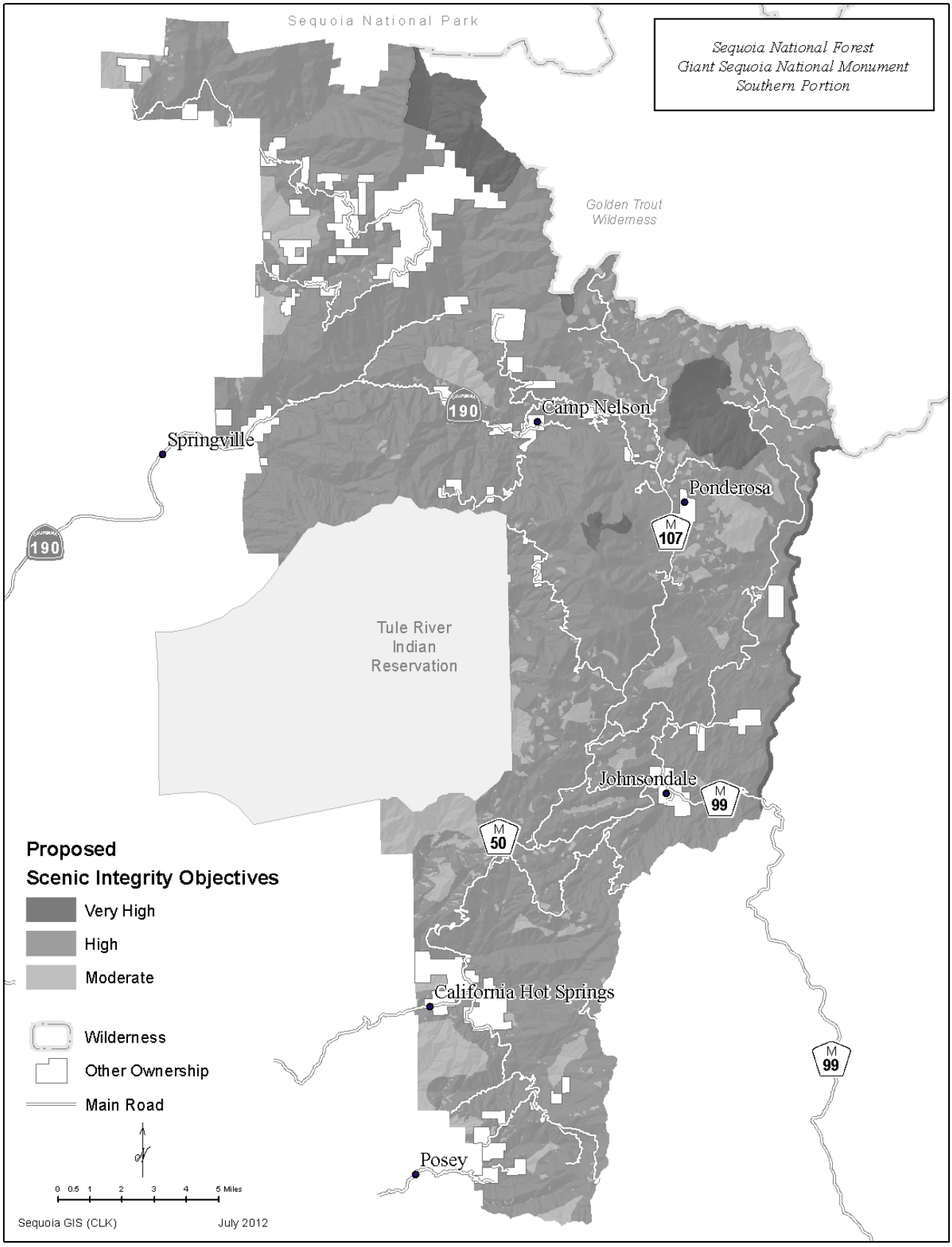
Table 114 Change in Acreage from Forest Plan VQOs to Monument Plan Proposed SIOs

VQOs/SIOs	Acres in the Plan	Proposed Acreage as a Monument
Preservation/very high	28,360	59,380
Retention/high	43,480	92,670
Partial retention/moderate	106,540	176,270
Modification/low	124,960	0
Maximum modification/very low	24,980	0

Map 25 Proposed Scenic Integrity Objectives for the Northern Portion of the Monument



Map 26 Proposed Scenic Integrity Objectives for the Southern Portion of the Monument



The scenic integrity objectives are expected to serve as a guide for design and implementation of management activities. Only very high, high, and moderate scenic integrity objectives are proposed for the Monument, all emphasizing a relatively natural-appearing landscape. It is important for national forests to manage scenery at this level. "Research has shown that high-quality scenery, especially that related to natural-appearing forests, enhances people's lives and benefits society" (USDA Forest Service 1995, p. 17). It should also be noted that according to Newby's findings that "people expect to see natural or natural-appearing scenery," (cited in USDA Forest Service 1995, pp. 2-3). Furthermore, "research shows that there is a high degree of public agreement regarding scenic preferences. This research indicates that people value most highly the more visually attractive and natural-appearing landscapes" (USDA Forest Service 1995, p. 30).

Ongoing Activities

Activities and conditions that will continue into the future in Alternative A include dispersed and developed recreation. Studies support the strategy of minimizing recreation use effect by concentrating use (Cole 1993). Dispersed recreation could potentially degrade natural resources that contribute to scenic quality (USDA Forest Service 1995c), as demand for these activities rises in the future.

As demand for dispersed use in undisturbed areas rises, the greater the risk becomes of lowering the scenic integrity in undisturbed areas of the Monument. As use increases in heavily used areas, effects are not expected to increase significantly (Cole 1993).

Developed recreation sites protect scenery by concentrating use and by providing amenities such as restrooms, hardened walkways, designated parking areas, and visitor information stations. Alternative A allows for the development of more recreation sites as visitor demand increases and can protect the scenery resources in both developed and undeveloped areas of the Monument.

Landscapes in areas of high public concern that have missed natural fires (see effects on fire and fuels in Chapter 4) are expected to experience a continued degradation of scenery resources, as the landscapes become increasingly overstocked, dense with vegetation, and have increasing amounts of dead and down wood, all of which are conditions that people do not prefer (Ryan 2005), potentially lowering scenic integrity. These landscapes are more susceptible to large scale disturbances. In areas that experience large scale disturbances, such as moderate or severe fire (see effects on fire and fuels in Chapter 4), or exhibit large areas of dead and dying vegetation from competition for limited resources, pests, or disease, the scenery resources will be degraded (Ryan 2005). This vulnerability leads to lower scenic stability.

Although the no action alternative, Alternative A, is managed according to the Forest Plan, which established VQOs, the Clinton proclamation increased the emphasis on recreation and public enjoyment and protection of the objects of interest within the Monument boundaries. Consequently, scenery resources, which enhance public enjoyment and the recreation experience, are given higher consideration, and the proposed SIOs, which are considerably higher than those established in the Forest Plan, are used as a guide for design and implementation of management activities.

Socioeconomics

This overview explores the social and economic conditions within the areas influenced by the Monument including Fresno, Kern, and Tulare Counties located in the San Joaquin Valley. By understanding the overall social and economic conditions within this area of influence, better decisions concerning social and economic well-being of those affected can be made. What follows is a summary of the sections contained within this social and economic overview.

Three-County Socioeconomic Profile

To place the area of influence in context with the larger Sierra Nevada region, a brief synopsis of key social and economic facts is presented. Following this synopsis is a socioeconomic profile of Fresno, Kern, and Tulare Counties. This three-county socioeconomic profile will discuss population demographics, housing, educational attainment, personal income sources, unemployment, major economic sectors

related to public lands, economic specialization, development in the Wildland Urban Interface (WUI), and transfer payments to counties. This information will help address the following questions, "Where National Forest lands are involved, what activities or conditions occur on adjacent lands and what are their ties to the Monument" and "What portion of county government revenues depend on agency activities"?

Major Natural Resource Economic Sectors

Next, the major natural resource economic sectors in the three-county area, including timber, mining, agriculture, and travel and tourism will be considered. This section will explore job trends, share of the economy attributed to each sector, differences between counties, and a breakdown of the different types of activity within each sector. An analysis of the Forest Service contribution to these sectors will also be discussed. The information presented in this section will help address several questions: "Who uses the resources of the Monument," "Does the Monument supply a large portion of each user's need for goods and services," and "Are other local businesses and industries indirectly linked to agency programs"?

Gateway Communities

While socioeconomic differences exist among the three counties, differences also exist among the smaller communities adjacent to the Monument. Activities in the Monument have the potential to affect those communities frequently referred to as "gateway communities." Gateway communities are defined as (adapted from the National Park Service 2006):

> Communities that exists in close proximity to a unit of the national forest system whose residents and elected officials are often affected by the decisions made in the course of managing the Monument. Because of this, there are shared interests and concerns regarding decisions. Gateway communities usually offer food, lodging, and other services to Monument visitors. They also provide opportunities for employee housing, and a convenient location to purchase goods and services essential to national monument administration.

This section will assess the following gateway communities for their unique social and economic characteristics: Springville, Wofford Heights, Lake Isabella, Squaw Valley, Porterville, Kernville, and the Tule River Indian Reservation. While other communities such as Glenville, California Hot Springs, Camp Nelson, Posey, and Dunlap also meet this definition, data is not available from the U.S. Census to discuss them specifically (i.e. they are not classified as "Census Designated Places"). This section will consider the question, "What is the current capacity of gateway communities for improving economic development opportunities associated with the Monument?"

Public Values, Beliefs, and Attitudes

Knowing about public values, beliefs and attitudes relevant to management of the Monument is important to understanding the linkages among the forest, surrounding communities, and other stakeholders, including the national public. This section will address people's orientations to nature and public lands management, and specifically answers the question, "What types of public land opportunities or benefits are viewed as the most desirable in the Monument"?

Environmental Justice

Another important component of this social and economic overview is consideration of potential environmental justice and civil rights issues. Environmental justice means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are made, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment.[26] This section will consider indicators of poverty, race, ethnicity, poverty by race, age distribution, language and education. This section helps to address the questions, "Does everyone have the opportunity to participate in decisions affecting the Monument" and "Are the distribution of potential harms and benefits

26. As defined in U.S. Department of Agriculture, Departmental Regulation 5600-2, dated December 15, 1997.

related to the Monument more prevalent for any identifiable subgroup than another"?

Area of Influence

Key Sierra Nevada Facts (Sierra Nevada Conservancy Revised Strategic Plan March 2009):[27]

- The Sierra Nevada is the third fastest growing Region in California. Some estimates predict the population will triple by 2040. The area is experiencing rapid retiree and commuter resident growth, and large intermittent recreational populations that increase resource pressures.
- For some time, the Sierra Nevada's economy has been diversifying from primarily a resource-based economy to one increasingly dependent on tourism and related services specialized goods and services tied to the state economy, and health, financial, and other services needed by the growing population.
- Many parts of the Region face significant threats from natural disaster, in particular the risk of catastrophic fire.
- There is increasing conflict over various land use decisions in certain portions of the Region and over Regional resource conservation strategies.
- In some Sierra communities there is a lack of affordable housing, declining personal income, low literacy rates, and outdated communications infrastructure.
- In some subregions there are a growing number of children living in poverty.

More specifically, the Monument is located within the Sequoia National Forest in the southern portion of the Sierra Nevada region. The outer boundaries of the area encompass approximately 328,315 acres of federal land within Fresno, Tulare and Kern Counties. The Monument is located in two parcels bisected by the Sequoia and Kings Canyon National Parks. The northern boundary is the Kings River. The southern parcel is entirely in Tulare County. The eastern boundary is the North Fork of the Kern River.

The San Joaquin Valley counties of Fresno, Tulare, and Kern are most affected by management decisions in the Monument and comprise the area of influence. The Monument 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. The Sequoia National Forest (including the northern section of the Monument) is classified as an "urban" forest since it is within 50 miles of the Fresno/Clovis metropolitan area with a population center of over a million persons (Dwyer and Chavez 2005). The Monument is administered by the Sequoia National Forest Supervisor's Office located in Porterville in Tulare County. There are about 266 full time forest employees and a large contingent of temporary workers during the fire season. Historically, the Sequoia National Forest has been a strong producer of timber that contributed to local mills along with supplies from privately owned lands. In recent years, national forest timber harvests have declined, but the Monument has emerged as a primary recreation destination for residents of adjacent communities as well as for visitors from the nearby urban areas of Fresno, Clovis, Bakersfield and Visalia.

Fresno, Tulare, and Kern County Socioeconomic Profile

This three-county socioeconomic profile will discuss population demographics, housing, educational attainment, personal income sources, unemployment, major economic sectors related to public lands, economic specialization, development in the Wildland Urban Interface (WUI), and transfer payments to counties. The primary sources of information in this section were derived from the 2008 version of the Economic Profile System (EPS) and the Economic Profile System Community (EPSC) (www.headwaterseconomics.org).[28] Another important source document was The State of the Sierra (2007) published by the Sierra Business Council in partnership with the Sierra Nevada Conservancy.

27. The Sierra Nevada Conservancy Revised Strategic Plan can be viewed and downloaded at: http://www.sierranevada.ca.gov/docs/SNC_Strategic_Plan_3-5-09.pdf

28. Databases used for EPS and EPSC profiles are from: Bureau of the Census including County Business Patterns; Bureau of Labor Statistics; and the Regional Economic Information System (REIS) of the Bureau of Economic Analysis, U.S. Department of Commerce.

Population Demographics

The Sierra Business Council stated (2007):

> Throughout the Sierra Nevada, population growth is the driving force of change. Increased population is the origin of the variety of changes and needs occurring in the Sierra Nevada: home construction, changing land uses from agricultural or forestry to commercial and residential, demands for infrastructure improvements such as schools, roads, and utilities, and employment opportunities (p. 16).

Population growth in the three-county area is no exception: from 1970 to 2006 the population grew by 1,136,986 people, a 122 percent increase in population. At an annual rate, this represents an increase of 2.2 percent. To put these numbers in perspective, over the past 36 years population growth in the three-county area has outpaced that of California and the nation, 122 percent versus 81 percent and 41 percent respectively. It is important to note that these numbers only account for full-time residents, not the growing number of visitors and second homeowners who also stay in the area.

A comprehensive assessment of population demographics in the three-county area can be found in, "A Profile of the Environmental Justice in three-county study area" by Headwaters Economics (October 13, 2008).[29] This assessment includes information on race, ethnicity, age, gender, and tribal affiliation among other attributes. Also, the sections contained in this document on environmental justice and civil rights will provide a more detailed summary of population demographics in the three-county area.

Age demographics: Another parallel trend between the three-county area and the Sierra Nevada as a whole is an increasingly older population without a complementary increase in the next generation of residents. The age group that has grown the fastest from 1990-2000, as a share of the total population, is 45 to 54 years of age across the three counties. As this Baby Boom generation continues to age, a corresponding increase in economic sectors such as health and human services will be required (Sierra Business Council 2007). Yet the younger generation, ages 25-34, make up an increasingly smaller proportion of the area's population. The Sierra Business Council notes that, "Members of this age bracket often are at the beginning stages of a career, frequently have young children, and lack much disposable income. Combining these factors with the escalating costs of housing in the Sierra Nevada makes the region less hospitable to them" (2007 p. 18). They further note that "…the percentage of school-aged children in the Sierra Nevada continues to lag behind the state, and with public funding tied to school enrollment our school systems may suffer. This trend perpetuates itself by making the region less welcoming to younger generations and families" (Sierra Business Council 2007 p. 18).

Hispanic demographics: Another key demographic trend is the increasing Hispanic or Latino population in the three-county area. In the 2000 census, California was 47 percent non-Hispanic white and 32 percent Hispanic. Most of the central San Joaquin Valley had even higher Hispanic percentages—about 38 percent in Kern County, 44 percent in Fresno, Kings and Madera counties, 45 percent in Merced County, and a majority of 51 percent in Tulare County. Yet, according to a 2002 Sequoia and Kings Canyon National Park survey, Hispanics were not visiting national parks at the same rate as non-Hispanics. Only 10 percent of visitors to Sequoia and Kings Canyon National Parks were of Hispanic descent, according to the 2002 survey (National Parks Conservation Association [n.d.], accessed on October 21, 2009 from http://www.npca.org/familyday/NPFD09_Fact_Sheet.pdf). While Hispanics represent about 44 percent of Fresno County's population, only 8 percent of visitors to Yosemite in 2005 were Hispanic (National Parks Conservation Association [n.d.], accessed on October 21, 2009 from http://www.npca.org/familyday/NPFD09_Fact_Sheet.pdf).

In addition to ethnic differences in visitation to national parks, another study conducted in 2000 indicated the following possible differences between non-white and white ethnic groups when camping (Dean Runyan Associates 2000 p.52):

- White campers take more overnight camping trips and have longer stays.
- Non-white campers are more than twice as likely to travel to the campground in an auto, van or truck with a tent.

29. This assessment can be viewed and downloaded at http://www.headwaterseconomics.org/sequoia.php

- Non-white campers are with family and friends slightly more often.
- White campers are much more likely to have no children along on camping trips.
- Non-white campers are an average of 5.9 years younger.
- Non-white campers are more than twice as likely to participate in fresh water fishing.
- White campers use guidebooks almost twice as often as non-white campers; non-white campers rely more on information from friends/relatives as compared to white campers.
- Regarding conditions required for taking more camping trips, twice as many non-white campers would prefer more participation of family/friends as compared to white campers.[30]

These demographic trends are important considerations to the development of a Monument plan. Key to understanding these changing needs and desires is the active engagement of these communities in the planning process.

Housing

The Sierra Business Council suggests that, "With population the dominant driver of change in the Sierra Nevada, home prices may be the most immediate indicator of the region's rapid growth" (2007 p. 19). This is certainly true in the three-county area. The owner occupied Housing Affordability Index is one way to measure whether the median family can afford the median priced house.[31] Based on the index values for all three counties in the year 2000, the medium family can afford the median house (see the following table). This is in sharp contrast to the State as a whole, and the Sierra Nevada region in general, where the index value suggests that the median family cannot afford the median house (see the following table; information from EPSC profiles for California and each county 2008) (Sierra Business Council 2007). It should be noted that these findings do not take into account the most recent recession. Yet, population growth and earnings per job (both up 2.2 percent) during the previous recovery (2001-2006) in the three-county area outpaced both California and the United States. This suggests that the three-county area weathered the previous recession fairly well and may likely do the same as it moves through the current recession. Housing affordability and the likely ability to recover from recession are both indicators that the three-county area will continue to grow at a rapid pace. Population growth, land-use change and development patterns will continue to put pressure on existing agriculture, forestry and open space lands. Accompanying this growth will be increased use of the Monument and the potential for greater effects from increasing population and development.

Table 115 Housing Affordability Index for California and Three-Counties: Kern, Fresno, and Tulare

	California	Kern	Fresno	Tulare
Housing Affordability Index in 2000 (100 or above means that the median family can afford the median house.)	89	149	130	131

Educational Attainment[32]

It is well recognized that adults with higher levels of education have greater employment options than less educated adults. Employment opportunities with the Forest Service encompass a range of educational levels, yet opportunities for higher wage, professional-level positions require positive education requirements beyond high school. Also, the Sierra Business Council noted that, "…entrepreneurs look for places to grow their businesses, they are attracted to places with more highly educated populations, indicating the quality and diversity of the labor pool" (2007 p. 23).

30. This study was a cooperative project of the California Roundtable on Recreation, Parks and Tourism and California Tourism. Non-white ethnic groups were aggregated since the quantity of responses from individual non-white ethnic groups was too small for reporting purposes.

31. The housing affordability figures assume a 20 percent down payment and that no more than 25 percent of a family's income goes to paying the mortgage. It is based on an interest rate of 10.01 percent in 1990 and 8.03 percent in 2000.

32. Data obtained for educational attainment came from EPSC profiles for U.S., California, and each county, 2008

The three-county area has a higher percentage of residents 25 years and older (34 percent) with less than a high school degree than either the state (23 percent) or the nation (20 percent). In contrast, California has a lower percentage of high school graduates (20 percent) than either the three-county area (23 percent) or the nation (29 percent). The percent of residents 25 and older with some college (21-23 percent) or an associate degree (6-7 percent) are consistent throughout the nation, state and three-county area. The state and the nation have a relatively higher concentration of bachelor (16-17 percent) and graduate degrees (9 percent) than the three-county area (10 percent and 4 percent, respectively).

Because a full third of the residents in the three-county area have less than a high school diploma, public outreach and access to information concerning the Monument should be easily obtainable through a wide-variety of sources and presented in clear, bi-lingual language and visual representations.

Personal Income Sources

Personal income is calculated as the sum of wages and salary disbursements, other labor income, proprietors' income, rental income, personal dividend income, personal interest income, and transfer payments to persons. A comprehensive view of personal income sources shows how and where an area makes its money.

Average earnings per job:[33] This statistic is calculated by dividing the total wages earned by the total number of workers. The average earnings per job, adjusted for inflation, have risen from $37,530 in 1970 to $41,854 in 2006. In comparison, in 2006, the average earnings per job in the three-county area ($41,854) were lower than in the state ($54,828) and the nation ($47,286). It is important to note that this statistic includes full and part-time employment. The comparative decline in wages from the state and the nation is due in part to higher levels of seasonal employment in the three-county area (see the following table; information from EPSC profiles for California and each county 2008). The potential for increased levels of recreation opportunities within the Monument may lead to an increase in tourism throughout or within certain sectors of the three-county area. Yet, an increase in tourism has the potential to further the decline in earnings due to the increase in seasonal (part-time) workers.

Table 116 Percent Seasonal Workers in U.S., California and Three-Counties: Kern, Fresno, and Tulare

	U.S.	California	Kern	Fresno	Tulare
Seasonal workers (less than 40 weeks/year)	20.9	21.9	28.4	28.7	30.5

Commuting share of total income: (EPS profiles for each county 2008 p. 20). As explained by the Sierra Business Council (2007 p. 24), "Commute wages are earned outside a person's county of residence. People commute when they prefer to live elsewhere from where they work, they can't afford to live where they work, or they can't find appropriate work where they live." Commuting data suggests that Tulare County is a bedroom community. In other words, income derived from people commuting out of the county to work exceeds the income from people commuting into the county. The net difference represents 2.2 percent of total income in the county.

In contrast, commuting data suggests that Fresno and Kern Counties are employment hubs. In other words, the income derived from people commuting into the county to work exceeds the income from people commuting out of the county. The net difference represents 1.0 percent of total income in each county.

These trends suggest that a portion of people in Tulare County are commuting to employment hubs in either Fresno or Kern Counties, particularly in jobs related to finance, professional, education, health and social service sectors (EPS—Differences between Counties 2008 p. 2). It is expected that this trend will continue as the population expands and the Baby Boom generation continues to age—both become more

33. Data for average earnings per job from EPS—3-County Aggregation Profile, 2008, p.14

dependent on service sectors provided in employment hubs.

Non-Labor income:[34] The term "non-labor income" consists of dividends, interest, and rent as well as transfer payments. Transfer payments refer to payments from government to individuals such as Medicare, Social Security, unemployment compensation, disability insurance payments and welfare. These sources of income can buffer the local economy against downturns in regional or seasonal industries such as timber and tourism. As the Sierra Business Council acknowledges, this type of income can also "…disconnect[s] residents from local economic fortunes" (2007 p.25).

As a percentage of total personal income in 2006, 32.6 percent came from non-labor sources in the three-county area. This percentage ranks close to the state average (30.4 percent) and the national average (31.6 percent). Within transfer payments, medical payments across the U.S. were the fastest growing source of income, likely due to increasing medical costs (Sierra Business Council 2007 p. 25). In 2006, welfare represented 18.5 percent of transfer payments, and 3.8 percent of personal income. This is down from 1970 and down from 1980, indicating that levels of poverty have steadily decreased from 1970-2006.

Importantly, much of this transfer income belongs to the Baby Boom generation. It is possible that as this generation passes on, in large part over the next 25-30 years, this income will be transferred through inheritance and taxes, potentially outside the area. This could leave the three-county area more vulnerable to national and state-wide fluctuations in a global economy.

Unemployment[35]

In 2007, the unemployment rate was 8.6 percent in the three-county area, compared to 5.4 percent in the state and 4.6 percent in the nation. In 2009, the annual average unemployment rate rose in all states. The U.S. jobless rate rose 3.5 percentage points in 2009 from the prior year to 9.3 percent nation-wide.[36]
In California, the average annual unemployment rate in 2009 rose 4.2 percentage points from the prior year to 11.4 percent. For the period February 2009 through March 2010 the unemployment rates were 15.7 percent in Fresno County; 14.3 percent in Kern County; and 16.1 percent in Tulare County. Since 1990, the unemployment rate in the three-county area varied from a low of 8.0 percent in 2006 to a high of 16.2 percent in 1993. Importantly, the unemployment rate throughout the San Joaquin Valley is consistently higher than the state or the nation as a result of the seasonality of the agricultural economic sector

Unemployment has obvious and well-documented links to economic disadvantage. Further, unemployment among youth not only causes current hardship, but may also hinder future economic success. This is because unemployed youth are not able to gain experience and on-the-job training and because a history of joblessness signals that the individual may not have the qualities that are valued in the labor market (Unemployment Encyclopedia 2009, accessed on September 10, 2009 from Unemployment -Consequences Of Unemployment).

Major Economic Sectors Related to Public Lands[37]

The primary economic sectors associated with public lands include: timber related, mining, and travel and tourism. As illustrated in the following figures, the total share of these sectors is consistent with those in the state and the nation except for Kern County, where the share of mining (3 percent) is higher than Tulare or Fresno Counties (0 percent), the state (0 percent), or the nation (0 percent). The major economic sectors related to public lands combined represent a small proportion of jobs (6 percent) in the three-county area compared to all other jobs (94 percent). This combined percentage of major economic sectors related to public lands is consistent with both the state (6 percent) and the nation (5 percent). A more thorough discussion of the potential effects to these economic sectors directly attributable to the Monument can be found in the next section "Major Natural Resource Economic Sectors."

34. Data for non-labor income from EPS profiles for U.S., California and 3-County Aggregate, 2008, p. 10
35. Data for unemployment from EPS—3-County Aggregation Profile, 2008, p.19
36. Data for 2009 unemployment from U.S. Bureau of Labor Statistics, Division of Labor Force Statistics, http://www.bls.gov/cps/
37. Data for major economic sectors related to public lands from Economic Profile System Analyst (EPSA) Profile for Major Sectors Related to Public Lands in Three-County Study Area, 2008, p. 4.

Specialization[38]

Counties heavily reliant on only a few industries may be economically vulnerable to changes in the global economy. By using the composition of sectors within the U.S. economy as a benchmark for economic diversity, a comparison can be drawn to the relative diversity of the three-county area. In so doing, the sectors that most diverge from the U.S. norm are:

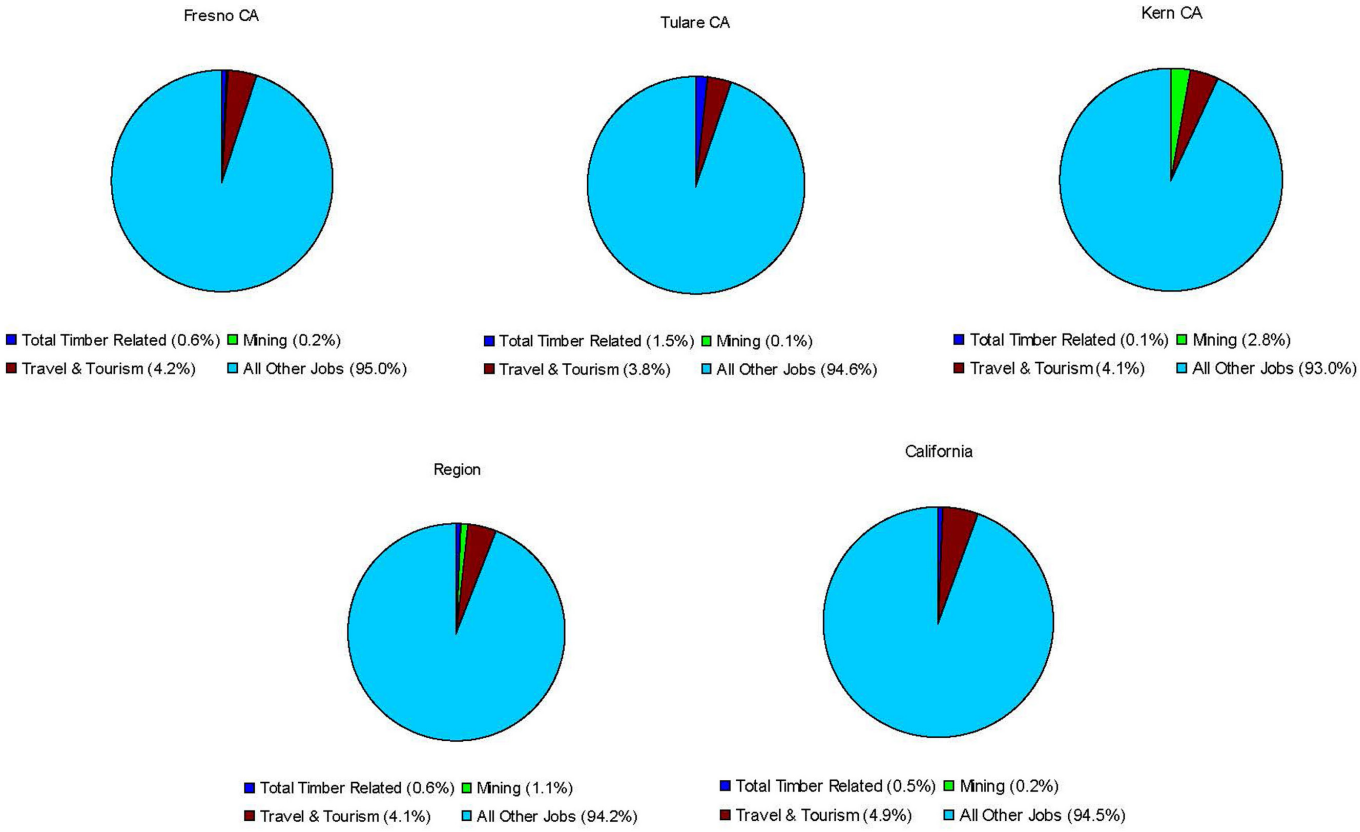
- Over reliance on agriculture, forestry, fishing, and hunting (9.7 percent in the three-county area compared to 1.5 percent in the U.S.).
- Under reliance on manufacturing (7.7 percent in the three-county area compared to 14.1 percent in the U.S.).
- Under reliance on professional, scientific and technical services (3.4 percent in the three-county area compared to 5.9 percent in the U.S.).
- Over reliance on public administration (7.1 percent in the three-county area compared to 4.8 percent in the U.S.).

According to the Sierra Business Council (2007 p. 27):

> Traditional natural resource extraction industries continue to decline in economic importance in the Sierra Nevada. Creating and sustaining natural resource industries within the region through biomass energy production and carbon sequestration would [improve] financial wealth while maintaining or improving natural and social wealth.

The proposed activities within the Monument have the potential to generate sustainable opportunities in these new industries, potentially assisting in the diversification of the local economy.

Figure 12 EPSA Profile for Major Sectors Related to Public Lands in the Three-County Study Area 2008



38. Data for specialization from EPS—3-County Aggregation Profile, 2008, p.23

Wildland Urban Interface (WUI)

According to Headwaters Economics (2007):

> More and more people are building homes in the western "wildland urban interface," the forested areas where housing borders undeveloped public lands. With more homes built in forested areas, it has become increasingly expensive to fight the inevitable wildfires that are part of life in the arid West" (accessed on September 11, 2009 at http://www.headwaterseconomics.org/wildfire/#cht).

Further, a Headwater Economics study of development in the western U.S. along the WUI concluded (2007, accessed on September 11 2009 at http://www.headwaterseconomics.org/wildfire/#cht):

- Only 14 percent of forested western private land adjacent to public land is currently developed for residential use. Based on current growth trends, there is tremendous potential for future development on the remaining 86 percent.
- If homes were built in 50 percent of the forested areas where private land borders public land, annual firefighting costs could range from $2.3 billion to $4.3 billion per year. By way of comparison, the U.S. Forest Service's annual budget is approximately $4.5 billion.
- One in five homes in the wildland urban interface is a second home or cabin, compared to one in twenty-five homes on other western private lands.

Within the three-county area, Fresno (42 percent) and Tulare (22 percent) Counties exceed the percent developed in the west and the state (17 percent): Kern County is consistent with the west-wide average (14 percent). Also, the three-county area has a much higher percentage of second homes (46-79 percent) than either the state (19 percent) or west wide (21 percent) (see the following table).

Specifically, the Sequoia National Forest is adjacent to 41 "communities at risk" from wildfire. Thirteen of these communities have Community Wildfire Protection Plans (CWPPs) in place. The communities of Kennedy Meadows, Pine Mountain, and Alder Creek are currently in the process of developing a CWPP. The majority of these communities are serviced by the following Fire Safe Councils: Sequoia, Alder Creek, Kern Valley, and Highway 180.

It should be noted that the Sierra Nevada Forest Plan Amendment Final Environmental Impact Statement, Record of Decision (January 2001) defines the WUI more specifically as the Wildland Urban Intermix Zone including both "defense" and "threat" zones.[39] The specificity of these zones changes the actual number of structures potentially affected, thus the data presented here is for comparative purposes only.

In addition to on-going Forest Service and other government-assisted wildland fire protection measures, these higher than average numbers in the three-county area suggest additional measures could assist in protecting these developing areas from wildfire. Additional measures could include: appropriate zoning, wildfire protection ordinances, volunteer fire departments, and additional Fire Safe Councils and Community Wildfire Protection Plans.

Table 117[40] Development in the Wildland Urban Interface (WUI)

	Developed Square miles	Undeveloped Square Miles	Percent Developed	Homes	Percent Second-homes
West-wide	3,290.0	20,350.1	14	915,071	21
California	871.8	4,257.0	17	341,175	19
Fresno County	20.7	28.5	42	3,351	62
Kern County	5.2	33.4	14	2,633	46
Tulare County	9.8	35.1	22	2,264	79

39. See Sierra Nevada Forest Plan Amendment, FEIS, ROD, Appendix A, pp. 46-47 for a detailed definition of "defense" and "threat" zones.

40. Data accessed on September 11, 2009 at http://www.headwaterseconomics.org/wildfire/#cht

Transfer Payments to Counties (Secure Rural Schools)[41]

Secure Rural Schools, Fiscal Years (FY) 2000-2007: The Secure Rural Schools and Community Self-Determination act of 2000 (SRS) (PL 106-393) was enacted to provide transitional assistance to rural counties affected by the decline in revenue from timber harvests in federal lands. Traditionally, these counties relied on a share of receipts from timber harvests to supplement local funding for school systems and roads. Funding from SRS has been used to support more than 4,400 rural schools and to help maintain county road systems. In addition SRS has authorized the establishment of over 55 Resource Advisory Committees (RACs) in 13 States, which has increased the level of interaction between the Forest Service, local governments, and citizens, resulting in broader support and understanding of our mission. RACs have implemented over 4500 resource projects on national forests, grasslands and adjacent non-federal lands with a value of $185,000,000 from SRS funds and leveraged funds of over $192 million dollars.

Secure Rural Schools, Fiscal Years (FY) 2008-2011: On October 3, 2008, the Secure Rural Schools and Community Self-Determination Act of 2000 was reauthorized as part of Public Law 110-343. The new Secure Rural Schools Act has some significant changes from the original law. A county electing to receive a share of the Secure Rural Schools State payment also was requested to allocate between 15 to 20-percent of its share for one or more of the following purposes: projects under Title II of the Act; projects under Title III; or the Treasury of the United States (county allocations).

Title I. Secure payments for state and counties containing federal land: The Title I portion of the State payment must be used for roads and schools in the manner provided for by state statute.

Title II. Special projects on federal land: Title II funds may be used for the for protection, restoration, and enhancement of fish and wildlife habitat, and other resource objectives consistent with the Secure Rural Schools Act on Federal land and on non-Federal land where projects would benefit the resources on Federal land.

The purposes of the Secure Rural Schools Act include making additional investments in, and creating employment opportunities through projects that:

- improve the maintenance of existing infrastructure;
- implement stewardship objectives that enhance forest ecosystems; and
- restore and improve land health and water quality.

The funds may be used for projects that enjoy broad based support and have objectives that may include:

- road, trail, and infrastructure maintenance or obliteration;
- soil productivity improvement;
- improvements in forest ecosystem health;
- watershed restoration and maintenance;
- the restoration, maintenance, and improvement of wildlife and fish habitat;
- the control of noxious and exotic weeds; and
- the re-establishment of native species.

Planning and implementing the projects should help improve cooperative relationships among the people that use and care for Federal land and the agencies that manage the Federal land.

Title III. County funds: Title III funds may be used to carry out activities under the Firewise Communities program, to reimburse the county for search and rescue and other emergency services, and to develop community wildfire protection plans.

On January 15, 2009 the Forest Service began distributing more than $477 million to 41 states and Puerto Rico for improvements to public schools, roads and stewardship projects. These payments include 25 percent payments, special acts payments and Secure Rural Schools payments. The 2008 Secure Rural Schools payment and projected payments for FY 2009-2011 can be found in the following table for Fresno, Kern and Tulare Counties.

Finally, under the new legislation, all three counties have elected to use a Resource Advisory Committee

41. For more information on Secure Rural Schools Act go to http://www.fs.fed.us/srs/

(RAC) to recommend special projects on federal land. Fresno County will continue use of their existing RAC, while Tulare and Kern counties are in the process of forming a joint RAC. Once appointed by the Secretary of Agriculture, the RAC will solicit projects for two year's implementation. RACs were established as a provision of the Secure Rural Schools and Community Self-Determination Act of 2000 under Title II (see previous page). By law the 4-year term, fifteen-member committee is composed of a wide representation of National Forest interests. More information on the Secure Rural Schools Act, RACs, or transition payments can be found at the following website: http://www.fs.fed.us/srs/.

Table 118 Secure Rural Schools Act, PL 110-343, FY 2008 payment and projected FY 2009-2011 Forest Service Payments to States, July 20, 2009

State	Eligible County	Transition Payment FY 2008	Projected Transition Payment FY 2009	Projected Transition Payment FY 2010	Projected County Share of State Payment FY 2011	Projected Total State or Transition Payment, 2008 thru 2011
CA	Fresno	$2,559,116	$2,303,205	$2,075,728	$2,093,420	$9,031,469
CA	Kern	$402,898	$362,608	$326,795	$616,284	$1,708,584
CA	Tulare	$1,010,700	$909,630	$819,790	$1,707,359	$4,447,479

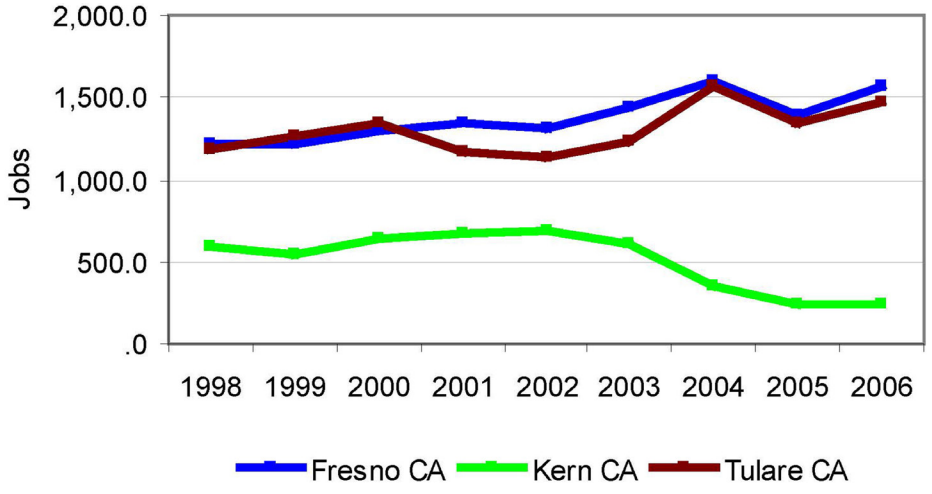
Major Natural Resource Economic Sectors[42]

This section will explore job trends, share of the economy attributed to each sector, differences between counties, and where applicable, a breakdown of the different types of activity within each sector. Finally an assessment of the Forest Service contribution to these sectors will be presented.

Timber[43]

From 1998 to 2006 the number of timber related jobs in the 3-county study area exhibited a small upward trend. Since 1986, of all private jobs added to the 3-county economy, about 1 in 420 was timber-related. Since 1986, the share of timber related jobs as a share of the total private employment varied from a low of 0.6 percent in 2005 to a high of 1.2 percent in 1987. All the gain was in Fresno and Tulare counties with some jobs lost in Kern County in the same period.

Figure 13 Timber Related Jobs

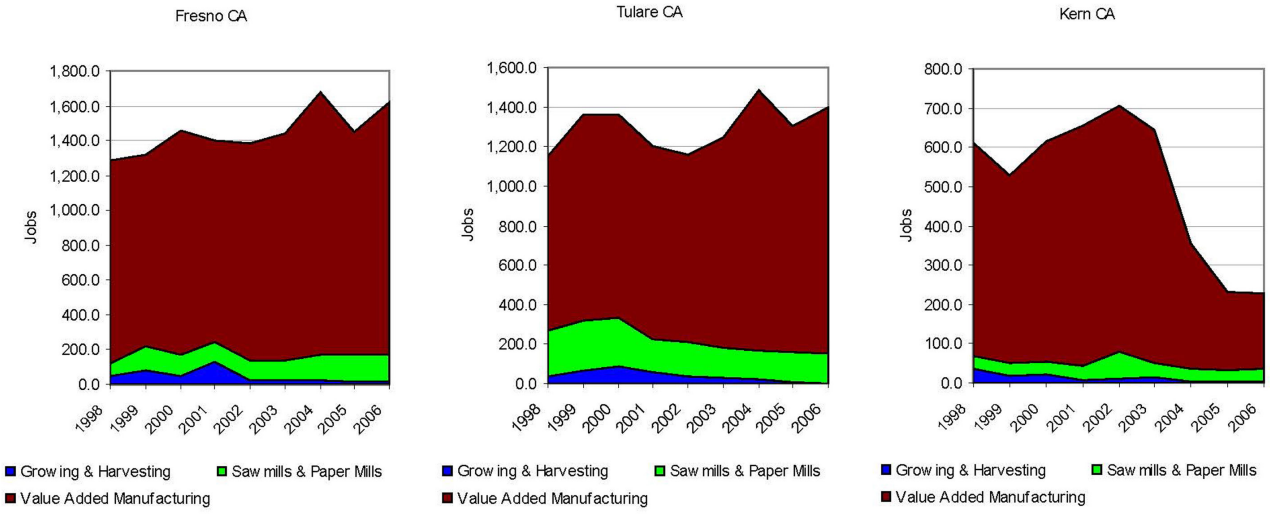


42. Databases used for EPS and EPSC profiles are from: Bureau of the Census including County Business Patterns; Bureau of Labor Statistics; and the Regional Economic Information System (REIS) of the Bureau of Economic Analysis, U.S. Department of Commerce.

43. Data from EPSA—A Profile of the Timber Industry in 3-County Study Area, 2008.

To look at differences within the timber-related employment, this section breaks that employment into three categories. 1) "**Growing and Harvesting**" are jobs directly related to logging and forestry. These jobs typically are in the forest. 2) "**Primary manufacturing**" includes the manufacturing that generally takes raw logs and does the first stage of processing (e.g. sawmills and paper mills). 3) "**Secondary manufacturing**" includes manufacturing that generally takes the output from the primary manufacturing and produces finished products. These jobs tend to yield the most income per log and are often located far from the source of the logs.

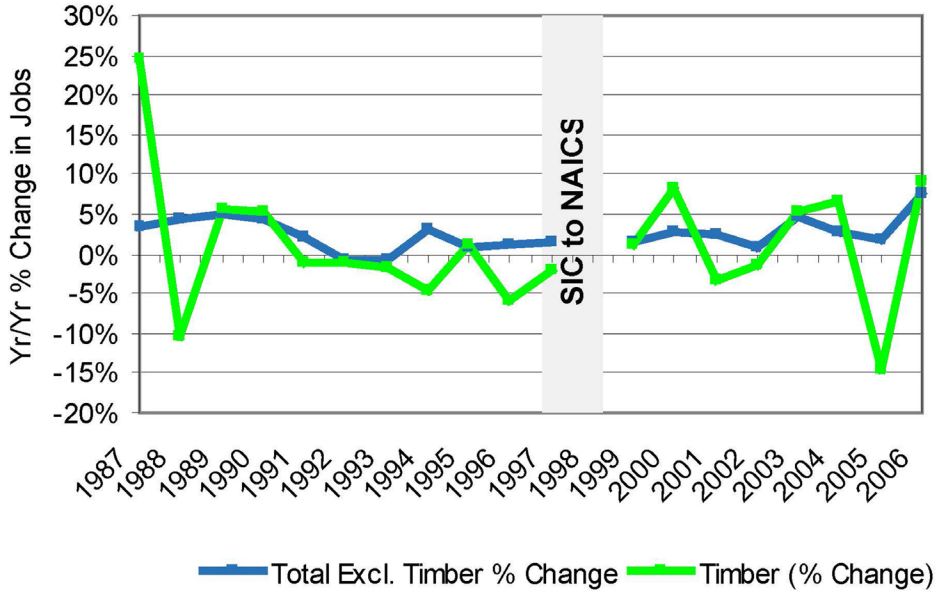
Figure 14 Timber Jobs by Stage of Processing Over Time, 1998-2006



Lines are stacked to sum to total timber related jobs.

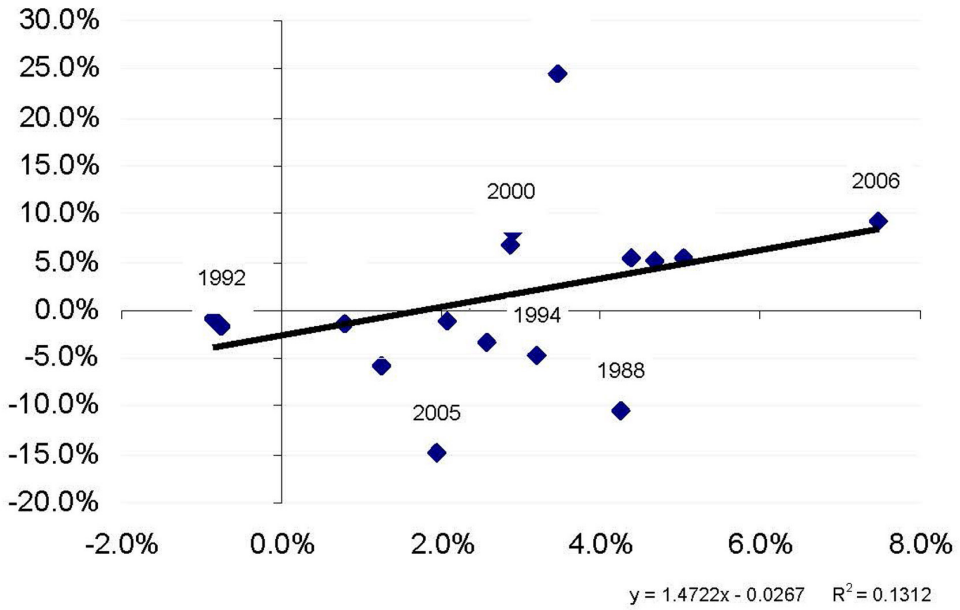
Total timber jobs in Fresno and Tulare counties were high compared to the national average, ranking in the top 6.0 percent of all counties. With about 0.1 percent of its employment in timber jobs, Kern County still ranks near the upper third of all U.S. counties. The largest number of jobs in all three counties is in secondary timber related employment. You can see a steady decline in the "Growing and Harvesting" category.

Figure 15 Percent Change in Timber vs. Total, excluding Timber



The previous figure shows the year to year volatility of the timber industry (in green) compared to the rest of the economy (in blue), from 1987 to 2005. It is clear that the timber sector has experienced more variation from year to year than the economy as a whole.

Figure 16 Percent Change in Timber vs. Total, excluding Timber



This scatter chart plots the percent change in timber jobs versus the percent change in total jobs excluding timber. When there is a strong relationship, the dots should cluster along a line (straight or perhaps curved). Each observation (dot) is labeled with the year that it represents. This also plots the results of a statistical test—a regression analysis. An R-Squared (RSQ) statistic of 1.0 means there is a perfect linear relationship between the timber industry and the rest of the economy. A small RSQ means there is no statistically significant relationship. A linear relationship between timber jobs and total jobs excluding timber is extremely weak (RSQ = 0.13).

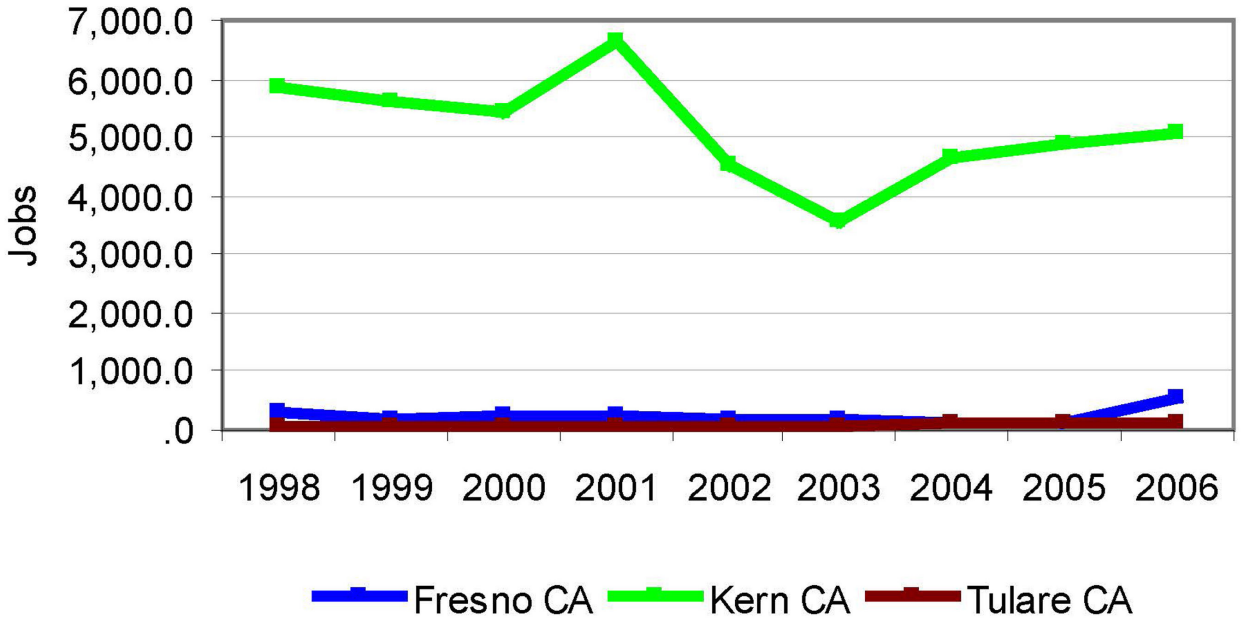
Mining[44]

From 1998 to 2006 the number of mining related jobs in the 3-county study area declined by roughly 8 percent. Since 1986, the share of mining related jobs as a share of the total private employment varied from a low of 0.8 percent in 2003 to a high of 3.5 percent in 1986. All the gain was in Fresno and Tulare counties with some jobs lost in Kern County in the same period.

Total mining jobs in Fresno and Tulare counties were roughly at or slightly above the national average. With about 2 percent of its employment in mining jobs, Kern County ranks in the top 1.0 percent U.S. counties. Most of these jobs are in oil and gas extraction and not connected to either the national forest or the Monument. Even while losing jobs in this sector, Kern County still ranks number 8 nationally for mining employment.

44. Data from EPSA—A Profile of the Mining Industry in 3-County Study Area, 2008.

Figure 17 Mining Jobs



Travel and Tourism[45]

Travel and tourism related jobs are defined as the proportion of the county's (or region's) jobs that are in industries likely to be closely associated with travel and tourism. For example, some part of the transportation industry is in charter buses, shuttle services, and similar sectors. A portion of these sectors is assumed to be travel related and not local use. Likewise the retail trade industry includes sectors like gasoline stations, where only part of the activity can be attributed to travel and tourism. To see the Bureau of Economic Analysis (BEA) description of the Travel and Tourism industry, see: http://www.bea.gov/industry/iedguide.htm #ttsa. For a methodology paper on this technique, see: http://www.bea.gov/scb/pdf/2009/06%20June/0609_travel-text.pdf

According to County Business Patterns, in 2006, just over 4 percent of the jobs in the 3-county area were in travel and tourism. By comparison, travel and tourism related jobs in the US accounted for 4.9 percent of the national economy (excludes proprietors and government).

As displayed in the following figure, from 1998 to 2006, travel and tourism employment in the 3-county study area has grown by 15 percent, faster than the state or the nation. This growth rate, while impressive, is still almost half that all private jobs excluding travel and tourism which grew by nearly 28 percent over the same period.

For the same period, all three counties gained travel and tourism related jobs. The share of tourism related jobs as a share of the total private employment varied from a high of 4.5 percent in 1998 to a low of 4.1 percent in 2006 and generally declined. Close to 42 percent of these jobs are in "Food Service and Drinking Places" and 11 percent in Retail excluding gasoline stations. Together, the 3-county study area accounts for just over 3 percent of California's travel and tourism jobs.

The scatter chart plots the percent change in travel and tourism jobs versus the percent change in total jobs excluding travel and tourism. A linear relationship between travel and tourism jobs and total jobs excluding travel and tourism is weak (RSQ = 0.35), but stronger than that for timber related jobs.

Travel and tourism jobs in Fresno County were high compared to the national average, ranking in the top 4.0 percent of all counties. With about 4 percent of its employment in these jobs, Kern County ranks in the top 6 percent of all U.S. counties and Tulare County ranks in the top 10 percent.

45. Data from EPSA—A Profile of the Travel and Tourism in 3-County Study Area, 2008.

Figure 18 Travel and Tourism Jobs

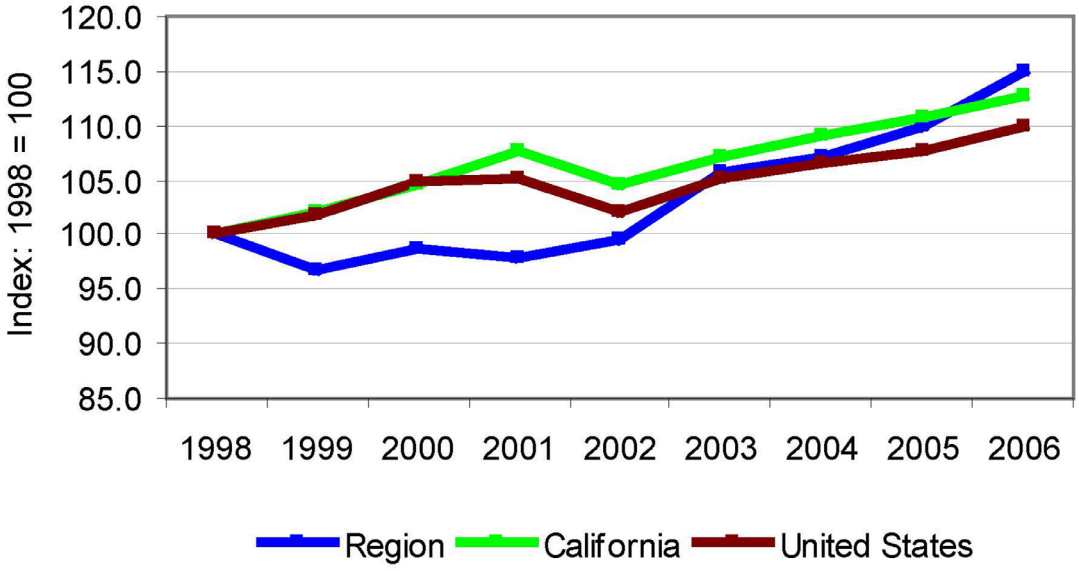


Figure 19 Percent Change in Travel and Tourism vs. Total, excluding Travel and Tourism

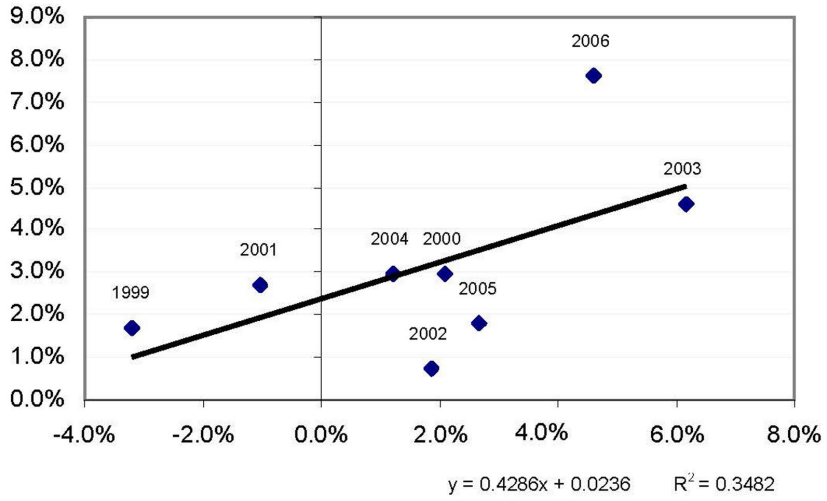
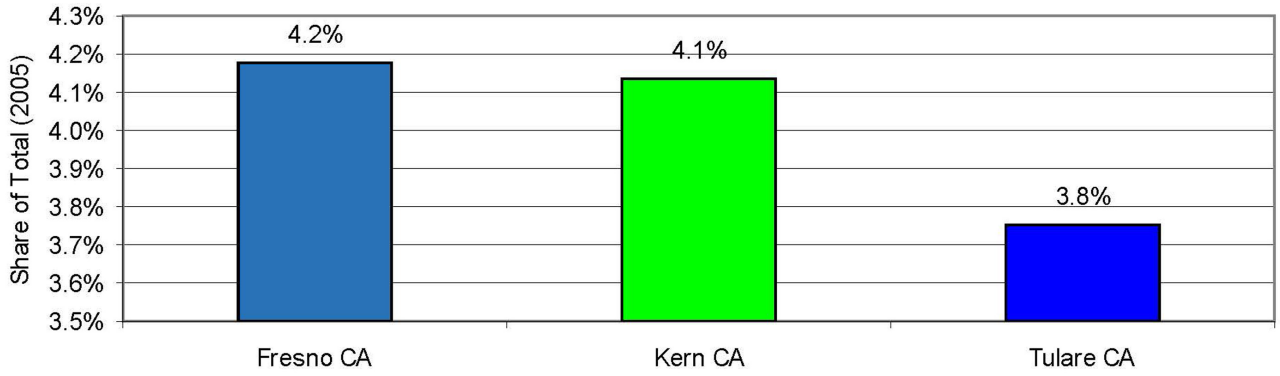


Figure 20 Travel and Tourism Share of Total Employment, 2006



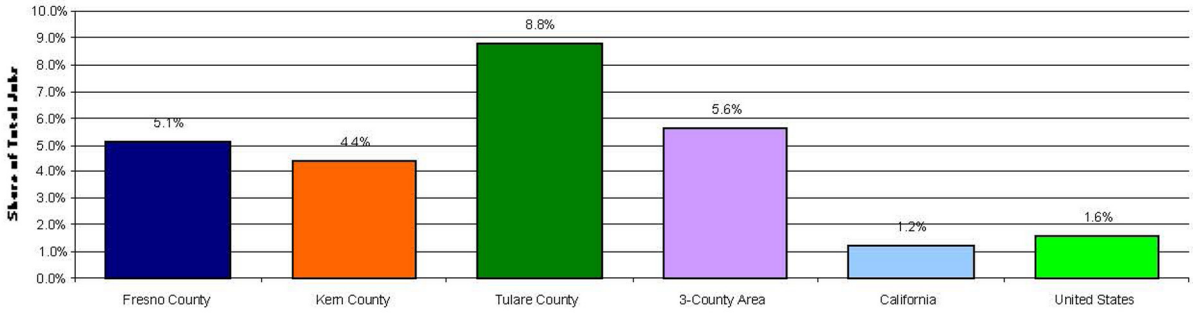
Agriculture[46]

The 3-county study area ranks among the top 5 California counties in terms of volume of inventory and production in the following sectors: cattle and calves, almonds, grapes, corn for silage, all vegetables, sheep and lambs, colonies of bees, oranges, and tomatoes. The area has witnessed a major increase in the volume of cattle and calves since the early 1990s, with dairy cattle increasing over 3½ times while beef show a slight decline. Sheep numbers also are in decline.

The 3-county area is unique in that farmers' net income has been positive since the early 1970s. The volatility in net income is strongly influenced by income from crops; any changes in livestock appear to be less important annually.

Agriculture's share of total jobs as shown in the following graph is higher than timber, mining, and travel/tourism combined.

Figure 21 Agriculture Jobs, Share of Total



Forest Service Contribution

A portion of the economic activity in the three-county area is associated with industries dependent on the use of natural resources within the Forest. The following table includes the direct, indirect, and induced effects of the linkages in the economy. For example, a job as a logger would be a direct effect, the indirect effects would be the jobs created by the logger's need for rigging, gasoline, saws, and the like. The induced effects are what happens to the logger's wages as well as the wages from the saw shop and the gas station.

The following table is the result of IMPLAN/FEAST analysis. IMPLAN is a proprietary system of software and databases produced by Minnesota IMPLAN Group. IMPLAN uses a variety of data sources including:

- U.S. Bureau of Economic Analysis Benchmark Input/Output Accounts of the U.S.
- U.S. Bureau of Economic Analysis Output Estimates
- U.S. Bureau of Economic Analysis Regional Economic Information System (REIS) Program
- U.S. Bureau of Labor Statistics Covered Employment and Wages (ES202) Program
- U.S. Bureau of Labor Statistics Consumer Expenditure Survey
- U.S. Census Bureau County Business Patterns
- U.S. Census Bureau Decennial Census and Population Surveys
- U.S. Census Bureau Economic Censuses and Surveys
- U.S. Department of Agriculture Crop and Livestock Statistics
- U.S. Geological Survey

FEAST is a national Forest Service application which takes the IMPLAN description of the linkages in an economy and adds information specific to Forest Service management to arrive at the Forest Service contribution to that economy. Data include:

- Forest Service Cut and Sold Report

46. Data from EPSA—A Profile of Agriculture in 3-County Study Area, 2008.

- Forest Service authorized use for a permit reports (grazing)
- Forest Service National Visitor Use Monitoring reports
- Census of Agriculture reports
- Mill surveys
- Forest Service full time equivalent (FTE) employment figures
- Forest Service budgets

Table 119 Current Role of Forest Service-Related Contributions to the Area Economy

Industry	Employment (jobs)		Labor Income (Thousands of 2008 dollars)	
	Area Totals	FS-Related	Area Totals	FS-Related
Agriculture	159,433	61	$4,698,104.1	$1,511
Mining	10,290	2	$1,246,666.6	$424
Utilities	4,054	2	$601,376.4	$274
Construction	68,018	32	$3,864,102.2	$1,838
Manufacturing	55,211	29	$3,251,478.8	$1,476
Wholesale trade	30,546	43	$1,845,495.4	$2,604
Transportation and warehousing	35,377	23	$1,968,696.5	$1,242
Retail trade	96,430	122	$3,111,047.2	$3,827
Information	8,544	11	$573,782.8	$611
Finance and insurance	26,817	20	$1,487,478.9	$1,155
Real estate and rental and leasing	23,344	28	$718,293.7	$797
Prof, scientific, and tech services	39,428	29	$2,081,775.5	$1,331
Mngt of companies	6,819	5	$406,822.5	$318
Admin, waste mngt and rem serv	50,724	31	$1,355,542.0	$809
Educational services	8,295	6	$180,920.9	$136
Health care and social assistance	87,117	50	$3,883,728.0	$2,317
Arts, entertainment, and rec	9,328	51	$179,083.9	$1,149
Accommodation and food services	54,559	316	$966,172.7	$6,070
Other services	57,967	32	$1,378,015.0	$747
Government	148,843	545	$9,739,458.5	$18,707
Total	981,144	1,438	$43,538,042	$47,343
FS as percent of total	—	0.15 percent	—	0.11 percent

Gateway Communities[47]

While socioeconomic differences exist among the three counties, differences also exist among the smaller communities adjacent to the Monument. Activities in the Monument have the potential to affect those communities frequently referred to as "gateway communities."

This section will assess the following gateway communities for their unique social and economic characteristics: Springville, Porterville, Tule River Indian Reservation, Squaw Valley, Wofford Heights, Lake Isabella, and Kernville. For each of these communities, the following characteristics are summarized: demographics (race, ethnicity, and age), housing, employment by industry (top 10), place of work, method of commute, specialization index, and source of income. It should be noted that the term "tourism" incorporates a cross-section of categories of employment by industry type, please refer to the "Travel and Tourism" section above for a complete description.

To begin, a comparison of characteristics among the gateway communities, Kern County, Fresno County, Tulare County, the state and nation will be presented from the 2000 census. These comparisons provide an indication of key differences between and among gateway communities.

Demographics: The demographic patterns considered include: median age, largest age category, percent by race, and percent Hispanic or Latino of any race. Generally, residents of gateway communities are predominately white and older in age (88.3 percent White or higher and a median age range of 46.1 to 58.3). Notable exceptions occur on the Tule River Indian Reservation (87.5 percent American Indian or Alaska Native and a median age of 25.8) and Porterville (32.7 percent some other race and a median age of 28.6). Hispanic or Latino populations are greatest in the three-county area and the city of Porterville, ranging from 38.4 percent to 54.5 percent.

Table 120 Comparison of Demographics

Demographics	United States	California	Fresno Co.	Kern Co.	Tulare Co.	Porterville	Springville	Squaw Valley	Tule River Indian R.	Lake Isabella	Kernville	Wofford Heights
Median age	35.3	33.3	29.9	30.6	29.2	28.6	46.1	43.5	25.8	46	52.1	58.3
Largest age category	35-39	35-39	5-9	5-9	5-9	5-9	45-49	50-54	10-14	10-14	15-19	70-74
Percent white	75.1	59.5	54.3	61.6	58.1	54.8	94.1	88.3	6.2	90.4	90.6	93.3
Percent black or African American	12.3	6.7	5.3	6.0	1.6	1.3	0.1	1.4	0.0	0.1	1.2	0.1
Percent American Indian or Alaska Native	0.9	1.0	1.6	1.5	1.6	1.7	0.5	2.4	87.5	1.9	2.1	1.2
Percent Asian	3.6	10.9	8.1	3.4	3.3	4.6	0.3	0.6	0.2	0.8	0.7	0.7

47. Unless otherwise noted, data for each of the listed gateway communities was accessed on October 21, 2009 from "Profiles for Selected Towns Near the Forest (2000 Census Designated Places)" http://www.headwaterseconomics.org/sequoia.php

Demographics	United States	California	Fresno Co.	Kern Co.	Tulare Co.	Porterville	Springville	Squaw Valley	Tule River Indian R.	Lake Isabella	Kernville	Wofford Heights
Percent Pacific Islander	0.1	0.3	0.1	0.1	0.1	0.2	0.0	0.2	0.0	0.1	0.1	0.0
Percent some other race	5.5	16.8	25.9	23.2	30.8	32.7	1.8	4.8	4.8	2.5	2.2	1.4
Percent two or more races	2.4	4.7	4.7	4.1	4.6	4.7	3.2	2.3	1.4	4.2	3.2	3.3
Percent Hispanic or Latino (of any race)	12.5	32.4	44	38.4	50.8	54.5	5.6	12.2	21.6	6.8	8.2	6.2

Housing: Housing patterns considered include: percent of housing units occupied, percent owner occupied or for sale, percent renter occupied or for rent, and percent seasonal, recreational or occasional use (i.e., second home). The highest percent of housing units occupied is in the state (94.2 percent) while the lowest is in the communities of Lake Isabella, Kernville, and Wofford Heights (70.4 percent, 66.1 percent, and 58.4 percent respectively). These same three communities also have the greatest percent of seasonal, recreational, or occasional use: Lake Isabella 15.1 percent, Kernville 28 percent, and Wofford Heights 29.4 percent. Two communities, Squaw Valley (77.7 percent) and the Tule River Indian Reservation (67.6 percent) have a greater percentage of owner occupied or units for sale than the nation (61.3 percent). Fresno County (43 percent) and the communities of Porterville (44 percent) and Springville (48 percent) have a greater percentage of renter occupied or units for rent than the state (42.1 percent).

Table 121 Comparison of Housing

Housing	United States	California	Fresno Co.	Kern Co.	Tulare Co.	Porterville	Springville	Squaw Valley	Tule River Indian R.	Lake Isabella	Kernville	Wofford Heights
Percent housing units occupied	91	94.2	93.4	90.1	92.3	93.6	88.7	88.4	88.8	70.4	66.1	58.4
Percent owner occupied or for sale	61.3	54.3	53.6	57.4	57.8	53.9	47.6	77.7	67.6	50.4	51.2	52
Percent renter occupied or for rent	33	42.1	43	37.2	37.7	44	48	13.8	21.8	26.7	18.2	11.6

Housing	United States	California	Fresno Co.	Kern Co.	Tulare Co.	Porterville	Springville	Squaw Valley	Tule River Indian R.	Lake Isabella	Kernville	Wofford Heights
Percent seasonal, recreational, or occasional use	3.1	1.9	1.3	2.5	2.3	0.4	3.3	5.6	0.0	15.1	28	29.4

Place of Work and Method of Commute: Where residents worked and the time spent commuting included: percent of residents who worked in town, and percent commute time under 20 minutes. The communities of Kernville (34 percent), Wofford Heights (24 percent), Springville (24 percent), and Squaw Valley (6 percent) had a smaller percentage of residents who worked in town than either the state (36 percent) or the nation (42 percent). The percentage of residents with a commute time of 20 minutes or less was greatest in Porterville (64 percent), Kernville (61 percent), and Lake Isabella (59 percent). It should be noted that the commuting distance between the communities of Lake Isabella, Wofford Heights, and Kernville is 20 minutes. The percent of residents with a commute time of 20 minutes or less was least in Squaw Valley (9 percent).

Table 122 Comparison of Place of Work and Method of Commute

Place of Work and Method of Commute	United States	California	Fresno Co.	Kern Co.	Tulare Co.	Porterville	Springville	Squaw Valley	Tule River Indian R.	Lake Isabella	Kernville	Wofford Heights
Percent residents who worked in town	42	36	59	50	44	57	24	6	###	56	34	50
Percent commute time under 20 minutes	44	39	50	54	55	64	32	9	51	59	61	54

Specialization: A diversified regional economy is defined as an economy that has an industrial mix similar to the nation's. A specialized economy is heavily focused in particular industries. Such specialization may lead to greater variation in labor demand (relative to the nation) if businesses in the same major industry group tend to expand or contract at the same time. The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. The Tule River Indian Reservation (1,455) and Kernville (1,028) had the highest index values compared to the nation (789) indicating a greater level of industrial specialization. In Kernville, the education, health and social service sector employed the highest percentage of workers (26 percent), with the majority of these jobs attributable to Camp Owen, a non-secure juvenile forestry camp. On the Tule River Indian Reservation both the education, health and social service sector (27 percent) and the arts, entertainment, recreation, accommodation, and food service sector (24 percent) employed the greatest percentage of workers (a primary employer is the Eagle Mountain Casino).

Table 123 Comparison of Specialization

	United States	California	Fresno Co.	Kern Co.	Tulare Co.	Porterville	Springville	Squaw Valley	Tule River Indian R.	Lake Isabella	Kernville	Wofford Heights
Index of industrial specialization	789	746	752	692	840	930	928	750	1455	913	1028	911

Sources of Income: Sources of income considered include: labor earnings (wages and self-employed); retirement, social security, or from investments; and public assistance programs. The communities of Lake Isabella (51.6 percent), Kernville (55.6 percent), and Wofford Heights (41.1 percent) had the lowest percentage of labor earnings while the Tule River Indian Reservation (82.1 percent) had the highest. All gateway communities had a higher percentage of income earned through retirement, social security or investment than the nation (17 percent). Receiving at least twice the amount of public assistance than the state (0.4 percent) were Fresno County (0.9 percent), Tulare County (0.9 percent), Porterville (1.3 percent), Springville (0.9 percent), Squaw Valley (1.2 percent), and the Tule River Indian Reservation (3.5 percent).

Table 124 Comparison of Sources of Income

Sources of Income	United States	California	Fresno Co.	Kern Co.	Tulare Co.	Porterville	Springville	Squaw Valley	Tule River Indian R.	Lake Isabella	Kernville	Wofford Heights
Percent labor earnings	80.4	81.4	79.8	79.7	79.6	77.7	58.1	70.4	82.1	51.6	55.6	41.1
Percent retirement, social security, or from investments	17	15.8	15.6	16.1	15.6	17.1	36.8	22.6	11.8	39.8	39.6	52.9
Percent public assistance	0.2	0.4	0.9	0.7	0.9	1.3	0.9	1.2	3.5	0.2	0.1	0.4

Springville: The Chamber of Commerce website for the community of Springville (2009, accessed on October 21, 2009 from http://www.springville.ca.us/) states, "Welcome to Springville: Gateway to the Giant Sequoia National Monument." Springville is a census-designated place (CDP) located in Tulare County, California. The population was 1,109 at the time of the 2000 census.

Demographics: As of the 2000 census the racial makeup of the CDP was 94.14 percent White, 0.09 percent African American, 0.54 percent Native American, 0.27 percent Asian, 1.80 percent from other races, and 3.16 percent from two or more races. Hispanic or Latino of any race was 5.59 percent of the population. The median age in 2000 was 46.1 years of age and the largest age category was 45-49 years old (98 people or 8.8 percent of the population).

Housing: In 2000, of the 613 total housing units 88.7 percent were occupied. 47.6 percent of the housing units were owner occupied or for sale while 48 percent were renter occupied or for rent.

3.3 percent of the housing units were vacant for use as seasonal, recreational, or occasional use (e.g. second homes). Guest lodging is available and includes several Bed and Breakfast Inn's as well as guest ranches (Springville Chamber of Commerce 2009, accessed on October 21, 2009 from http://springville.ca.us/businesstour.html).

Employment by industry: The following table illustrates the top ten categories of employment by industry type for the community of Springville in the year 2000. The education, health, and social service sector employed the largest percent of residents (34 percent).

Table 125 Top 10 Categories of Employment by Industry Type in Springville

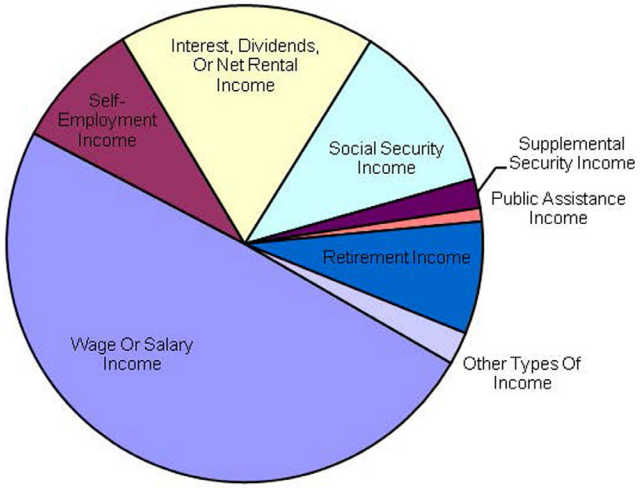
	Number	Percent
1) Educational, health and social services	129	34
2) Construction	32	8
3) Other services (except public administration)	28	7
4) Finance, insurance, real estate and rental and leasing	28	7
5) Transportation and warehousing, and utilities	25	7
6) Profess., scientific, management, admin., and waste management services	24	6
7) Retail trade	22	6
8) Public administration	20	5
9) Arts, entertainment, recreation, accommodation and food services	19	5
10) Agriculture, forestry, fishing and hunting, and mining	19	5
Total of top 10	346	91

Place of work and method of commute: As of 2000, 24 percent of residents worked in Springville while 76 percent of residents worked outside of the community. 32 percent of residents experienced a commute time of less than 20 minutes.

Specialization index: The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. An over dependence on a narrow range of industries can be detrimental in terms of employment, activity, and workers' displacement. The index in 2000 was 928 for Springville compared to 789 in the United States.

Sources of income: 58.1 percent of income in Springville was from labor earnings (wages and self-employed income). 36.8 percent of income was from retirement, social security, or from investments while 0.9 percent income came from public assistance programs (see the following figure).

Figure 22 Sources of income in Springville



Porterville: According to Wikipedia, the free on-line encyclopedia, "Porterville is located in the foothills of the Sierra Nevada Mountains, and many of the town's inhabitants are intimately familiar with the upper regions of the hills. There is also a large man-made body of water, Lake Success, which finds much use for recreation and revelry when in season" (Wikipedia 2009, accessed on October 14, 2009 from (http://en.wikipedia.org/wiki/Porterville,_California).

Porterville is a city in Tulare County, California. The population was 39,615 at the time of the 2000 census. The current population is listed as 52,056 on the City of Porterville's website (2008, accessed on October 14, 2009 from http://www.chooseporterville.com). The city's population grew dramatically as the city annexed many properties and unincorporated areas in and around Porterville (Wikipedia 2009, accessed on October 14, 2009 from http://en.wikipedia.org/wiki/Porterville,_California). Porterville is considered part of the Census Bureau's designation of the Visalia-Porterville metropolitan statistical area.

Demographics: As of the 2000 census the racial makeup of the city was 49.75 percent White, 1.28 percent African American, 1.73 percent Native American, 4.63 percent Asian, 0.15 percent Pacific Islander, 32.71 percent from other races, and 4.75 percent from two or more races. Hispanic or Latino of any race was 54.45 percent of the population. The median age in 2000 was 28.6 years of age and the largest age category was 5 to 9 years old (3,919 people or 9.9 percent of the population).

Housing: In 2000, of the 12,691 total housing units 93.6 percent were occupied. 53.9 percent of the housing units were owner occupied or for sale while 44 percent were renter occupied or for rent. 0.4 percent of the housing units were vacant for use as seasonal, recreational, or occasional use (e.g. second homes). Guest lodging is available in a number of hotels and motels in and around the city.

Employment by industry: The following table illustrates the top ten categories of employment by industry type for the city of Porterville in the year 2000. The education, health, and social service sector employed the largest percent of residents (28 percent). Major employers include the Porterville Developmental Center, the Porterville public schools, and the Sierra View District Hospital (City of Porterville 2008, accessed on October14, 2009 from http://www.chooseporterville.com). Retail trade and agriculture were the second and third largest employers at 13 percent and 11 percent respectively. Major retail trade and agriculture employers include Wal-Mart and Foster Farms (City of Porterville 2008, accessed on October14, 2009 from http://www.chooseporterville.com).

Table 126 Top 10 Categories of Employment by Industry Type in Porterville

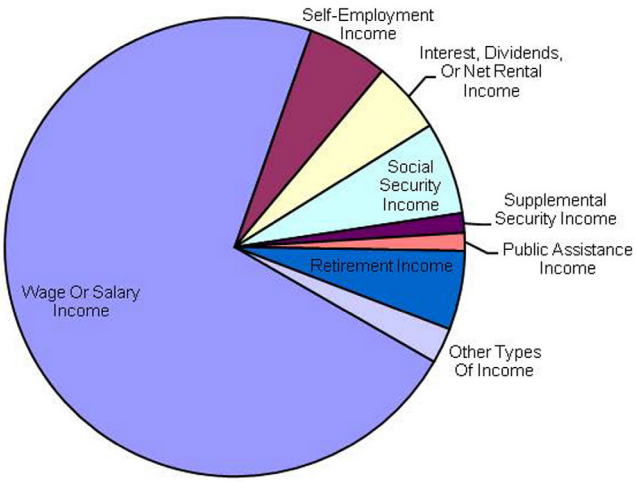
	Number	Percent
1) Educational, health and social services	3,984	28
2) Retail trade	1,769	13
3) Agriculture, forestry, fishing and hunting, and mining	1,588	11
4) Manufacturing	1,079	8
5) Arts, entertainment, recreation, accommodation and food services	954	7
6) Public administration	900	6
7) Wholesale trade	734	5
8) Other services (except public administration)	728	5
9) Profess., scientific, management, admin., and waste management services	665	5
10) Construction	649	5
Total of top 10	13,050	92

Place of work and method of commute: As of 2000, 57 percent of residents worked in Porterville while 43 percent of residents worked outside of the city. 64 percent of residents experienced a commute time of less than 20 minutes.

Specialization index: The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. An over dependence on a narrow range of industries can be detrimental in terms of employment, activity, and workers' displacement. The index in 2000 was 930 for Porterville compared to 789 in the United States.

Sources of income: 77.7 percent of income in Porterville was from labor earnings (wages and self-employed income). 17.1 percent of income was from retirement, social security, or from investments while 1.3 percent income came from public assistance programs (see the following figure).

Figure 23 Sources of income in Porterville



Tule River Indian Reservation: The Tule River Indian Tribe's official website states, "Established in 1873, the Tule River Indian Reservation is estimated to cover almost 85 square miles of rugged foothill lands of the Sierra Nevada Mountains. The reservation is located in a remote rural area approximately 20 miles from the nearest town of Porterville. The two nearest cities of size are Fresno, approximately 70 miles north of Porterville and Bakersfield, which is approximately 50 miles south of Porterville. The Reservation is accessible only by one winding paved road that follows the meandering South Fork of the Tule River. It is isolated in a rugged setting that allows for privacy and for development independent from urban or recreational sprawl" (Tule River Indian Reservation 2009, accessed on October 14, 2009 from http://www.tulerivertribe-nsn.gov/index.php). At the time of the 2000 census, 566 tribal members lived on the reservation.

Demographics: As of the 2000 census the racial makeup of the reservation was 87.5 percent Native American, 6.2 percent White, 0.2 percent Asian, 4.8 percent from other races, and 1.4 percent from two or more races. Hispanic or Latino of any race was 21.6 percent of the population. The median age in 2000 was 25.8 years of age and the largest age category was 10 to14 years old (60 people or 10.6 percent of the population).

Housing: In 2000, of the 179 total housing units 88.8 percent were occupied. 67.6 percent of the housing units were owner occupied or for sale while 21.8 percent were renter occupied or for rent. 0 percent of the housing units were vacant for use as seasonal, recreational, or occasional use (e.g. second homes).

Employment by industry: The following table illustrates the top ten categories of employment by industry type for the Tule River Indian Tribe in the year 2000. The education, health, and social service sector employed the largest percent of residents (27 percent). The Tule River Tribe has three enterprises that contribute to their self-sufficiency, including: the Eagle Mountain Casino, Tule River Aero Industries, and the Eagle Feather Trading Post (Tule River Indian Reservation 2009, accessed on October 15, 2009 from http://www.tulerivertribe-nsn.gov/enterprises).

Place of work and method of commute: Fifty-one percent of residents experienced a commute time of less than 20 minutes.

Specialization index: The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. An over dependence on a narrow range of industries can be detrimental in terms of employment, activity, and workers'

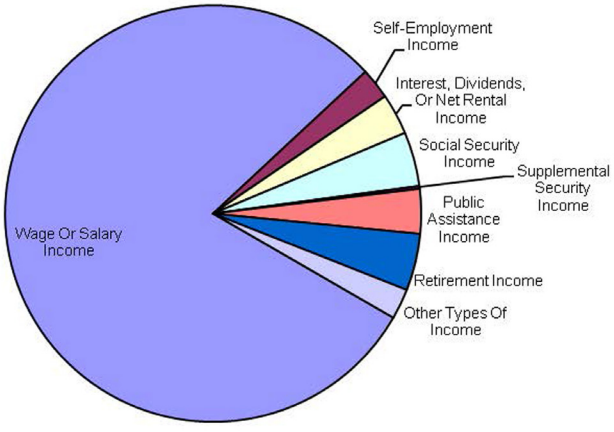
Table 127 Top 10 Categories of Employment by Industry Type on the Tule River Indian Reservation

	Number	Percent
1) Educational, health and social services	48	27
2) Arts, entertainment, recreation, accommodation and food services	43	24
3) Public administration	18	10
4) Retail trade	14	8
5) Agriculture, forestry, fishing and hunting, and mining	14	8
6) Construction	12	7
7) Profess., scientific, management, admin., and waste management services	10	6
8) Finance, insurance, real estate and rental and leasing	6	3
9) Transportation and warehousing, and utilities	6	3
10) Other services (except public administration)	5	3
Total of top 10	176	###

displacement. The index in 2000 was 1,455 for the Tule River Indian Reservation compared to 789 in the United States. On the Tule River Indian Reservation both the education, health and social service sector (27 percent) and the arts, entertainment, recreation, accommodation, and food service sector (24 percent) employed the greatest percentage of workers (a primary employer is the Eagle Mountain Casino).

Sources of income: 82.1 percent of income on the Tule River Indian Reservation was from labor earnings (wages and self-employed income). 11.8 percent of income was from retirement, social security, or from investments while 3.5 percent income came from public assistance programs (see the following figure).

Figure 24 Sources of income on the Tule River Indian Reservation



Squaw Valley: Squaw Valley is a sparsely populated, rural area in the Sierra Nevada foothills in Fresno County, California. The population was 2,691 at the time of the 2000 census. The population in 2007 was listed as 3,016 on the City-data.com website for Squaw Valley (2009, accessed on October 15, 2009 from http://www.city-data.com/city/Squaw-Valley-California.html). The closest town is Orange Cove, 3 miles south-southwest and the closet city is Visalia, approximately 26 miles south-southwest with a population of over 91,000.

Demographics: As of the 2000 census the racial makeup of the community was 88.3 percent White, 1.4 percent African American, 2.4 percent Native American, 0.6 percent Asian, 0.2 percent Pacific Islander, 4.8 percent from other races, and 2.3 percent from two or more races. Hispanic or Latino of any race was 12.2 percent of the population. The median age in 2000 was 43.5 years of age and the largest age category was 50 to 54 years old (257 people or 9.6 percent of the population).

Housing: In 2000, of the 1160 total housing units 88.4 percent were occupied. 77.7 percent of the housing units were owner occupied or for sale while 13.8 percent were renter occupied or for rent. 5.6 percent of the housing units were vacant for use as seasonal, recreational, or occasional use (e.g. second homes). Limited guest lodging is available in Squaw Valley although additional hotels and motels are available in the nearby towns of Miramonte and Dunlap.

Employment by industry: The following table illustrates the top ten categories of employment by industry type for the community of Squaw Valley in the year 2000. The education, health, and social service sector employed the largest percent of residents (19 percent).

Table 128 Top 10 Categories of Employment by Industry Type in Squaw Valley

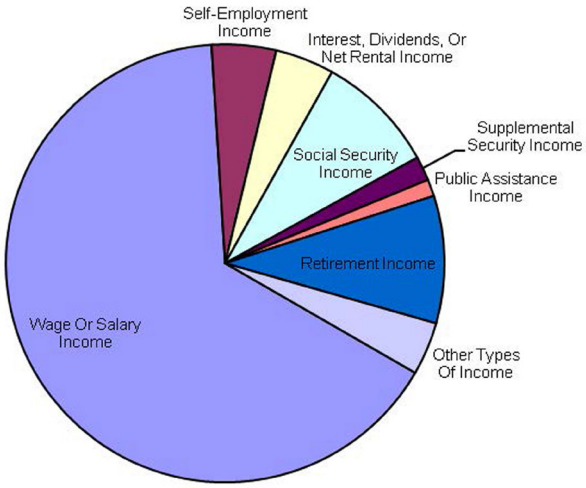
	Number	Percent
1) Educational, health and social services	191	19
2) Public administration	123	12
3) Construction	106	10
4) Transportation and warehousing, and utilities	94	9
5) Retail trade	93	9
6) Wholesale trade	68	7
7) Profess., scientific, management, admin., and waste management services	65	6
8) Manufacturing	61	6
9) Arts, entertainment, recreation, accommodation and food services	57	6
10) Finance, insurance, real estate and rental and leasing	48	5
Total of top 10	906	89

Place of work and method of commute: As of 2000, six percent of residents worked in Squaw Valley while 94 percent of residents worked outside of the community. Nine percent of residents experienced a commute time of less than 20 minutes.

Specialization index: The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. An over dependence on a narrow range of industries can be detrimental in terms of employment, activity, and workers' displacement. The index in 2000 was 750 for Squaw Valley compared to 789 in the United States.

Sources of income: 70.4 percent of income in Squaw Valley was from labor earnings (wages and self-employed income). 22.6 percent of income was from retirement, social security, or from investments while 1.2 percent income came from public assistance programs (see the following figure).

Figure 25 Sources of income in Squaw Valley



Wofford Heights: I.L. Wofford founded the community as a resort in 1948 (Wikipedia 2009, accessed on October 15, 2009 from http://en.wikipedia.org/wiki/Wofford_Heights,_California). Today, Wofford Heights is a small retirement village on the edge of Lake Isabella and the Sequoia National Forest. Wofford Heights is a census-designated place (CDP) in Kern County, California. The community is located 3.5 miles south-southwest of Kernville, at an elevation of 2684 feet. The population was 2,276 at the time of the 2000 census.

Demographics: As of the 2000 census the racial makeup of the community was 93.3 percent White, 0.1 percent African American, 1.2 percent Native American, 0.7 percent Asian, 0 percent Pacific Islander, 1.4 percent from other races, and 3.3 percent from two or more races. Hispanic or Latino of any race was 6.2 percent of the population. The median age in 2000 was 58.3 years of age and the largest age category was 70 to 74 years old (241 people or 10.6 percent of the population).

Housing: In 2000, of the 1,989 total housing units 58.4 percent were occupied. 52 percent of the housing units were owner occupied or for sale while 11.6 percent were renter occupied or for rent. 29.4 percent of the housing units were vacant for use as seasonal, recreational, or occasional use (e.g. second homes). Guest lodging, vacation rentals and camping is available in Wofford Heights as well as in the surrounding communities of Kernville and Lake Isabella.

Employment by industry: The following table illustrates the top ten categories of employment by industry type for the community of Wofford Heights in the year 2000. The education, health, and social service sector employed the largest percent of residents (23 percent).

Table 129 Top 10 Categories of Employment by Industry Type in Wofford Heights

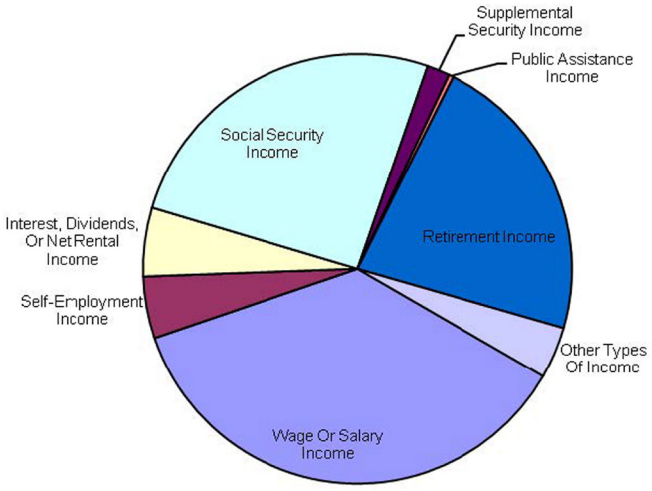
	Number	Percent
1) Educational, health and social services	128	23
2) Construction	84	15
3) Arts, entertainment, recreation, accommodation and food services	75	14
4) Retail trade	55	10
5) Manufacturing	48	9
6) Profess., scientific, management, admin., and waste management services	40	7
7) Agriculture, forestry, fishing and hunting, and mining	35	6
8) Transportation and warehousing, and utilities	33	6
9) Public administration	18	3
10) Finance, insurance, real estate and rental and leasing	16	3
Total of top 10	532	97

Place of work and method of commute: As of 2000, 24 percent of residents worked in Wofford Heights while 76 percent of residents worked outside of the community. 47 percent of residents experienced a commute time of less than 20 minutes.

Specialization index: The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. An over dependence on a narrow range of industries can be detrimental in terms of employment, activity, and workers' displacement. The index in 2000 was 911 for Wofford Heights compared to 789 in the United States.

Sources of income: 41.1 percent of income in Wofford Heights was from labor earnings (wages and self-employed income). 52.9 percent of income was from retirement, social security, or from investments while 0.4 percent income came from public assistance programs (see the following figure).

Figure 26 Sources of income in Wofford Heights



Lake Isabella: Lake Isabella is a census-designated place (CDP) in Kern County, California, located near Lake Isabella. Lake Isabella is located 35 miles (56 km) east-northeast of Bakersfield, at an elevation of 2513 feet. Lake Isabella was created by a dam on the Kern River in 1953 and sits at the confluence of the North and South Forks of the Kern River (Wikipedia 2009, accessed on October 15, 2009 from http://en.wikipedia.org/wiki/Lake_Isabella,_California). The population was 3,315 at the time of the 2000 census.

Demographics: As of the 2000 census the racial makeup of the community was 90.4 percent White, 0.1 percent African American, 1.9 percent Native American, 0.8 percent Asian, 0.1 percent Pacific Islander, 2.5 percent from other races, and 4.2 percent from two or more races. Hispanic or Latino of any race was 6.8 percent of the population. The median age in 2000 was 46 years of age and the largest age category was 10 to 14 years old (248 people or 7.5 percent of the population).

Housing: In 2000, of the 2,168 total housing units 70.4 percent were occupied. 50.4 percent of the housing units were owner occupied or for sale while 26.7 percent were renter occupied or for rent. 15.1 percent of the housing units were vacant for use as seasonal, recreational, or occasional use (e.g., second homes). Guest lodging, vacation rentals and camping is available at Lake Isabella as well as in the surrounding communities of Kernville, Wofford Heights, and Alta Sierra.

Employment by industry: The following table illustrates the top ten categories of employment by industry type for the community of Lake Isabella in the year 2000. The education, health, and social service sector employed the largest percent of residents (24 percent).

Place of work and method of commute: As of 2000, 56 percent of residents worked in Lake Isabella while 44 percent of residents worked outside of the community. 59 percent of residents experienced a commute time of less than 20 minutes.

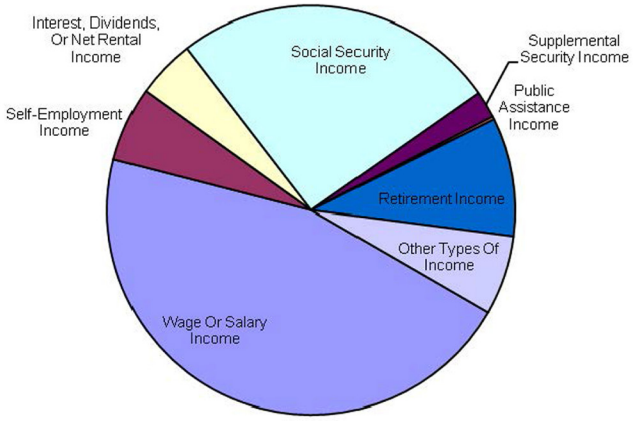
Table 130 Top 10 Categories of Employment by Industry Type in Lake Isabella

	Number	Percent
1) Educational, health and social services	203	24
2) Retail trade	131	15
3) Arts, entertainment, recreation, accommodation and food services	92	11
4) Profess., scientific, management, admin., and waste management services	68	8
5) Transportation and warehousing, and utilities	60	7
6) Construction	57	7
7) Other services (except public administration)	56	7
8) Finance, insurance, real estate and rental and leasing	54	6
9) Manufacturing	44	5
10) Public administration	34	4
Total of top 10	799	93

Specialization index: The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. An over dependence on a narrow range of industries can be detrimental in terms of employment, activity, and workers' displacement. The index in 2000 was 913 for Lake Isabella compared to 789 in the United States.

Sources of income: 51.6 percent of income in Lake Isabella was from labor earnings (wages and self-employed income). 39.8 percent of income was from retirement, social security, or from investments while 0.2 percent income came from public assistance programs (see the following figure).

Figure 27 Sources of income in Lake Isabella



Kernville: Kernville is a census-designated place (CDP) in Kern County, California. Kernville is located 42 miles northeast of Bakersfield, at an elevation of 2667 feet. The Kern River, Kernville and the Kern Valley they occupy were named after artist and topographer Edward M. Kern, who was a part a group of settlers led by Captain Joseph Reddeford Walker in 1845-46 (Wikipedia 2009, accessed on October 15, 2009 from http://en.wikipedia.org/wiki/Kernville,_CA). Today, Kernville supports a tourist industry centered on the white water rapids of the Kern River. The population was 1,736 at the time of the 2000 census.

Demographics: As of the 2000 census the racial makeup of the community was 90.6 percent White, 1.2 percent African American, 2.1 percent Native American, 0.7 percent Asian, 0.1 percent Pacific Islander, 2.2 percent from other races, and 3.2 percent from two or more races. Hispanic or Latino of any race was 8.2 percent of the population. The median age in 2000 was 52.1 years of age and the largest age category was 15 to 19 years old (179 people or 10.3 percent of the population). The large size of this age category is attributable to wards of Camp Owen, a non-secure juvenile forestry camp.

Housing: In 2000, of the 1,210 total housing units 66.1 percent were occupied. 51.2 percent of the housing units were owner occupied or for sale while 18.2 percent were renter occupied or for rent. 28 percent of the housing units were vacant for use as seasonal, recreational, or occasional use (e.g., second homes). Guest lodging, vacation rentals and camping is available in Kernville as well as in the surrounding communities of Lake Isabella, Kernville, Wofford Heights, and Alta Sierra.

Employment by industry: The following table illustrates the top ten categories of employment by industry type for the community of Kernville in the year 2000. The education, health, and social service sector employed the largest percent of residents (26 percent).

Place of work and method of commute: As of 2000, 34 percent of residents worked in Kernville while 66 percent of residents worked outside of the community. 61 percent of residents experienced a commute time of less than 20 minutes.

Specialization index: The Index of Industrial Specialization indicates the degree of specialization in a given area. The more diverse the economy is, the lower the index value. An over dependence on a narrow range of industries can be detrimental in terms of employment, activity, and workers' displacement. The index in 2000 was 1028 for Kernville compared to 789 in the United States. In Kernville, the education, health and social service sector employed the highest percentage of workers (26 percent), with the majority of these jobs attributable to Camp Owen, a non-secure juvenile forestry camp.

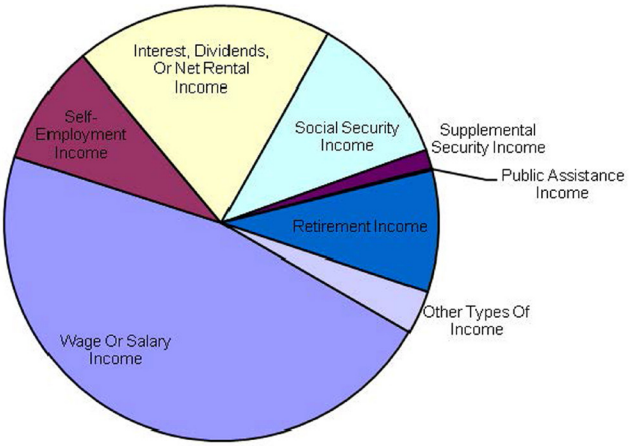
Sources of income: 55.6 percent of income in Kernville was from labor earnings (wages and self-employed income). 39.6 percent of income was from retirement, social security, or from

investments while 0.1 percent income came from public assistance programs (see the following figure).

Table 131 Top 10 Categories of Employment by Industry Type in Kernville

	Number	Percent
1) Educational, health and social services	129	26
2) Public administration	60	12
3) Retail trade	59	12
4) Construction	58	11
5) Other services (except public administration)	54	11
6) Arts, entertainment, recreation, accommodation and food services	37	7
7) Agriculture, forestry, fishing and hunting, and mining	33	7
8) Wholesale trade	31	6
9) Finance, insurance, real estate and rental and leasing	22	4
10) Manufacturing	22	4
Total of top 10	505	###

Figure 28 Sources of income in Kernville



Public Values, Beliefs, and Attitudes

Our values, beliefs and attitudes are the force behind almost any decision-making activity. According to RFP Evaluation Centers (2009), "They are responsible for the perceived discrepancy between the present and a desirable state. Values are articulated in a goal, which is often the first step in a formal decision process. This goal may be put forth by an individual (decision- maker) or by a group of people."

On the Sequoia National Forest, a third-party neutral facilitator hired by the U.S. Institute for Environmental Conflict Resolution interviewed stakeholders and Forest Service staff over the course of a year to understand issues and develop goals for the Monument management plan. Identified goals (i.e. criteria) formed the basis of a decision process or framework for evaluating alternatives. These sometimes competing goals include: protecting individual objects, protecting ecosystems, managing fire processes, fostering socio-economics, increasing enjoyment of the monument, reducing cost, creating a compelling plan, and complying with the law (see the nxt figure). Each of these goals was further refined through a series of meetings and workshops to describe the key components of each goal (i.e. sub-criteria).[48] For example, the goal to foster socioeconomics was refined to include the sub criteria: gateway economic development, diversity of opportunities, protecting communities from fire, connecting people to place, strengthening partnerships, and research, inventory and analysis.[49]

The decision framework is essentially a multi-criteria decision support tool used to evaluate each alternative for its importance (values) and for its performance

48. Workshops included: Sequoia National Forest leadership team meeting in August, 2008; 4 public meetings with the Sequoia Monument Recreation Council, focusing primarily on the goal "increase enjoyment of the monument;" and 3 public meetings focused on vegetation management.

49. Decision framework dated June 15, 2009.

(ratings). The use of a multi-criteria decision support tool is not new, and has been used by decision-makers in a variety of situations to assist in reaching the best decision given complex and often competing criteria. The International Society on Multiple Criteria Decision Making defines Multi-Criteria Decision Making (MCDM) as, "The study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process" (RFP Evaluation Centers 2009). RFP Evaluation Centers (2009) offer further background on this decision process:

Decision Theory

"Decision analysis looks at the paradigm in which an individual decision maker (or decision group) contemplates a choice of action in an uncertain environment. The theory of decision analysis is designed to help the individual make a choice among a set of pre-specified alternatives. The decision making process relies on information about the alternatives. The quality of information in any decision situation can run the whole gamut from scientifically-derived hard data to subjective interpretations, from certainty about decision outcomes (deterministic information) to uncertain outcomes represented by probabilities and fuzzy numbers. This diversity in type and quality of information about a decision problem calls for methods and techniques that can assist in information processing. Ultimately, these methods and techniques (MCDM) may lead to better decisions."

Decision Model

"The actual decision boils down to selecting "a good choice" from a number of available choices. Each choice represents a decision alternative. In the multi-criteria decision-making (MCDM) context, the selection is facilitated by evaluating each choice on the set of criteria. The criteria must be measurable—even if the measurement is performed only at the nominal scale (yes/no; present/absent) and their outcomes must be measured for every decision alternative. Criterion outcomes provide the basis for comparison of choices and consequently facilitate the selection of one, satisfactory choice."

Running concurrently with the scoping period was a public opportunity to use the Values and Interest-Based Explorer (VIBE) model. This web-based tool uses the multi-criteria decision support model to help users see how the value they placed on different criteria would affect a decision among several pseudo alternatives (A pseudo alternative was a fake set of criteria that would not be legal to implement, and yet are similar to the criteria likely to be included in the real alternatives described in the Monument EIS). Using the pseudo alternatives in the VIBE model was intended to give users a feel for how the decision support process works. Comments made in the VIBE were reviewed to help the interdisciplinary team understand how values and interests were compared and weighted by the users. Opportunity for comment on the decision framework was further extended to stakeholders through four additional public meetings held in April, 2009. The results of these general scoping efforts are summarized in the following table. This website will also be used during the comment period for this draft EIS and will let the public compare the alternatives considered in detail based on their values, interests and beliefs.

After the Sequoia National Forest interdisciplinary team analyzed public comment, preliminary alternatives were developed. Also, based on the comments received, several changes were proposed to the decision framework including: adding hydrology as a process; establishing fire as a criterion; and refining sub-criteria for "create a compelling plan" (U.S. Institute for Environmental Conflict Resolution June 2009). Preliminary alternatives and the updated decision framework were shared in public meetings held on June 18, 19, and 20, 2009.

Based on subsequent interdisciplinary team meetings the decision framework was changed again in November, 2009 (see the following figures). The interdisciplinary team felt the decision framework needed to be reworked to more closely address the issues raised in scoping and informed by all previous public involvement. The interdisciplinary team realized the majority of the criteria and sub-criteria were actually desired conditions or current direction as set out by law, regulation, policy or the Forest Plan as amended. Importantly, most of the criteria and sub-criteria did not/could not change by alternative. The decision framework was then re-drafted to reflect: criteria and sub-criteria critical to the decision being made; measurably different sub-criteria across

one or more alternatives and; whether issues are sensitive to the decision being made or Forest Service management. To ensure all criteria and sub-criteria identified in the June, 2009 decision framework were incorporated into the planning process, a matrix was developed to illustrate where the eliminated components were incorporated into the DEIS (see the second table below).

Table 132[50] **Results of Comments Registered on Framework Criteria (VIBE)**

Criteria	Value Scale					
	All that matters	Really matters	One thing that matters	Does not much matter	Could hardly care less	Is a sideboard
Protect individual objects	6	21	41	9	3	1
Protect ecosystems	8	41	25	5	1	1
Manage processes	4	27	34	12	3	1
Increase enjoyment of the Monument	7	40	25	6	2	1
Foster socioeconomics	3	18	36	15	8	1
Reduce cost of development and implementation	5	19	36	16	3	2
Create a compelling plan	3	28	37	7	5	1

Table 133 Decision Framework Matrix

Criteria	Sub-criteria	Rationale for removing from June 2009 Decision Framework	Changes if Kept in November 2009 Decision Framework	Notes
Protect individual objects		Removed because all sub-criteria removed		
	Geology	Required by proclamation. Will be covered in desired conditions		
	Individual named Sequoias	Required by proclamation. Will be covered in desired conditions		
	Individual cultural objects	Required by proclamation and law. Will be covered in desired conditions		
	Individual T&E species	Required by proclamation and law. Will be covered in desired conditions		
Improve ecosystem health		Removed because all sub-criteria removed		
	Diversity of flora and fauna	Will be covered in desired conditions, does not vary by alternative.		

50. Fox Mediation and InfoHarvest on behalf of the U.S. Institute for Environmental Conflict Resolution June 2009.

Criteria	Sub-criteria	Rationale for removing from June 2009 Decision Framework	Changes if Kept in November 2009 Decision Framework	Notes
	Resilience to disturbance	Will be covered in desired conditions, does not vary by alternative.		
	Mixed conifer	Part of several specialists reports, part of desired condition		
	Mixed conifer (groves)	Required by proclamation. Will be covered in desired conditions		
	Oak and savannah	Required by proclamation. Will be covered in desired conditions		
	Caves	Addressed as non-significant, same across all alternatives		
	Hydrologic conditions	Will be covered in desired conditions, does not vary by alternative.		
	Climate change adaptation	Will be covered in desired conditions, does not vary by alternative.		
Manage/allow fire			Becomes “Fuels Management/ Community Protection” to be in line with significant issues	
	Increase fire diversity	Will be covered in desired conditions, does not vary by alternative.		
	Restore natural fire processes	Required by proclamation. Will be covered in desired conditions		
	Protect objects outside WUIs, groves, and at risk habitats		Simply becomes “protect objects of interest”	
	Protect objects inside WUIs, groves, and at risk habitats			
	No “unwanted” fire	Will be covered in desired conditions. Also addressed in Silvicultural report.		
	Minimize effects of air quality on people and plants			Keep, no change

Criteria	Sub-criteria	Rationale for removing from June 2009 Decision Framework	Changes if Kept in November 2009 Decision Framework	Notes
	Effects on aesthetics		Changes to "effects on scenery"	
	Protect human safety outside WUIs		Becomes "Protecting humans and property"	
	Protect human safety inside WUIs			
	Manage grove fuels risk			Added
Increase enjoyment of the Monument			Becomes "Recreation and Public Use" to be in line with significant issues	
	Enjoy objects of Interest			Keep, no change
	Promotes diversity of users			Keep, no change
	Promotes diversity of uses			Keep, no change
	Provides access			Keep, no change
	Connects people to others and across generations			Keep, but maybe merge with one below
	Connects people to place			Keep, no change
Foster socioeconomics		Removed because all sub-criteria removed		
	Supports gateway economic development	Covered in social/economic analysis, no change across alternatives, desired condition		
	Provides for diverse economic opportunities	Covered in social/economic analysis, no change across alternatives, desired condition		
	Protects communities from fire	In "Protecting humans and property" above		
	Supports connection of all to place	In "Connects people to others and across generations" and "Connects people to place" above		

Criteria	Sub-criteria	Rationale for removing from June 2009 Decision Framework	Changes if Kept in November 2009 Decision Framework	Notes
	Strengthens partnerships	Covered in desired conditions, will also be covered in management plan as a partnership strategy for entire plan		
Creates compelling plan		Removed because all sub-criteria removed		
	Is cost effective	Required by the Administrative Procedures Act		
	Develops cost offsets	Required by the Administrative Procedures Act		
	Engenders community support	See “Strengthens partnerships” above		
	Allows for course correction	Required through planning via monitoring and revisions		
	Holds FS accountable	Required by the Administrative Procedures Act		
	Creates/ reinforces identity of Monument	This is a desirable condition, does not vary across alternatives, will be covered in partnership strategy		
Tree Removal				Added to merge with significant issues
	Circumstances for Removal			Added
Methods for Sequoia Regeneration				Added to merge with significant issues
	Management for regeneration			Added
	Creates desirable environment			Added

Figure 29 Giant Sequoia National Monument Decision Framework—June 15, 2009

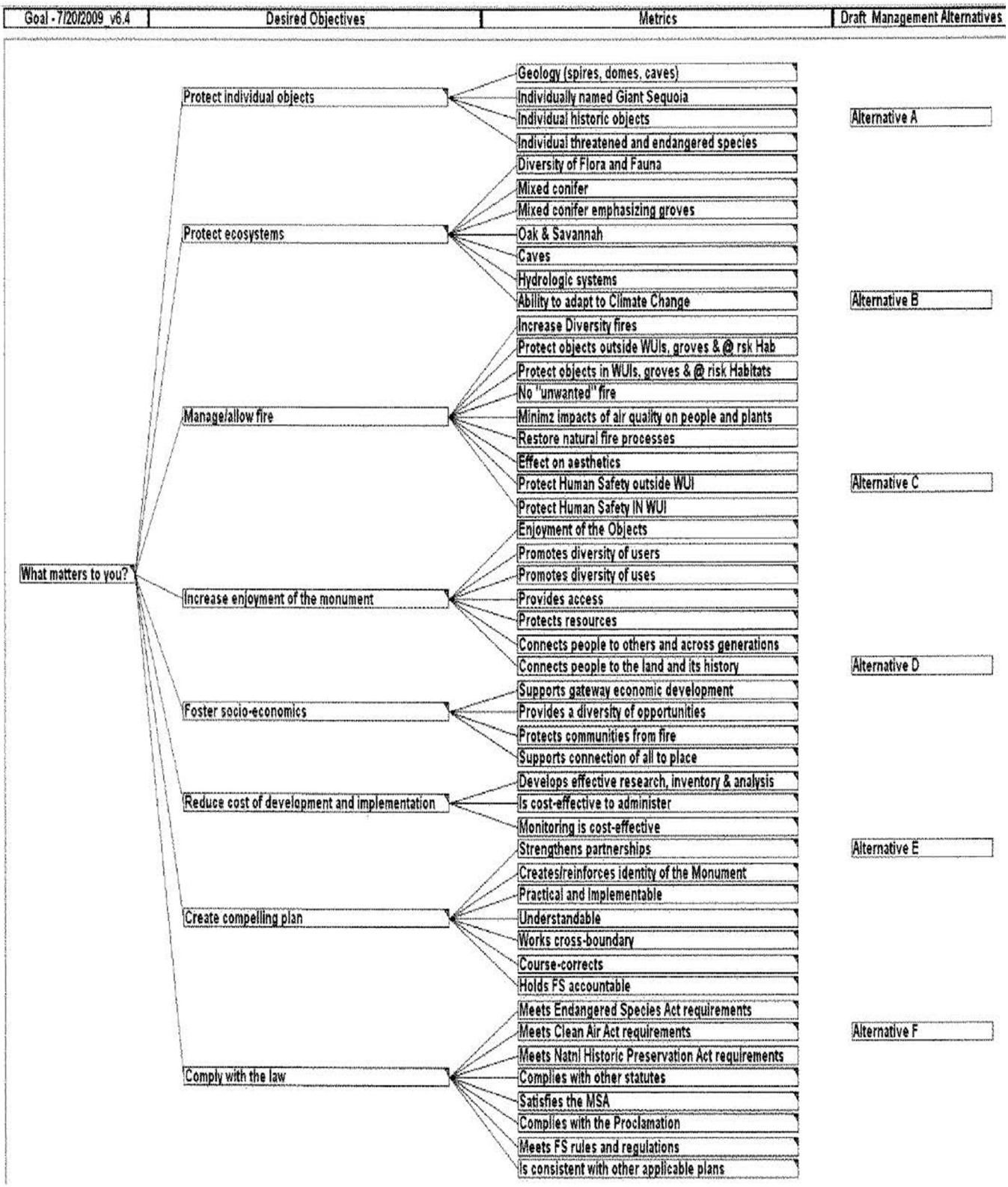
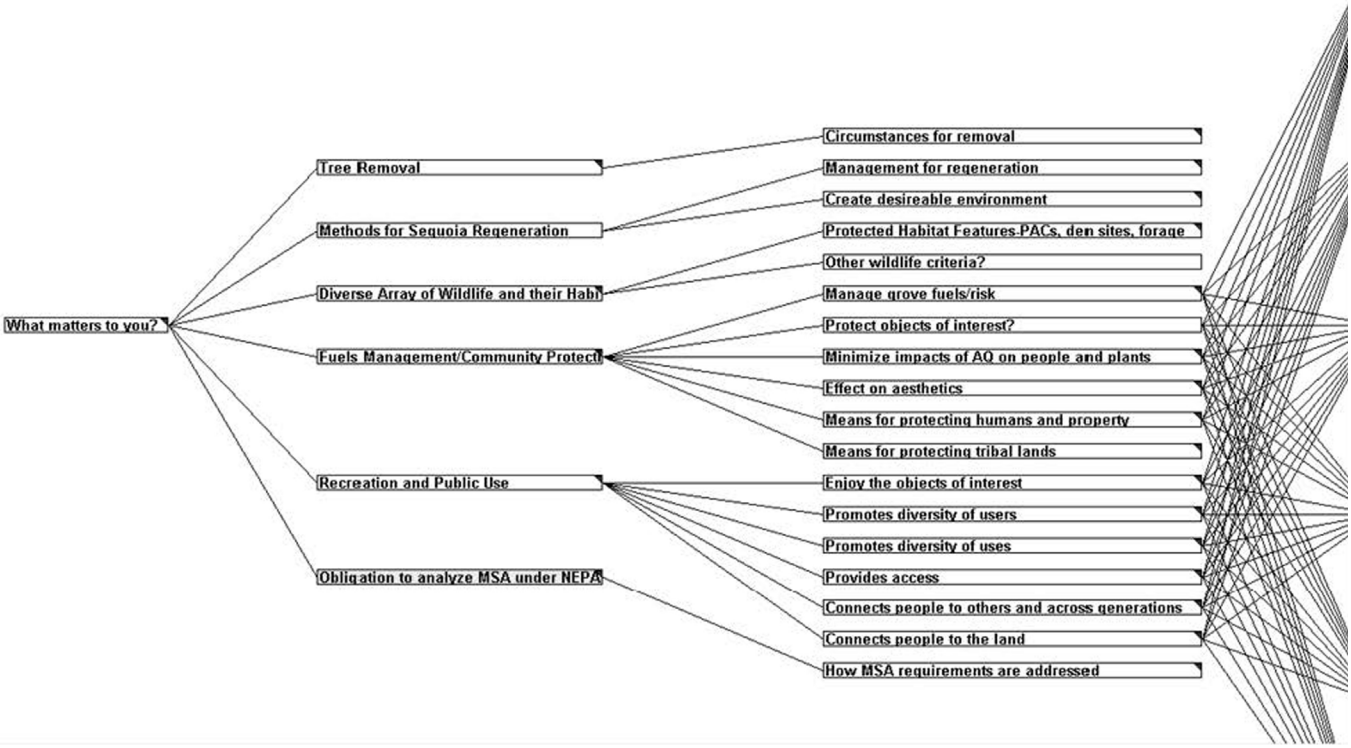


Figure 30 Giant Sequoia National Monument Decision Framework—November 9, 2009



Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," provides that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." This section contains an analysis of the following indicators to describe the composition of the area: race, ethnicity, age distribution, education, language, and poverty.

Composition of the Area of Influence (Fresno, Kern, and Tulare Counties)[51]

Race: The population of the three-county area has increased at a rapid pace over the past 40 years, growing by 122 percent from 1970 to 2006 alone (see following tables and figures for population data). At an annual rate, this represents an increase of 2.2 percent, outpacing both California and the nation. The racial distribution of the region is shown in one of the following tables and figures (population by race in the region). Within the region, the greatest share of the population is in the White alone racial category (57.7 percent). The lowest share of the population is in the Native Hawaiian and Other Pacific Islander alone (0.1 percent) racial category. Black or African American populations in Fresno and Tulare counties are at least 20 percent lower than in the state. Asian and Native Hawaiian and other Pacific Islander populations are also at least 20 percent lower than in the state. American Indian and Alaska Native, and the Census category "some other race" exceed the value for the state by at least 20 percent.

51. Source for data in this section: U.S. Census, U.S. Department of Commerce, 2001. U.S. Census Bureau, Census 2000, Washington D.C.

Table 134 and Figure 31 Population in the Region (2000)

Geography	Population
Fresno CA	799,407
Kern CA	661,645
Tulare CA	368,021

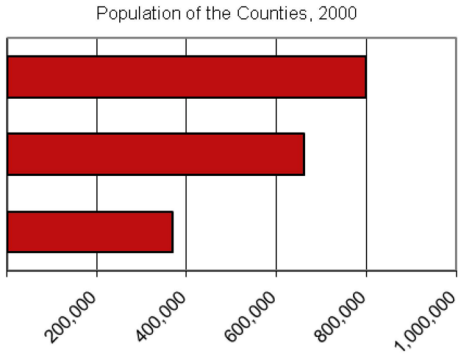


Table 135 and Figure 32 Population by Race in the Region (2000)

Race or Ethnicity	Population	Share of Total
All Races	1,829,073	
White alone	1,055,377	58%
Black or African American alone	87,987	5%
American Indian alone	28,526	2%
Asian alone	98,648	5%
Native Hawaiian and other Pacific Islander alone	2,380	0%
Some other race	473,988	26%
Two or more races	82,167	4%

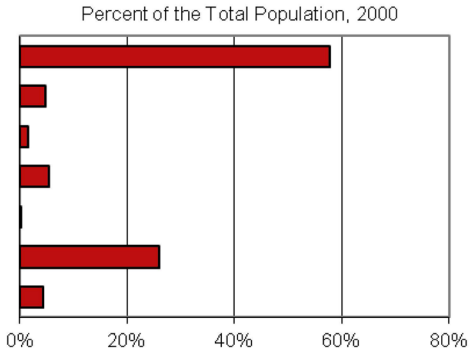
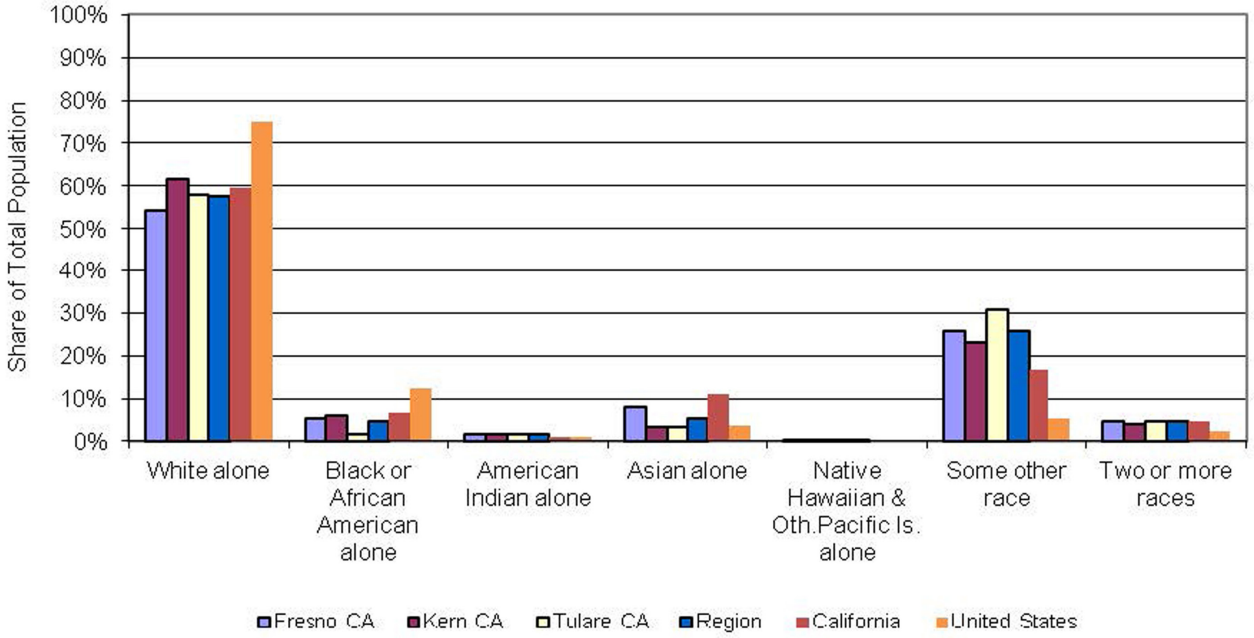


Table 136 Population by Race (2000)

	Fresno CA	Kern CA	Tulare CA	Region	California	United States
White alone	434,045	407,581	213,751	1,055,377	20,170,059	211,460,626
Black or African American alone	42,337	39,798	5,852	87,987	2,263,882	34,658,190
American Indian alone	12,790	9,999	5,737	28,526	333,346	2,475,956
Asian alone	64,362	22,268	12,018	98,648	3,697,513	10,242,998
Native Hawaiian and other Pacific Islander alone	1,000	972	408	2,380	116,961	398,835
Some other race	207,061	153,610	113,317	473,988	5,682,241	15,359,073
Two or more races	37,812	27,417	16,938	82,167	1,607,646	6,826,228
All races	799,407	661,645	368,021	1,829,073	33,871,648	281,421,906
	Percent of Total					
White alone	54	62	58	58	60	75
Black or African American alone	5	6	2	5	7	12
American Indian alone	2	2	2	2	1	1
Asian alone	8	3	3	5	11	4

	Fresno CA	Kern CA	Tulare CA	Region	California	United States
	Percent of Total					
Native Hawaiian and other Pacific Islander alone	0	0	0	0	0	0
Some other race	26	23	31	26	17	5
Two or more races	5	4	5	4	5	2

Figure 33 Population by Race (2000)



Data on Hispanics are not provided in the race tables and figures, but are provided in the following tables and figures. It is important to note that Hispanics can be of any race (as measured by the Census, "Hispanic" is a cultural identity, and not a race). Within the region, Tulare county has the greatest share of people who are Hispanic or Latino (50.8 percent). The lowest Hispanic or Latino population is in Kern county (38.4 percent). In the region as a whole, 43.3 percent are Hispanic or Latino. Within the region, the Black or African American alone category has the greatest share of people who are Hispanic or Latino (35.0 percent). The lowest Hispanic or Latino population is in the White alone (15.1 percent) category.

Table 137 and Figure 34 Hispanic Population in the Region (2000)

Geography	Hispanic Population	Percent of Total Population
Fresno CA	351,636	44
Kern CA	254,036	38
Tulare CA	186,846	51
Region	792,518	43
California	10,966,556	32
United States	35,305,818	13

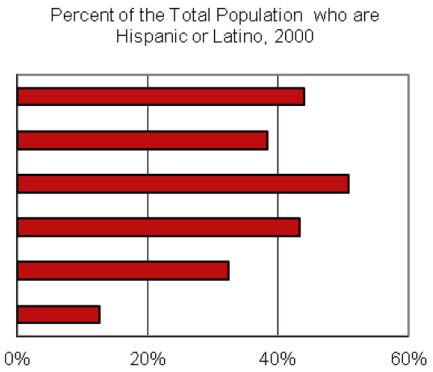


Table 138 and Figure 35 Hispanic Population by Race in the Region (2000)

Race or Ethnicity	Population	Percent of Total Population
Hispanic or Latino (of any race)	1,036,555	43
White alone	256,749	15
Black or African American alone	4,729	35
American Indian alone	13,407	31
Asian alone	2,985	32
Native Hawaiian and other Pacific Islander alone	713	23
Some other race alone	471,104	33
Two or more races	42,831	25
Not Hispanic or Latino	1,036,555	31

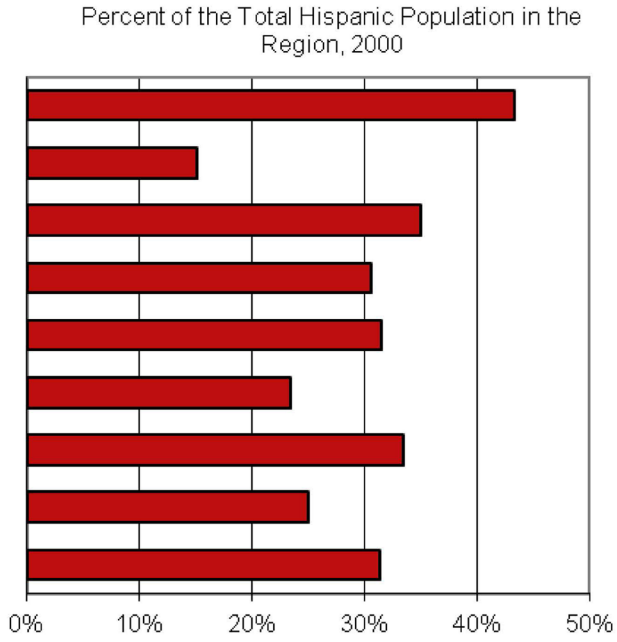


Table 139 Number of People Who Are American Indian and Alaska Native Alone or in Combination with One or More Races and with One or More Tribes Reported for Selected Tribes (2000)

	Fresno CA	Kern CA	Tulare CA	Region	California	United States
Total tribes tallied	20,999	18,080	9,565	48,644	648,200	4,230,356
American Indian tribes, specified	12,471	11,389	5,834	29,694	401,788	2,852,380
Apache	690	544	238	1,472	21,599	96,833
Blackfeet	234	326	91	651	14,310	85,750
Cherokee	2,791	3,681	1,394	7,866	97,838	729,533
Cheyenne	43	43	33	119	1,668	18,204
Chickasaw	151	190	84	425	4,145	38,351
Chippewa	116	109	39	264	7,166	149,669
Choctaw	688	1,069	483	2,240	21,011	158,774
Colville	4	6	6	16	305	9,393
Comanche	104	108	41	253	2,948	19,376
Cree	24	29	18	71	1,268	7,734
Creek	280	245	77	602	5,416	71,310
Crow	32	16	2	50	893	13,394
Delaware	30	23	10	63	1,331	16,341
Houma	3	3	-	6	133	8,713
Iroquois	110	97	22	229	5,975	80,822
Kiowa	18	29	13	60	811	12,242

	Fresno CA	Kern CA	Tulare CA	Region	California	United States
Latin American Indians	2,536	1,350	963	4,849	63,293	180,940
Lumbee	17	27	19	63	796	57,868
Menominee	2	-	9	11	319	9,840
Navajo	305	322	79	706	14,348	298,197
Osage	54	59	19	132	2,212	15,897
Ottawa	8	29	6	43	631	10,677
Paiute	102	620	55	777	4,979	13,532
Pima	48	74	30	152	1,772	11,493
Potawatomi	114	107	63	284	2,640	25,595
Pueblo	86	93	54	233	7,552	74,085
Puget Sound Salish	33	12	2	47	611	14,631
Seminole	71	63	48	182	2,855	27,431
Shoshone	36	70	39	145	2,118	12,026
Sioux	202	209	121	532	12,428	153,360
Tohono O'Odham	93	32	22	147	1,909	20,087
Ute	6	6	14	26	993	10,385
Yakama	11	11	2	24	403	10,851
Yaqui	367	239	115	721	7,304	22,412
Yuman	24	12	25	61	2,784	8,976
All other tribes	3,038	1,536	1,598	6,172	85,024	357,658
American Indian tribes; not specified	1,283	1,143	526	2,952	33,440	195,902
Alaska Native tribes; specified	57	65	26	148	4,433	116,915
Alaska Athabaskan	6	13	2	21	560	18,838
Aleut	8	16	-	24	995	16,978
Eskimo	25	13	8	46	1,252	54,761
Tlingit-Haida	15	22	16	53	1,393	22,365
All other tribes	3	1	-	4	233	3,973
Alaska Native tribes; not specified	12	7	8	27	497	8,702
American Indian or Alaska Native tribes; not specified	7,176	5,476	3,171	15,823	208,042	1,056,457

Table 140 Population in American Indian Areas by County[52]

American Indian Areas	County	Total	White	African American	American Indian	Asian	Native Hawaiian and Other Pacific Islander	Some Other Race	Two or More Races	Not Hispanic or Latino	Hispanic or Latino
Big Sandy Rancheria	Fresno	98	14	0	77	0	0	0	7	83	15
Cold Springs Rancheria	Fresno	193	3	0	177	0	0	2	11	160	33
Table Mountain Rancheria	Fresno	11	2	0	1	0	0	8	0	3	8
Tule River Indian Reservation	Tulare	566	35	0	495	1	0	27	8	444	122

In addition to Census specified American Indian tribes and areas (see the previous tables), the Sequoia National Forest Tribal Relations Program Manager maintains and shares among interested parties an updated, local tribal contact list. This list currently includes: federally recognized tribes, including the Tule River Indian Reservation, Santa Rosa Rancheria Tachi-Yokuts, Bishop Paiute Tribe; non-federally recognized tribes, including the Tubatulabals of Kern Valley, Dunlap Band of Mono Indians, Wuksachi-Michahai Tribe, Kern Valley Indian Council, Wukchumni Tribal Council, Traditional Choinumni Tribe, Kings River Choinumni Farm Tribe, California Choinumni Tribal Project, and tribal groups, organizations and interested parties, including the Sierra Nevada Native American Coalition, Kern River Paiute Council, Eshom Gathering—Davis Clan, Monache Intertribal Association, California Indian Basket weavers Association (CIBA) and Tule River—Yokut Archeological Advisory Team (YAAT). This list is not meant to be exclusive nor exhaustive and will be continuously updated to reflect changing conditions (please refer to the "Tribal and Native American Interest "section of this chapter for more information).

Age distribution: The following figure shows the age distribution by race, for the three-county area while the next figure shows the age distribution of the total population by geography. The white population, 60 years of age and higher, are more than 50 percent higher, or 1.5 times, the percent of the total population in that age category in the three-county area. As this generation continues to age, a corresponding increase in economic sectors such as health and human services will be required (Sierra Business Council 2007). The largest proportion of the population in the three-county area is found in the age group 10 to 19 years of age. Yet the generation, ages 25 -34 make up an increasingly smaller proportion of the area's population. The Sierra Business Council notes that, "Members of this age bracket often are at the beginning stages of a career, frequently have young children, and lack much disposable income. Combining these factors with the escalating costs of housing in the Sierra Nevada makes the region less hospitable to them" (2007 p. 18).

In 2005, the state of California published Parks and Recreation Trends in California. This publication stated that the changes in the state's population in the coming years will affect outdoor recreation more than anything else. The population is growing rapidly, is becoming more culturally and racially diverse, and is aging. According to predictions, based on existing growth rates (in 2005), the population in California will surpass 50 million before 2040 (about 2032) and reach 60 million by about 2050 (projected by the California Department of Finance). With the rate of population growth predicted, even if outdoor recreation participation rates are static or decline, overall participation will increase in sheer numbers simply because more Californians exist.

52. Data source: Census 2000 SF1 Tables 7,8, and 13.

Figure 36 Age Distribution of Each Race in the Region (2000)

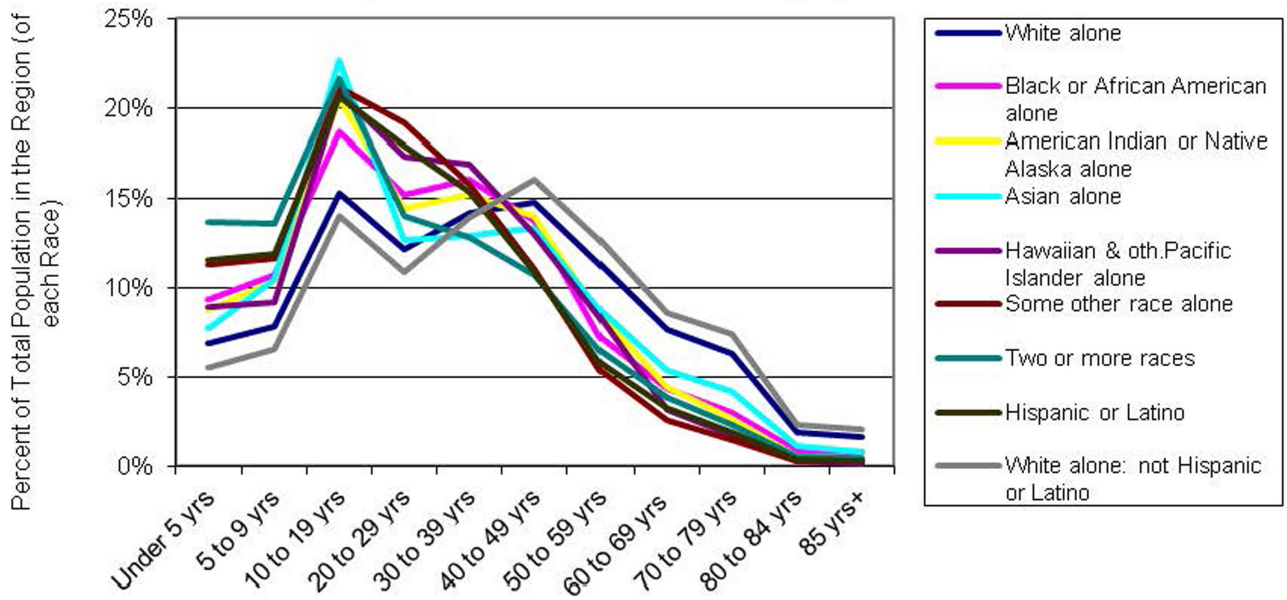
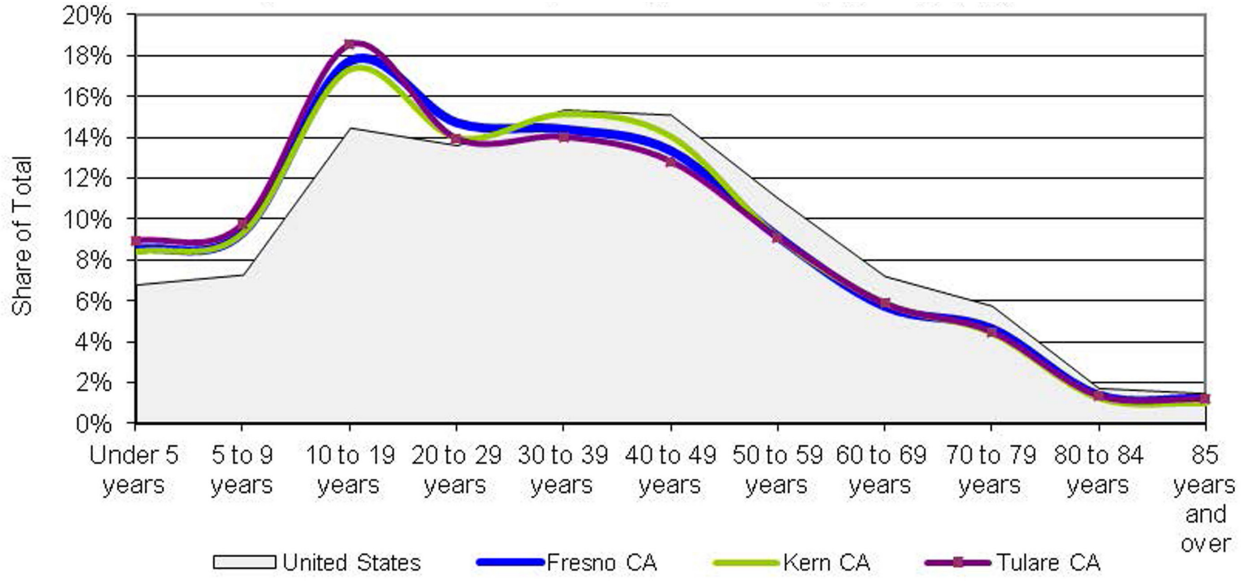


Figure 37 Age Distribution of Total Population by Geography (2000)



Education: It is well recognized that adults with higher levels of education have greater employment options than less educated adults. The Sierra Business Council noted that, "…entrepreneurs look for places to grow their businesses; they are attracted to places with more highly educated populations, indicating the quality and diversity of the labor pool" (2007 p. 23).

The three-county area has a higher percentage of residents 25 years and older (36 percent) with less than a high school degree than either the state (27 percent) or the nation (23 percent). The percent of residents 25 and older with some college (21-23 percent) or an associate degree (6-7 percent) are consistent throughout the nation, state and three-county area. The state and the nation have a relatively higher concentration of bachelor degrees or higher (29 percent) than the three-county area (16 percent) (see the following tables and figures).

Within the three-county area, Fresno has the greatest share of people with a college education (18 percent).

The lowest college education level is in Tulare County (12 percent). In the three-county area as a whole, 16 percent are college educated. One table and figure illustrate the number of adults in each race in the three-county area (25 years and older) with a bachelor's degree or higher. Within the three-county area, the Asian alone racial category has the greatest number of college educated adults (25 percent). The least number of people with a college education are in the "Some other" race category (3 percent). Another table and figure show the number of Adults in each Race in the Region (25 yrs+) without a high school diploma (2000). Within the three-county area, Tulare County has the greatest share of people without a high school education (41 percent). The lowest share of people without a high school education is in Fresno County (34 percent). In the three-county area as a whole, 36 percent are without a high school diploma. Within the three-county area, the "Some other" race category has the greatest share of people without a high school education (61 percent). The lowest share of people without a high school education is in White alone; not Hispanic/Latino category (17 percent).

Table 141 and Figure 38 Number of Adults (25 Years and Older) with a Bachelor's Degree or Higher (2000)

Geography	Number of Adults	Percent of Total Population
Fresno CA	79,927	18
Kern CA	51,869	15
Tulare CA	23,560	12
Region	155,356	16
California	5,669,966	29
United States	44,462,605	29

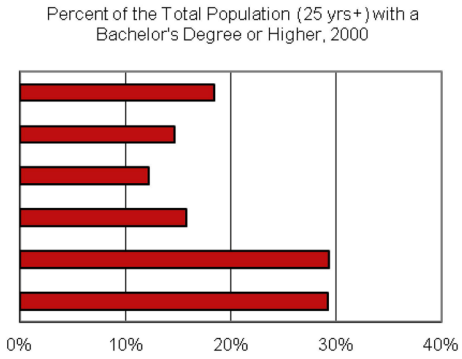


Table 142 and Figure 39 Number of Adults in Each Race in the Region (25 Years and Older) with a Bachelor's Degree or Higher (2000)

Race or Ethnicity	Number of Adults	Percent of Total Population
All Races	155,356	16
White alone	125,552	19
Black or African American alone	4,415	9
American Indian alone	953	7
Asian alone	12,806	25
Native Hawaiian and other Pacific Islander alone	132	15
Some other race	7,220	3
Two or more races	4,278	11
Hispanic or Latino	16,937	5
White alone; not Hispanic/ Latino	117,059	21

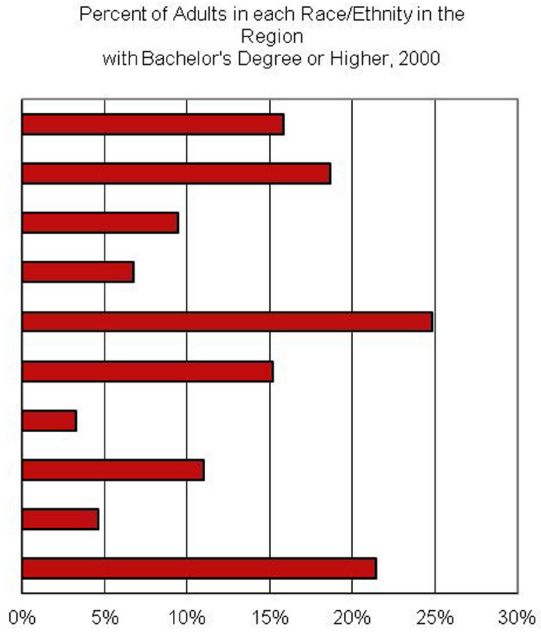


Table 143 and Figure 40 Number of Adults (25 Years and Older) without a High School Diploma (2000)

Geography	Number of Adults	Percent of Total Population
Fresno CA	147,937	34
Kern CA	120,981	35
Tulare CA	78,512	41
Region	347,430	36
California	4,942,743	27
United States	35,715,625	23

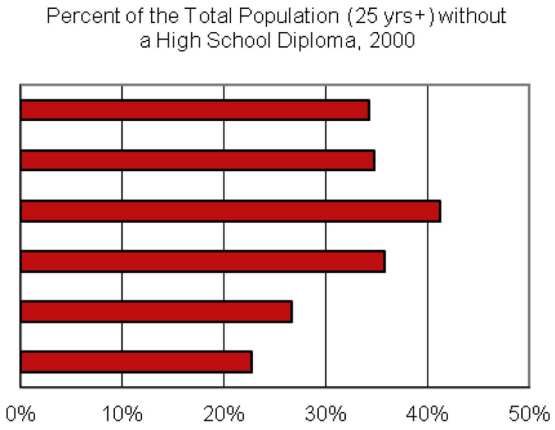
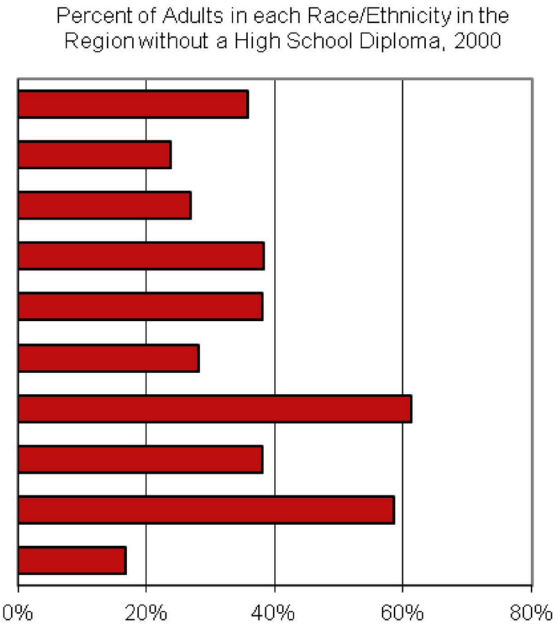


Table 144 and Figure 41 Number of Adults in Each Race in the Region (25 yrs+) without a High School Diploma (2000)

Race or Ethnicity	Number of Adults	Percent of Population
All Races	347,430	36
White alone	160,556	24
Black or African American alone	12,585	27
American Indian alone	5,424	38
Asian alone	19,638	38
Native Hawaiian and other Pacific Islander alone	244	28
Some other race	134,182	61
Two or more races	14,801	38
Hispanic or Latino	216,209	58
White alone; not Hispanic/Latino	91,056	17



Language: The following table illustrates the share of the population who speak English either "not well" or "not at all." Consistent with the state and nation, the following populations in each of the three counties who speak English "not well/not at all" by greater than 15 percent include: the Asian alone racial category (21 percent), the "some other" racial category (24 percent), and the Hispanic or Latino population (24 percent).

Table 145 Number of People (5 Years and Older) Who Speak English "Not Well" or "Not at All" (2000)

	Fresno CA	Kern CA	Tulare CA	Region	California	United States
White alone	24,432	17,998	14,353	56,783	1,119,313	4,834,786
Black or African American alone	297	535	208	1,040	21,727	332,146
American Indian alone	1,181	613	292	2,086	24,581	95,627
Asian alone	13,454	3,481	2,262	19,197	643,393	1,615,278
Native Hawaiian and other Pacific Islander alone	7	24	31	62	5,811	17,937
Some other race	42,810	33,427	27,515	103,752	1,373,437	3,516,626
Two or more races	4,595	2,723	2,232	9,550	168,648	574,451
Hispanic or Latino	69,391	53,108	43,004	165,503	2,458,967	7,472,225
White alone; not Hispanic/Latino	2,397	1,430	1,212	5,039	188,107	1,394,197
All races	86,776	58,801	46,893	192,470	3,356,910	10,986,851
	Percent of Total					
White alone	6	5	7	6	6	2
Black or African American alone	1	2	4	1	1	1
American Indian alone	10	7	7	9	9	4
Asian alone	23	17	20	21	19	17
Native Hawaiian and other Pacific Islander alone	1	3	12	4	6	5
Some other race	23	24	27	24	27	25
Two or more races	13	11	15	13	11	9
Hispanic or Latino	22	24	26	24	25	24
White alone; not Hispanic/Latino	1	0	1	1	1	1
All races	12	10	14	11	11	4

Poverty: The following table reveals how the races' poverty rates compare to each other and to the state and nation. The number of people living under poverty for all races (combined) in each of the three counties is greater than 20 percent, compared to 14 percent in the state and 12 percent across the nation. Also, the number of people living under poverty in each racial category within the three-county area, except "White alone" (15 percent), is also above 20 percent, from a low of 23 percent in the Native Hawaiian and Other Pacific Islander racial category to a high of 35 percent in the Black or African American racial category.

Table 146 Number of People Living Under the Poverty Level (1999)

	Fresno CA	Kern CA	Tulare CA	Region	California	United States
All races	179,085	130,949	86,572	396,606	4,706,130	33,899,812
White alone	61,409	58,766	35,182	155,357	2,059,640	18,847,674
Black or African American alone	13,035	11,472	2,118	26,625	470,155	8,146,146
American Indian alone	4,286	2,184	1,498	7,968	66,635	607,734
Asian alone	24,436	3,142	3,019	30,597	466,431	1,257,237
Native Hawaiian and other Pacific Islander alone	190	116	89	395	17,484	64,558
Some other race	65,747	48,410	40,094	154,251	1,345,522	3,687,589
Two or more races	9,982	6,859	4,572	21,413	280,263	1,288,874
Hispanic or Latino	105,608	75,075	62,011	242,694	2,377,589	7,797,874
White alone; not Hispanic/Latino	30,277	37,938	17,688	85,903	1,209,577	15,414,119
	Percent of Total					
All races	23	21	24	22	14	12
White alone	14	15	17	15	10	9
Black or African American alone	34	36	37	35	22	25
American Indian alone	34	25	32	31	22	26
Asian alone	39	15	25	32	13	13
Native Hawaiian and other Pacific Islander alone	30	15	33	23	16	18
Some other race	32	33	35	33	24	24
Two or more races	25	24	27	25	17	18
Hispanic or Latino	31	31	34	31	22	23
White alone; not Hispanic/Latino	10	12	12	11	8	8

Cultural Resources

Cultural resources in the Monument include prehistoric and historic archaeological sites, historic buildings and structures, cultural landscapes, and traditional cultural properties or ethnographic resources (both natural and cultural resources), the latter two being important to the continuing culture and traditions of monument-associated Native Americans. Some of the cultural resources are housed in museum collections. These resources reflect early settlement, use, and management of the lands by indigenous people; westward expansion of Euro-american people (as well as Asian, African, and other non-European people) and their conflicts with Native American groups; resource extraction such as logging, mining, and herding; early tourism; early environmental conservation efforts; development of water resources; and forest planning, design, and land management. They are the physical evidence of human presence spanning the Holocene epoch (approximately 11,700 years ago to present).

Only about 40 percent of the Monument has been inventoried for archaeological and historic sites; within this area, approximately 950 sites have been recorded. The survey coverage is relatively even throughout the Monument, with the exception of the northern portion of the Western Divide Ranger District, which has not been surveyed. Based on known sites, the predicted cultural resource site density is about one site per 98 acres, although site densities may vary greatly from one area to another. The number of sites, including sites not

yet discovered, is estimated to be 2,400. This will increase as Forest Service structures age. Of the known cultural resources, few have determinations eligible for or have been nominated for listing in the National Register of Historic Places.

The known cultural resources in the Monument are 67 percent prehistoric, 27 percent historic, six percent multiple component (containing both prehistoric and historic components), and three percent potential Traditional Cultural Properties (TCPs). The predominant prehistoric site components are bedrock milling features and lithic (e.g., obsidian or chert) scatters (see the following table). Twenty-six percent of prehistoric sites contain a bedrock basin feature.

Table 147 Percentage of Prehistoric Sites by Component

Lithic Scatter	Bedrock Milling Feature	Midden	Rock Art	Basin	Rock Shelter
55	77	12	7	26	3

Historic sites predominantly contain a structure, standing or collapsed, and are related to logging operations (see the following table).

Table 148 Percentage of Historic Sites by Component

Structure	Logging Related	Road or Trail
87	53	10

While most historic eras and events are documented, the location, extent, condition, and significance of many of the physical resources reflecting these episodes are unknown. The documentation available for known resources typically lacks the detail necessary to determine whether there is potential for effects from site-specific projects. Additional archaeological studies are needed.

Types of Cultural Resources

The 1988 Forest Plan outlined three types of cultural and historic resources:

1. Prehistoric and historic Native American properties, including lithic scatters, food processing sites with midden, lithic material or bedrock mortars, rock art sites, and quarries.
2. Practice of Indian religion: "These may or may not include tangible remains. Native Americans continue to receive permits for collecting foodstuffs and performing traditional ceremonies on public lands" (USDA Forest Service 1988a, pp. 3-10).
3. Historic properties including old Forest Service administrative sites, log cabins, lookouts, mining sites, remains of railroad logging, or old homestead properties (USDA Forest Service 1988a, pp. 3-10).

To better conform with how Forest Service direction, the National Historic Preservation Act (NHPA), and the National Register of Historic Places (NRHP) currently define and manage cultural resources, this analysis will use the following five cultural resource types: archaeological sites, architectural sites, cultural landscapes and districts, ethnographic and traditional cultural properties, objects, and museum collections.

Archaeological Sites: Prehistoric and Historic

Archaeology is the physical evidence of human actions in specific locations and interactions with the environment over the broader landscape. This evidence includes structures, remains of structures, accumulated or deposited trash, physical evidence of food extraction, mining, logging, livestock grazing, or agriculture. Archaeological evidence is often defined as a site, which under the NRHP is the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure (whether standing, ruined, or vanished), where the location itself possesses historic, cultural, or archeological value regardless of the value of any existing structure.

The Monument currently has over 900 recorded archaeological sites. These sites are the physical remains of human occupation over the last 9,000 years and range from small-scale obsidian flake scatters to large-scale complex Native American village sites occupied for thousands of years. Historic sites chronicle some of the earliest Euro-American exploration, settlement, and development of the southern Sierra Nevada. Historic sites in this part of California date from roughly 1850 to the 1960s.

Architectural Sites: Buildings and Structures

The NRHP divides architectural sites into buildings and structures. A building is created principally to shelter any form of human activity, while a structure is used to distinguish buildings whose functional constructions were usually made for purposes other than creating human shelter (e.g., dams, railroad grades, canals).

The Monument contains numerous buildings and structures, including historic buildings (e.g., fire lookouts and Forest Service guard stations) and historic structures (e.g., Hume Lake Dam), many of which are actively maintained and still function in their original capacity. These places reflect important historic eras, or the influence of individuals important in the human history of the Monument.

Cultural Landscapes and Districts

Cultural landscapes are geographic areas, subsuming both cultural and natural resources, and the wildlife or domestic animals therein, associated with an historic event, activity, or person, or exhibiting other cultural or aesthetic value. Cultural landscapes are not a recognized property type under the NRHP and are recognized as districts. The NRHP defines districts as possessing a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united historically or aesthetically by plan or physical development. A district derives its importance from being a unified entity, even though it is often composed of a wide variety of resources. The identity of a district results from the interrelationship of its resources, which can convey a visual sense of the overall historic environment or be an arrangement of historically or functionally related properties. Cultural landscapes are also ecological legacies from our past.

Currently only one district has been formally recorded in the Monument: the Springville Work Center. Other historic work centers (e.g., Pinehurst Work Center) and logging remains (e.g., Millwood mill and town site, Converse Basin mill, railroad and hoist system) in the Monument have been identified as potential districts.

Ethnographic and Traditional Cultural Properties

Traditional Cultural Properties (TCPs) are important places because of their association with the cultural practices or beliefs of a living community that (1) are rooted in that community's history; and (2) are important in maintaining the continuing cultural identity of the community. TCPs include sacred sites, natural resource collection areas, and the occasional archaeological site associated with ancestral Native American groups. TCPs must be a tangible property, that is a district, site, building, structure, or object as defined in 36 CFR 64.4 (FSM 2360.5).

Objects and Museum Collections

The NRHP describes objects to be relatively small things that are associated with a specific setting or environment. These objects are often recorded or catalogued and then remain in their original context (e.g., large mining and logging equipment) where they can be used for interpretation (e.g., the Dolbeer donkeys at Hume Lake Ranger Station and Turtle Bay Exploration Park).

In the past, many archaeological objects were collected which now form the bulk of federal museum collections. The acquisition and long-preservation of archival material, scientific reports, oral histories, ethnographic records, and/or archaeological materials (both historic and prehistoric) are important for documenting and understanding the natural and human history of the Monument and interpreting that understanding to the public. The location, management, and long-term preservation of these resources fall under museum collections. All artifacts and associated records (e.g., catalogues and photographs) removed from NFS lands remain federal property and must be managed according to 36 CFR Part 79.

The types and distribution of cultural resources in the Monument are based on what, where, why, and

how people of the past used the land. An overview of prehistoric and historic land use patterns and how that is manifested in currently known cultural resources is presented below.

Prehistoric Background

People first arrived in California more than 13,000 years ago (Johnson et al. 2002). Currently there are no known sites older than 7,000 years in the Monument. The Monument may have some of the oldest sites in the Sierra Nevada since this portion of the mountain range was not extensively glaciated during the Tioga glaciation. Occupation of the higher elevations (above 7,000 feet) of the southern Sierra Nevada would have been limited during this glaciation more than 14,000 years ago, but land below 7,000 feet was habitable.

The earliest human occupation of the Monument could have come from either the west (Tulare and Buena Vista Lakes) or the southeast (Great Basin), where fluted projectile points have shown the presence of people 8,000 to 10,000 years ago. Few large-scale archaeological excavations or data syntheses of sites in the southern Sierra Nevada have been undertaken, so chronologies based on sites in the Mojave Desert and Great Basin have been used, with their emphasis on pinyon procurement, a resource not commonly found in the Monument. Using data from lower elevation sites in the foothills of the San Joaquin Valley, Moratto et al. (1978) hypothesized that early prehistoric settlement consisted of large villages along the lower reaches of rivers by junctions with main tributaries. Large-scale sites did not appear in the mid-elevations until after 3,000 years Before the Present (B.P.). Unpublished data from archaeological sites in the Monument, however, have indicated that there were major villages located away from large rivers at times much earlier than Moratto et al. suggest. McGuire and Garfinkel (1980) hypothesized that sporadic nomadic groups used high elevations around 8,000 feet as early as 9,000 B.P. Post 6,000 years B.P., a dryer climate caused a shift to large game hunting until 3,200 B.P., when pinyon exploitation became dominant. Around 1,400 B.P., technology shifted from the atlatl and dart to the bow and arrow, and an increasingly diverse subsistence with bedrock mortars indicates intensification of acorn processing. The final prehistoric settlement shift came post 700 B.P., with increased population and use of pottery (Moratto 1984).

Geographic Forces on Human Occupation

In the northern two-thirds of the Sierra, north of the Kings River, the crest is consistently very far east of the center of the range, and long river canyons drain the deeply eroded, but relatively gentle western slope. In contrast, the south Sierra Nevada, south of the Kings River, has a unique geographic factor that influenced human occupation, settlement patterns, and trade routes. South of the Kings River, the "shape and texture of the Sierra change radically. South of the Kings River, the Sierra Nevada has a double crest. The main crest, and home of the highest peaks in the range, remains far to the east, but a second, parallel, crest appears—the Great Western Divide." (Dilsaver and Tweed 1990:3) West of the divide the Kaweah River, Tule River, and White River drop steeply into the San Joaquin Valley. "East of the Great Western Divide, but still west of the Sierran crest, is the fifteen-mile-wide canyon complex of the Kern River, draining not west, like every other Sierran river, but instead south for many miles, and finally, even reluctantly, west into the extreme southern end of the San Joaquin Valley." (Dilsaver and Tweed 1990:3)

> These two factors—the presence of the highest peaks in the Sierra, and the well-spaced double crest with extensive uplands between—make the southern Sierra very different from the remainder of the range. Nowhere else is the Sierra so high. Nowhere else are the canyons so rugged and deep. And nowhere else does the Sierra rise so steeply from the west. The peaks of the Great Western Divide are much closer to the floor of the Great Central Valley than any other alpine area in the range. (Dilsaver and Tweed 1990:3)

This geographic difference between the Great Western Divide, on which the Monument is a part, and the rest of the Sierra Nevada made for the potential for the prehistoric habitation of the Great Western Divide to differ from that of the rest of the southern Sierra Nevada. The differences included trade routes and outside cultural influences. Traditionally, the Monument has been associated with cultural phases based on work from the Pacific Crest trail on the main

crest of the Sierra Nevada with a major Great Basin influence without a discussion of the proximity to the central valley. More recent work has begun to explore the influence of central valley cultures on the Great Western Divide. Because of this new line of research, both the Great Basin influenced chronologies and the southern San Joaquin Valley chronology are presented below.

Ethnography

There are three identifiable ethnolinguistic groups whose traditional territories are now within the Monument: the Western Mono, Yokut, and Tubatulabal. Anthropologists have traditionally grouped California cultures on the basis of language, since other sociocultural and political features between groups are so similar that language is the best differentiator. It is assumed that peoples who speak related languages share a common historical origin and cultural similarities, in contrast to those who speak unrelated languages.

These broad ethnolinguistic groups are divided into tribal groups and tribelets. The tribelet was the basic political unit for the ethnographic groups in California. Each tribelet was centered in a major winter village, which might encompass one or more secondary satellite communities (Gayton 1945, p. 409). Although the tribelet was autonomous, it did interrelate with neighboring tribelets. This was in the form of marriages, use of one another's gathering areas, attendance of ceremonies, and sometimes engaging in hostilities (Gayton 1948).

The northern portion of the Monument, consisting of the Kings River and upper reaches of the Kaweah drainage, was inhabited by people from two language groups, the Western Mono and Yokuts. Seven tribelets inhabited this area: the *Michahai*, *Wobonuch*, *Waksachi*, *Patwisha*, *Entimbich*, *Choinimne*, and *Wukchumni*. The Yokuts occupied lands from the valley floor to about 3,000 feet elevation, and the Western Mono lived primarily between 3,000 and 7,000 feet elevation, though they also utilized and traveled in the higher elevations.

The southern portion of the Monument, consisting of the upper reaches of all forks of the Tule River, the Little Kern River, and the western half of the upper Kern River watershed, was inhabited by people from two language groups, Yokuts and *Tubatulabal*. Five tribelets were located in this area: the *Yaudanchi*, *Bokninuwad*, *Bankalachi*, *Pakanapul* (*Pahkanapil*) and *Palagewan*.

The Yokuts inhabited the Tule River area and the western portion of the Western Divide. *Tubatulabal* peoples occupied the upper Kern River reach in the south from where the Kern enters the San Joaquin Valley to Mt. Whitney, in the north, and Walker Pass in the east, sharing the Western Divide with the Yokuts in the west.

The Western Mono, also known as the Monache, speak dialects of Mono which belong to the Numic branch of the Uto-Aztecan language family. The preponderance of Numic speakers occupy the Great Basin, and it is thought that only within relatively recent prehistory that the Western Mono peoples moved across the Sierran crest to settle on the western slopes, in an elevational zone just above the Foothill Yokuts. This settlement is so recent that Gayton states, "The outward similarities of culture now to be found between Yokuts and Western Mono are largely a veneer assumed recently by the latter" (1948, p. 1).

The Yokuts speak dialects of Yokutsan which is a language group in the Penutian language family. The Yokutsan speaking groups are part of a widespread and populous set of peoples occupying the San Joaquin Valley from the Sacramento Delta to the Tehachapis, north and south, and from the east side of the southern Coastal Range to the Sierra Nevada foothills, east and west. The "Yokutsan" language family is related to several other large central California language families, the Wintuan, Maiduan, and Utian. Yokuts languages and dialects are subgrouped into three divisions which correspond only roughly to the environmental zones occupied: the Foothill Division, Valley Division, and Buena Vista Division. The Yokuts seem to have been well established in their regions over a significant period of time, certainly in excess of 1,000 years.

The *Tubatulabal* speak Tubatulabalic, a branch of the Uto-Aztecan language family, and are therefore related to the Mono peoples. However, Tubatulabalic is an "isolate" language, meaning that it is not closely related to any other language with which it forms a group or family. It is quite distinct from

other California or Basin Uto-Aztecan languages, thus suggesting considerable time has elapsed since its divergence from other Uto-Aztecan relatives (Smith 1978, Whistler 1984). Based on the language isolation and the fact that their mythology contains no migration tales their occupation of the area is long-standing (Smith 1978; Voegelin 1938), and may be of substantial antiquity.

Subsistence

The Western Mono, Yokuts, and Tubatulabal relied on a hunting, fishing, and gathering economy. This economy adapted to seasonal changes where specific resources were targeted based on the season. A significant part of the economy was trade with tribes from both sides of the Sierra Nevada traveling across the mountains. Items brought from the east were rock salt, pine nuts, mountain sheep skins, moccasins, buckskin jackets, leggings made of fox skin, baskets, pine sticks, sinew-backed bows, and unfinished obsidian blanks. Items taken east were beads, acorn meal, and baskets.

This economy caused tribelets to have seasonal rounds where "permanent" villages were occupied for the most part in the winter months. During the summer, villages would split into groups of two or three families and travel to summer camps. The elderly or sick were left in the village with someone in attendance. Although there were no definite tribal boundaries, village sites were regarded as the seat of the tribelet, and territories were confined to hunting and gathering areas. In cases of food shortage, adjacent tribes with whom there were friendly relations were asked for permission to obtain food from their territory (Gayton 1930a). Winter villages were in the lower elevation where groves of black oaks (*Quercus kelloggii*) grew.

Native Americans, Vegetation Manipulation, and Fire

Native Americans and the groups that inhabited the area now known as the Monument manipulated the vegetation in order to provide diverse and sustainable food and material supplies. This manipulation came in the form of gathering, cutting, sowing, burning, hunting, and limited planting. While direct intense hand manipulations would have been limited by population, distance from habitation sites, and length of occupation, more indirect manipulations, such as fire, would not have had such limits and would have only been limited by the susceptibility of fuels to burn. Fire was used to promote vegetation regeneration, for hunting, to capture insects for food, and for other activities (Blackburn and Anderson 1993, Anderson and Moratto 1996, Lewis 1973, Bean and Lawton 1973). Euro-American settlement in the 19th century ended much of the tribal manipulation of the ecosystems.

Historical Background

Prior to direct contact with Europeans, Native American cultures in the Sierra Nevada were affected by European exploration and settlements outside the region. Europeans brought disease, the horse, and the gun, which spread to peoples whom they had not directly met. Disease caused catastrophic plagues that decimated the Native Americans, causing large-scale changes and interruptions in trade and social networks.

The first Spanish settlements along the California coast, starting in 1769, had heavy effects on the population of coastal Indians, and these effects were also felt by peoples of the San Joaquin Valley and the Sierra foothills. By 1776, Spanish missionary Francisco Garces, with a small group of soldiers, explored the eastern San Joaquin Valley visiting Kern Valley, the White River, and possibly California Hot Springs, including the Bokninuwad village of the Hoin Tinliu Yokuts (Latta 1977). The Tubatulabal were known to have come in contact with the Spanish at Mission San Buenaventura while on trading trips to the coast (Smith 1978). In 1806, Gabriel Moraga traversed the western foothills in search of favorable mission sites, ascending and camping along a river which he named El Rio de Los Santos Reyes (River of the Holy Kings), now known as the Kings River, and passing through the area now occupied by Visalia. Though subsequent plans to establish a mission near Visalia never materialized, the route traveled by Moraga and others during the Spanish and Mexican periods became known as the Old Spanish Trail, and later the Tulare or Visalia Trail (Hoover et al. 1966, p. 91). In 1819, Lt. Estudillo explored parts of the Yokuts territory (Theodoratus Cultural Research 1984).

The 1820s also brought an increase in American explorers passing through the southern Sierra Nevada including Jedediah Smith, who explored the upper reaches of the Kings and Kaweah Rivers in 1827, Joseph Walker in 1834, and Peter Skene Ogden in 1843 (Farquhar 1966; Hoover et al. 1966, p. 561).

The 1850s brought large-scale change to California and the Monument region. The discovery of gold and the subsequent Gold Rush in 1849 brought some 100,000 gold miners into California and, on September 9, 1850, California became a state. This influx resulted in a devastating decline in the Native American population which, between 1845 and 1855, fell from approximately 150,000 to 50,000 (Cook 1978). Discovery of gold in the southern Sierra Nevada during the early 1850s brought nonnatives to the Greenhorn Mountains and the Kern River Valley south of the Monument. While the majority of miners went north or south of the Monument, others used or developed the trails that passed through what is now the Monument. In addition to miners, military operations also took place in the Monument.

The large influx of people into the San Joaquin Valley and Sierra Nevada foothills during the 1850s resulted in major conflicts, including the Mariposa Indian War and the fighting at Battle Mountain near Springville.

The Sierra Nevada, and particularly those areas not mined, became a refuge for Native Americans. In 1861, while William H. Brewer (1949) passed through the White River, Deer Creek, and the Kern River Canyon areas, he encountered two refugee populations in the southern Sierra and Great Basin. One camp of Tubatulabal was located in the upper Kern, whose population had fled the massacre at Tilly Ranch near Kernville. Another camp at Vermillion Valley included a large population of Mono, Miwok, and Yokuts who, according to Brewer, had been "hunted out of the valleys" (Theodoratus Cultural Research 1984).

Emergence of Timber and Grazing Interests

While the area that is now the Monument was largely left untouched by miners, the Gold Rush left a significant effect on the San Joaquin Valley west of the Monument. The growth of the Euro-American occupation in the Monument is closely tied to that of the growth of the eastern San Joaquin Valley. By the mid 1850s, the town of Visalia was a major station along the Stockton-Los Angeles and Butterfield Stage Roads and, in 1852, Tulare County was organized. Fresno County was organized in 1856. Cattle ranching and timber harvesting quickly spread eastward from Visalia into the foothills and mountains. By the early 1860s, foothill communities such as Squaw Valley were being settled, and people were traveling through the area that would become the Monument on the Dennison, Jordan, and Hockett Trails.

A drought in 1863-64 caused ranchers to drive their sheep, cattle, and horses into the Sierra Nevada for relief from the heat and forage in the mountain meadows. The number of livestock increased throughout the late 1800s with estimates of almost 1 million sheep in the San Joaquin Valley in the 1870s (Rose 2005, p. 8).

By the mid 1850s, the demand for lumber in the valley brought loggers to the mountains. Between the mid-1850s and 1920, more than 35 sawmills operated in what is now the Hume Lake Ranger District. Small mills were prevalent in the current Western Divide Ranger District as well. The earliest lumber mills were located in the lower elevations, investments were minor, and the operations were small. These mills were technologically primitive compared with the mills to follow (Brown and Elling 1981, p. 54). They usually focused on sugar pine or yellow pine and only logged those giant sequoias in their way. But in 1869, Charles Converse made an unsuccessful individual attempt to log the giant sequoias (Rose 2005, p. 13).

The California State Legislature acknowledged the importance of protecting sequoias when, in 1873, they passed a law stating that "any person or persons who shall willfully cut down or strip of its bark any tree 'over sixteen feet in diameter' in the groves of big trees situated in the counties of Fresno, Tulare or Kern or shall destroy any of said trees by fire, shall be guilty of a misdemeanor" (Johnston 1974:18). Despite this protection, some of the first major logging of sequoias occurred in the Big Stump Grove between 1883 and 1889 by Smith Comstock.

The expansion of settlements into the mountains continued with the establishment of California Hot

Springs by the Witt brothers in 1883 (Muller 1990, p. 1), Pine Flat in 1883, Camp Nelson in 1886, and Springville in 1890.

In 1878, the Timber and Stone Act was passed, which allowed people to purchase public domain land that was "unfit for farming," for "timber and stone" purposes (logging and mining), for $2.50 per acre in 160-acre blocks. This introduced well-organized "outside" interests, and the local lumber industry transitioned from individual business enterprises to large corporations. The Act was used by speculators to increase their land holdings at minimal expense, and this is exactly what happened in the formation of the Kings River Lumber Company. This company built two mills next to Abbott Creek and Mill Flat Creek. The most notable accomplishment of this company was the installation of a 54-mile-long flume, which was constructed to float cut lumber from the Millwood Mill down the Kings River Canyon.

In 1894, the Kings River Lumber Company was re-formed into the Sanger Lumber Company and moved forward with logging the giant sequoias in Converse Basin. In 1905, the Sanger Lumber Company was sold to the Hume-Bennett Lumber Company. In 1908, a new mill was built in Long Meadow, four miles east of Converse Basin. A multiple-arch concrete dam was built to retain waters from Ten Mile and Long Meadow Creeks, creating a storage pond for logs and the modern day Hume Lake. The flume was extended up Ten Mile Creek to the dam, increasing its length to 73 miles. Logging of mostly pine continued until 1914, when the market for redwood became more active. In 1917, the Hume-Bennett Company was re-organized into the Sanger Lumber Company. Later that year the Hume Lake Mill was consumed by fire. This and World War I caused the Sanger Lumber Company to go into a steady decline. By 1927, the flume was being sold off in sections and, on April 8, 1935, the Sanger Lumber Company sold over 20,000 acres, including 11 giant sequoia groves, to the U.S. Forest Service.

The loggers did not confine their interest to the northern portion of the monument. "On the North Fork of the Tule River, Comstock, Smith and Moore operated as partners in the Tule River Lumber Company" (Dilsaver and Tweed 1990, p. 56).

The Ghost Dance and the Reservation

Native Americans continued to go about their lives during this time of Euro-American expansion. The upheavals in their cultures continued and brought new responses, including the expansion of the Ghost Dance religion to the southern Sierra Nevada.

The Ghost Dance religion emanated from the Northern Paiute and diffused among the indians of the Western United States. This occurred in two waves, one in 1870 and another about 1890. The doctrine of the movement was that, when the Ghost Dance was performed, the dead would return and peaceful and prosperous conditions would be re-established for the Native Americans (Gayton 1930b). The last large dance was in Eshom Valley at Čitatu during the fall of 1872. Subsequent dances were held at the Tule River Reservation as the new religion spread farther south.

In 1851, while the governor was sending militia to fight, punish, and bring Native Americans to reservations, President Millard Filmore sent three agents--O. M. Wozencraft, Redick McKee, and George W. Barbour--to negotiate treaties with the California tribes. Subsequently, Congress authorized seven reservations of 25,000 acres each to be set aside. The Tule Farms/River Reservation (also known as Madden Farm) was established in 1856 and the Fresno River Reservation was established a year later in 1857. In 1861 both the Fresno and Tule River combined and moved to the mountains, where the Tule River Reservation exists today (Theodoratus Cultural Research 1984).

The shuffling and segregation of Native American people continued when President Ulysses S. Grant issued an executive order on January 9, 1873, establishing the Tule River Indian Reservation at its present location. The new reservation was originally comprised of about 48,000 acres but was almost doubled in size on October 3, 1873, when President Grant issued a second executive order resetting the northern boundary to the drainage between the Middle and North Forks of the Tule River. The expanded reservation did not last long when, in 1878, President Rutherford B. Hayes cut the reservation to its original size and returned all the additional land to the public domain (http://www.tulerivertribe-nsn.gov/history).

The Indian Homestead Act of 1884 permitted indians to homestead land similar to the way non-indian settlers acquired land. The Mono and "San Joaquin Indians" (possibly Foothill Yokuts—no further specification or tribal affiliation is made) received 30 allotments (Theodoratus Cultural Research 1984). Throughout the late 1800s, missions and mission schools were established in Native American communities and on rancherias (Theodoratus Cultural Research 1984).

Mining

For the most part little mining took place within what is today the Monument, but prospectors did explore the area while passing through on the way to areas with productive mines in Mineral King, Greenhorn Mountain, and Owens Valley. Some mines did produce gold along with tungsten, lead, zinc, and copper. While the foothills west of the monument produced magnesite.

Beginning in the early 1890s, magnesite, used in the production of paper, was discovered and mined in the hills southwest of Springville, and by the early twentieth century Porterville Hill and Success Hill accounted for a significant portion of California's production of the mineral. William Pitt Bartlett, who headed the magnesite mining operations of the Willamette Pulp and Paper Company, was also instrumental in developing the area's granite industry. Granite mined from quarries in the nearby foothill was used in the construction of several buildings in Porterville. (Lloyd, Baloian, et. Al. 2010)

Hydroelectric Development

In addition to mining, people began to see the potential for hydroelectric development in the southern Sierra Nevada in the late 1800s. Most of the hydroelectric development in and around the Monument was focused on the Kaweah and Tule Rivers. In 1899 Albert Graves Wishon founded the Mt. Whitney Power Company, and built its first company's hydroelectric plant on the confluence of the South and Middle Forks of the Kaweah River. The facility produced hydroelectric power and diverted water to citrus lands around Exeter. Wishon was forced out in 1902. That same year while seeking backers for a hydroelectric plant on the Tule River he became the manager for the San Joaquin Power Company. With backing from Henry H. Hunting, William G Kerckhoff and A.C. Balch, in 1903 Wishon sought construction permits to build a hydroelectric plant at the junction of the North and South Forks of the Middle Fork Tule River.

That same year (1903) Wishon's former company and now rival, the Mt. Whitney Power Company, formed the Globe Light Power Company and claimed water and power rights to the Lower Tule, the area lying below the junction of the North and South Forks of the Middle Fork, where Wishon wanted to place his plant. The competing claims for construction permits on Forest Service land lead to delays in construction. Wishon wrote to the District Forester (now known as Regional Forester) in 1910 of the situation:

> Shortly after receiving these permits, as the record of the Land Department will show, controversies and contests arose in connection therewith and these controversies and contests continued before the Department of the Interior and Department of Agriculture for from two to three years after the permits were issued. (Wishon 1910, p. 2)

In 1905, Wishon began construction on the 14-mile long, 30-foot wide wagon road on the north bank of the Middle Tule River and the road to Doyle Springs. In 1908, construction of Camp One at Doyle Springs began. Doyle Springs was the headworks and water flowed into an aqueduct consisting of a series of 26 tunnels, over 16,960 feet long, ending on the point of the high ridge which overlooks the junction of the North and South Forks of the Tule River. The water then drops 1,523 feet vertically through a penstock.

The permit required Wishon to return the water he used to the intake point of the Globe Light and Power Company, which was building the lower Tule River hydroelectric project.

Construction of the powerhouse complex began in 1913 and in January 1914 the system was completed Company.

The Globe Light Power Company hydroelectric complex diverts water from the North and South Forks of the Middle Fork Tule River below the San Joaquin Power Companies complex. This hydroelectric complex consists of a 6 mile flume constructed and penstocks constructed in 1908 to 1914. Today this hydroelectric complex is owned and operated by Southern California Edison.

The San Joaquin Power Company evolved into Pacific Gas and Electric Company, while the Globe Light Power Company later became part of Southern California Edison.

Tourism and Recreation Development

Early recreation in what is today the Monument began in the 1870s and 1880s, with families heading to higher elevations to escape the summer heat in the San Joaquin Valley. Families would explore the backcountry by pack trains, exploring "the old sheep, cattle, mining, and Indian trails." By 1868, Frank Dusy was offering professional packing and guiding services into the Kings and Kaweah backcountry. Mountaineering parties began to use the Dennison, Jordan, and Hockett Trails to access Mount Langley and Mount Whitney (Jackson 2004, p. 65).

By the 1890s, John Nelson and Carmel Wilson opened a commercial pack station near Springville, taking tourists and supplies to Camp Nelson. In 1894, a road was completed from Sanger to Millwood and the community was promoted as a resort (Johnston 1966, p. 46).

Road improvements resulted in marked increases in visitors, particularly as automobiles became an alternative means of transportation. During the 1890s, only a few hundred persons each year made the trek to the Sequoia and General Grant National Parks (Small 1926, p. 254). However, visitation increased dramatically as road access improved.

Early tourism in the Sequoia National Forest was somewhat hampered by the fact that the Forest Service did not consider recreation to be a primary use of public lands. Management and expenditure of funds on recreation development was initially limited to purposes of fire prevention and public safety (Lux et al. 2003, p. 29). In the 1910s, however, the dramatic growth of automobile tourism, and consequent increased public demand for recreational development on national forests, led to Congress passing the Occupancy Permits Act (1915). This law allowed the Forest Service to issue term permits of up to 30 years for concessions, organizational camps, and private recreation residence tracts on forest land (Lux et al. 2003, pp. 24, 30).

The dramatic growth of the automobile industry and auto tourism in the 1910s and 1920s resulted in a correspondingly larger need for more recreational facilities on public lands. New roads were pushed further into scenic forest and mountain areas, and existing routes were improved for automobile passage. The Millwood Road was improved to provide access into the Converse Basin, Hume Lake and General Grant National Park areas. Beginning in the 1920s, segments of nineteenth century logging roads and toll trails were incorporated into the Generals Highway, which accessed the groves from the south along the Kaweah River (Small 1926, p. 253). It was also during the 1920s and particularly in the 1930s, with the aid of federal work programs such as the Works Progress Administration (WPA) and the Civilian Conservation Corps (CCC), that the forest began cleaning up obsolete lumber camps at Hume, Millwood, and Converse Basin (USDA Forest Service 2008). In addition, the CCC and convict crews constructed the portion of State Highway 180 that leads down into Kings Canyon.

Conservation and Government Management

The area that is now the Monument, the surrounding Sequoia National Forest, and the Sequoia and Kings Canyon National Parks have been the focus of battling views on how to manage timbered lands and giant sequoias since Euro-Americans began using and settling in the area.

The expansion of logging and increased concerns of environmentalists, such as John Muir, brought the protection of sequoias to the national eye. In 1890, Sequoia National Park was established as the second national park, and a few days later General Grant National Park was established, both of which contain giant sequoia groves and are adjacent to the current Monument area. The two parks were placed under the protection of the United States Army Cavalry.

Government control of lands in the southern Sierra Nevada expanded when President Benjamin Harrison established the 13-million-acre Sierra Forest Reserve in 1893, which included the current Monument and surrounding Sequoia National Forest. At the turn of the 20th century, 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.

In 1905, President Roosevelt approved transfer of all forest reserves to the U.S. Department of Agriculture, and the Forest Service was established to manage the reserves. In 1906, William B. Greeley was appointed supervisor of the southern district of the Sierra Forest Reserve. On July 2, 1908, the Sequoia National Forest was created from more than 3 million acres of the southern part of the Sierra Forest Reserve (Executive Order 904, July 2, 1908). However, since its designation, portions of the Sequoia National Forest have been reassigned to the Sequoia and Kings Canyon National Parks and the Inyo National Forest.

Past management of what is today the Monument was dominated by private owners, as previously described, and the Forest Service. Anthony Godfrey (2005) outlines eleven historic periods of Forest Service management in *The Ever-Changing View: A History of the National Forests in California*. These phases are summarized in the following table.

Table 149 Phases of Forest Service Management of the Monument

Period	Theme
Pre 1889	California's forests prior to federal controls
1890-1904	California's forests conserved under federal control
1905-1911	Rise and early development of National Forest System
1911-1918	California National Forest System grows and goes to war
1919-1932	Maturation of District 5 to Region 5 and the Great Depression
1933-1941	A New Deal for Region 5 (multiple purpose and multiple-use management
1941-1945	Region 5 at war
1946-1954	Golden state of managing growth and multiple use
1955-1967	Programmed multiple use maximus
1967-1978	Region 5 conservation contested
1978-1987	Recommitment and roots of ecosystem management

Prior to the formation of the Forest Service in 1905:

> The Forest Reserve Act made no provision for the active management of forest reserves and/or legitimate use within them—either for timber cutting, grazing, mining or any other use (Robinson 1975:6). Forest watershed destruction by mining, lumbering and livestock interests, or by fire, did not halt simply because Washington "designated" an area a forest reserve. In fact, during the interim period between the passage of the Forest Reserve Act and the demarcation of the final boundaries of each forest reserve, private owners filed on millions of acres of California's choicest timberlands under the Timber and Stone Act (Godfrey 2005, p. 41).

In the early 1930s, the CCC constructed many of the roads and trails currently in use throughout the forest. The CCC also strung telephone lines in the mountains, cleared brush, cut trees, and constructed permanent bridges and administrative structures. From 1933 to 1938, the CCC constructed many of the currently used Forest Service administrative structures.

Along with the national forest came fire management. Fire management lookouts were constructed in trees, on peaks, and on mountaintops. Early fire lookouts were towers, small cabins, or one-room tree houses.

Today, many of the original stations are gone or have been replaced by modern buildings. Some of the remaining fire lookout towers and guard stations are still in use for administrative purposes, or have been converted to recreation rentals. Some of these facilities retain their historic character and may be eligible for listing on the National Register of Historic Places.

Tribal and Native American Interests

Native Americans and Alaska Natives are recognized as people with distinct cultures and traditional values. Historically, Native Americans have cared for and occupied lands that are currently being administered by the United States government. They have a special and unique legal and political relationship with the government of the United States as defined by history, treaties, statutes, executive orders, court decisions, and the U.S. Constitution. Tribal governments have jurisdictional powers that are frequently separate and equal to those of state and local governments. The policy of the U.S. Government is to support Native American cultural and political integrity, emphasizing self-determination and government-to-government relationships. This support comes from implementing and following laws aimed at protecting tribal rights and religious beliefs. The American Indian Religious Freedom Act 1978, the Archaeological Resources Protection Act 1979, the National Historic Preservation Act 1996, Executive Order 13175 on Tribal Consultation, and others all charge the federal government with protecting areas on public lands that are sacred to native peoples. In addition there are many Forest Service policies, including but not limited to Forest Service Manual 1500, Chapter 1560, the Traditional Gathering Policy, to help and assist with tribal relations between the Forest Service and tribal communities.

There are many rights and privileges associated with treaties, executive orders, and other agreements, such as grazing, hunting, subsistence gathering, and access to and gathering of national forest resources. In addition, land and resources hold a special and unique meaning in the spiritual and everyday lives of many Native Americans.

The Sequoia National Forest remains committed to cultivating good relationships with Native American tribes and Native American groups. National Forest System lands and resources represent significant cultural and economic values to Native Americans. Forest Supervisors have the responsibility to maintain a government-to-government relationship with federally-recognized Indian tribes. The Forest Service is to ensure that forest programs and activities honor Indian treaty and executive order rights, and fulfill trust responsibilities, as those responsibilities apply to National Forest System lands. Treaties, statutes, and executive orders often reserve off-reservation rights and address traditional interests relative to the use of federal lands.

Forest Supervisors also administer programs and activities to address and be sensitive to traditional native religious beliefs and practices, and provide research, transfer of technology, and technical assistance to tribal governments. The Sequoia National Forest also confers with non-federally recognized tribes, organizations and individuals.

Currently, the Sequoia National Forest has one agreement in place with Native American tribes concerning *Sequoia National Forest Protocol for the Inadvertent Discovery and Identification of Native American Human Remains, Funerary Objects, Sacred Objects and Objects of Cultural Patrimony*, that applies equally to federally and non-federally recognized tribes. The forest is in negotiation on a memorandum of understanding with the Tule River Indian Reservation that formally recognizes the government-to-government relationship. This memorandum of understanding will outline the goal of increased cooperation between the national forest and the Indian tribe in order to develop community opportunities and partnerships in areas of mutual interest. It documents national forest recognition of the importance of the tribe and its need to have access to and the use of certain natural resources existing in the national forest. Other Native American tribes have expressed interest in similar memorandums of understanding but no formal negotiations have taken place.

Native American people have occupied areas in the Monument for thousands of years. Archaeological evidence and historical and ethnographic accounts attest to the diversity, longevity, and importance that Native American groups have in this area (see the following table).

Table 150 Tribes and Native American Groups within the Monument's Sphere of Influence

Tribe	Federally Recognized
Tule River Indian Reservation	Yes
Santa Rosa Rancheria–Tachi Yokuts	Yes
Dunlap Band of Mono Indians	Seeking
Tubatulabals of Kern Valley	Seeking
Wukchumni Tribal Council	Seeking
Wuksachi-Michahai Tribe	No
Traditional Choinumni Tribe	Seeking
Kings River Choinumni Farm Tribe	No
California Choinumni Tribal Project	No

The Monument borders over one-half of the entire Tule River Indian Reservation and approximately 9,000 acres along the upper portion of the South Fork Tule River, to which the Tule River Tribe has water rights under the Winters Doctrine, are in the Monument. The Winters Doctrine established that when the federal government created indian reservations, water rights were reserved in sufficient quantity to meet the purposes for which the reservation was established. Water rights affect over 1,500 residents of the Tule River Indian Reservation.

Contemporary uses or concerns have centered on the protection of and access to Monument resources of cultural or traditional importance and areas with special or sacred values, often the locales of ceremonial activities. Issues include access and use of Forest Service roads that access reservation land, protection of the Tule River watershed, and protection of reservation lands from fires that start in the Monument.

There are other local tribes, groups, and individuals who have not been federally recognized, but who, like the federally recognized tribes, still look to the Monument for traditional and contemporary uses and as part of their ancestral homeland (see the previous table).

Studies indicate that Native Americans attach deep emotional, symbolic, and spiritual meanings to those areas that are their traditional lands, including those lands that are publicly owned and managed by government resource management agencies. These perceptions and meanings influence their current lifestyles, environment, and quality of life (McAvoy et al. 2001). Researchers have also noted that the dominant society's (in this case, Anglo-Hispanic) sense of place often conflicts and competes with the minority people's (Native Americans) sense of place, resulting in different realities or "contested terrain" that present challenges for public land management agencies (McAvoy et al. 2001).

Transportation

Transportation System

Road System Background

Most roads in the Monument were built primarily for vegetation management access between the 1950s and 1980s, although the higher standard roads were intended and designed for multiple uses, including public access. Vegetation management has declined substantially since the early 1990s; however, public use of forest roads has grown steadily, and driving for pleasure is the single largest recreation use of Forest Service-managed lands.

Almost all national forest visitors travel on National Forest System (NFS) roads. These roads provide access to more than a million national and international visitors every year. Forest roads provide access for recreation, fire protection, vegetation management, commercial use, grazing, research, private property use, and insect and disease control.

National Forest System roads are not public roads in the same sense as roads that are under the jurisdiction of state and county road agencies. NFS roads are not intended to meet the transportation needs of the public at large. Instead, they are authorized for the use and administration of NFS lands. Although roads

are generally open and available for public use, that use is at the discretion of the Secretary of Agriculture. Through authorities delegated by the Secretary, the Forest Service may restrict or control traffic to meet specific management direction (USDA Forest Service 2001f).

A few motorized routes in the Monument are not part of the authorized or inventoried National Forest Transportation System (NFTS). These routes evolved in different ways; some were built as temporary roads, often for vegetation management access. Some are user-defined routes created from unauthorized use. Since they are not part of the National Forest Transportation System, these routes are not maintained nor inventoried. They are often the source of environmental resource damage. According to the National Roads Policy, all unauthorized roads will be inventoried through travel analysis. However, decisions were made on most of the unauthorized motorized routes when the Monument was proclaimed on April 15, 2000, prior to the travel management rule. The Clinton proclamation (2000) limited motorized traffic to designated roads only and allowed existing roads to be altered prior to December 31, 2000. Routes not previously identified as system roads that were needed to further the purposes of the Monument were added to the road system, and the system was designated on December 31, 2000. Any remaining unauthorized motorized routes are generally expected to be decommissioned when funding is available following site-specific environmental analysis.

The Forest Service revised regulations regarding travel management on NFS lands in 2005 to clarify policy related to motor vehicle use, including the use of off-highway vehicles. The travel management rule requires designation of those roads, trails, and areas that are open to motor vehicle use. Designation is made by class of vehicle and, if appropriate, by time of year. The final rule prohibits the use of motor vehicles off the designated system, as well as use of motor vehicles on routes and in areas that is not consistent with the designations. The clear identification of roads, trails, and areas for motor vehicle use in each national forest enhances management of NFS lands; sustains natural resource values through more effective management of motor vehicle use; enhances opportunities for motorized recreation experience on NFS lands; addresses needs for access to NFS lands; and preserves areas of opportunity in each national forest for non-motorized travel. The Sequoia National Forest will ensure that the use of off-road vehicles on public lands within the Monument is controlled and directed so as to protect the resources of those lands, to promote the safety of all users of those lands, and to minimize conflicts among the various uses of those lands (USDA Forest Service, Travel Management Rule 36 CFR Parts 212, 251, 261, and 295). The current designated transportation system open for motor vehicles is shown on the motor vehicle use maps (MVUMs) (see accompanying map packet).

The transportation system discussion focuses on the road system over which the Forest Service has jurisdiction. The system consists of approximately 822 miles of authorized roads which form a hierarchical set of routes which access the Monument. State highways and county roads connect Forest Service roads to the rest of the transportation network in the state, but the Forest Service does not have jurisdiction over these other roads. Some specialists refer to road mileages including all jurisdictions, because all roads affect their resource area, such as wildlife and hydrology. The total road mileage within the Monument is approximately 1,100 miles including all jurisdictions. Some user-created roads also exist which are neither authorized nor maintained by the Forest Service. The following table lists the mileage of the roads over which the Forest Service has jurisdiction within the Monument and for the entire Sequoia National Forest.

Approximately 822 miles of authorized roads under Forest Service jurisdiction are located in the Monument. A road is defined as a motor vehicle travelway more than 50 inches wide that is not designated and managed as a trail. The quality of roads varies by both number of lanes and surfacing, by low/medium/high standards (maintenance levels 1-5), and by functional classification (local, collector, arterial) in a general relation to maintenance levels. Each of these road types requires a different level of maintenance for upkeep (see maintenance levels definition in the glossary). The mileage of each type of road is shown in the table below. Each road also has a functional designation as an local, collector, or arterial road.

Table 151 Miles of Roads in the Forest and Monument by Maintenance Level

Maintenanace Levels (ML)[1]	Objective ML		Operational ML	
	Forest	Monument	Forest	Monument
1	505	313	197	71
2	499	255	902	515
3	337	134	304	127
4	186	69	141	72
5	98	51	81	37
Total miles	1,625	822	1,625	822

1. These data were taken from the USDA Forest Service Infrastructure resource information database system (INFRA).

Maintenance levels are defined by the USDA Forest Service Handbook (FSH) as the level of service provided by and maintenance required for a specific road. Maintenance levels must be consistent with road management objectives and maintenance criteria. Roads may be currently maintained at one level and planned to be maintained at a different level at some future date. The operational maintenance level is the maintenance level currently assigned to a road, considering today's needs, road condition, budget constraints, and environmental concerns; in other words, it defines the level to which the road is currently being maintained. The objective maintenance level is the maintenance level to be assigned at a future date, considering future road management objectives, traffic needs, budget constraints, and environmental concerns. The objective maintenance level may be the same as, or higher or lower than, the operational maintenance level. The transition from operational maintenance level to objective maintenance level may depend on reconstruction or disinvestment. (Maintenance levels are defined in the glossary at the end of this FEIS.)

Access to the vicinity of the northern portion of the Monument is available on a variety of highways and county roads, including state highways 99 and 63 and county road J21, Dry Creek Road. These roads eventually focus traffic on state highway 180 or state highway 245, both of which enter the Monument. State highway 180 out of Fresno serves the northern portion of the Monument, where it becomes the Kings Canyon Scenic Byway. Highway 245 through Pinehurst serves the west side of the northern portion of the Monument. The General's Highway provides access to the Monument from the south through Sequoia National Park (see MVUM maps in map packet).

Access to the vicinity of the southern portion of the Monument is also provided by a variety of highways and county roads, including state highways 65, 178, 14, and 155, which eventually focus traffic on state highway 190, or county roads SM50, SM99, and SM107 that enter the Monument. State highway 190 out of Porterville provides access to the southern portion of the Monument. State highway 155 provides access from the east and west to the southern portion of the Monument. In addition to state highway 155 from the east, county road SM99 provides access to the Monument from the Kern River Valley. County roads SM56 and SM50 provide access to the southern portion of the Monument through California Hot Springs. The Western Divide Highway and county road SM107 provide access to the southern portion of the Monument and link state highway 190 to county road SM50 (see MVUM maps in map packet).

Arterial roads (typically maintenance levels 4-5) are the main roads that traverse the forest and connect to major state highways or county roads. They are paved and designed for higher-speed travel. Collector roads (typically maintenance level 3) connect the arterial roads to local roads and balance access needs with construction and maintenance costs. Local roads (typically maintenance levels 1-2) are at the ends of collector roads, tend to be low standard, and serve a small land area.

Table 152 Miles of Roads in the Forest and Monument by Functional Class

Functional Class[1]	Objective Class		Operational Class	
	Forest	Monument	Forest	Monument
Arterial	284	120	222	109
Collector	337	134	304	127
Local	1,004	586	1,099	586
Total miles	1,625	822	1,625	822

1. These data were taken from the USDA Forest Service Infrastructure resource information database system (INFRA).

Road Management Strategies

The Forest Service has five basic strategies for managing traffic on roads excluded from the Highway Safety Act (maintenance levels 1 and 2): encourage, accept, discourage, eliminate, and prohibit. Combinations of these strategies may be applied to different user groups on the same road or trail. Even though the Highway Safety Act does not apply to these roads, road user safety is still a concern. These five strategies are discussed below (FSH 7709.59, 25.22).

Encourage: The objective is to encourage use by high-clearance vehicles (pickups, trucks, 4 by 4s, etc.) and discourage passenger cars, which is accomplished by using information techniques such as maps and guide signing. The road is operated at the standard appropriate to the intended use and requires maintenance level 2. These roads are shown on the motor vehicle use map.

Accept: The objective is to accept high-clearance vehicles and discourage passenger cars. The road is passable and adequate for administrative use and requires maintenance level 2. Some public use may occur until passage becomes unsafe or resource damage becomes unacceptable. At that point, the management strategy should be changed to eliminate or prohibit use. Roads with an "accept" strategy are shown on the motor vehicle use map.

Discourage: The objective is to discourage all public use during certain periods. At the road entrance, passage appears feasible, but entrance information is designed to discourage the general public with advisory signs, warnings, and/or barriers. The maintenance level may vary according to contract or permit requirements. These roads are shown on the motor vehicle use map.

Eliminate: Under this strategy, all use is eliminated. The road is physically blocked rather than relying on regulations. Barriers include guardrails, logs or boulders, earthen mounds, or trees and brush used to camouflage the road entrance. The strategy does not include gates. Maintenance level 1 is required. These roads are not shown on the motor vehicle use map.

Prohibit: Under this strategy, certain or all users are not allowed to use the road. This strategy allows the use of gates. Maintenance level may vary in accordance with contract or permit requirements.

When public motor vehicle use is prohibited year-round, roads are not shown on the motor vehicle use map, and use is prohibited by 36 CFR 261.13. When seasonal public use is allowed, roads and the restrictions are shown on the motor vehicle use map.

The Sequoia National Forest has decommissioned about 3 to 6 miles of roads in the Monument. Roads previously selected for decommissioning were identified through site-specific road analysis and environmental analysis of negative effects on natural or cultural resources or lack of public and administrative use. Current Forest Service direction is to use travel analysis and environmental analysis at the project-specific level to identify potential roads for decommissioning.

Funding and Cost for Road Construction, Maintenance, and Decommissioning

Road Maintenance Terminology

Maintenance needs on NFS roads are categorized and quantified in several ways that must be understood to make sense of cost data and projected annual and deferred maintenance needs being reported at the national level. Common terms used in this section are defined in the glossary at the end of this final EIS.

National Forest Transportation System (NFTS) roads and trails require administration and maintenance to avoid problems that can arise when roads fall into disrepair; included are costs of maintenance that should be performed routinely to maintain the system to its current standard (annual maintenance) and costs of needed maintenance work that has not been completed for various reasons (deferred maintenance). Additional costs may be associated with proposed changes to the NFTS (implementation costs). These costs may be for constructing new routes that would be added to the NFTS, for safety improvements, or for increasing maintenance levels.

Each year, the Sequoia National Forest prepares a road maintenance plan, which identifies the road operation and maintenance priorities for the year, as well as maintenance that needs to be done prior to opening for traffic after seasonal closures. Resource protection and public safety are maintenance priorities. Needed maintenance that is not completed adds to the deferred maintenance backlog. Transportation system maintenance is completed by Forest Service maintenance crews, contractors, volunteers, user groups, cooperators, and other forest resources, as appropriate. Maintenance of the road system within the Monument is not funded or tracked separately from the rest of the forest. However, the Monument contains about 50 percent of the road system, so on average, about half of the available maintenance funds are used within the Monument. Annual maintenance needs and deferred maintenance backlog within the Monument would also be about half of the forest totals.

In past decades, commercial users maintained a substantial portion of Monument roads in the Sequoia National Forest. With the decrease in timber sales, however, fewer roads are being fully maintained. The following table shows forest-wide appropriated road maintenance funding and accomplishments reported for the past 8 years. Road program funding includes both routine road maintenance and other roads program related activities. Additional road maintenance may be accomplished using other funding sources, agreements, partnerships, and other methods. Accomplishments may vary from year to year depending on how the work is accomplished and what gets accomplished (in the following table, miles maintained means at least one maintenance activity was performed, not that every mile reported was fully maintained).

Table 153 Transportation System Appropriated Funding and Maintenance—Entire Sequoia National Forest

Road Activity[1]	2004	2005	2006	2007	2008	2009	2010	2011
Road program funding (CMRD)	$556,000	$462,000	$410,000	$575,000	$641,000	$548,000	$588,000	$492,000
Roads receiving maintenance (miles)	259	223	154	280	125	212	235	277

1. These data were taken from a variety of Forest Service budget and accomplishment reporting systems.

In recent years, the Forest Service has assessed the condition of its roads 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 travel analysis and environmental analysis.

Estimates of the annual maintenance costs for the existing road system in the Monument are included in the following table. Forest-wide average costs per mile to maintain each maintenance level were developed and applied to the road system to calculate the estimated total cost. The average unit costs per mile were developed on a regional (Pacific Southwest Region) level. Some maintenance activities need to be performed annually; others are performed on a less frequent cycle. The costs shown reflect the annualized cost of performing all needed maintenance activities on their required cycle.

Table 154 Existing Transportation System Average Annual Maintenance Needs—Monument

Road Activity	Miles	Cost/Mile ($)	Annual Maintenance Cost ($)
Maintenance level 1	71	225	15,975
Maintenance level 2	515	543	279,645
Maintenance level 3	127	10,870	1,380,490
Maintenance level 4	72	14,107	1,015,704
Maintenance level 5	37	14,107	521,959
Total	822		$3,213,733

National Forest System roads must receive a certain minimum amount of annual maintenance to safely accommodate their intended use. If the minimum needed maintenance activities do not occur, these activities are termed deferred maintenance. Deferred maintenance can adversely affect the road's functionality, safety of users, drainage capacity, potential loss of investment, and increased potential for environmental damage.

Deferred Maintenance Backlog

The Sequoia National Forest's transportation system has developed over the past 100 years, generally in response to public access and resource extraction needs. The current inventory shows 1,625 miles of roads in Sequoia National Forest and 822 miles of roads in the Monument, with 71 percent in maintenance levels 1 and 2 (operational ML), and 29 percent in maintenance levels 3, 4, and 5 (operational ML) for the Monument. Road maintenance budgets have declined over the past decade, and the forest's internal capability to maintain roads has been reduced with loss of maintenance personnel and equipment. The most recent estimate of deferred maintenance needs in the Sequoia National Forest is $49,728,000 for roads as recorded in the USDA Forest Service infrastructure resource information database system (INFRA) for maintenance. This value is based on a national random sample of deferred maintenance needs taken in 2007. This value is not statistically valid at the national forest level; however, it can be used as an indicator of maintenance needs for the existing road systems.

Trails and Motorized Recreation

The Monument offers a rich and varied range of recreation, interpretation, and education opportunities, much of which existed prior to its designation. Changes in some uses, most notably the exclusion of off-highway vehicles and snowmobiles on trails, occurred as a result of the proclamation (Clinton 2000) that established the Monument. As of December 31, 2000, the use of motorized vehicles was restricted to designated roads, and the use of non-motorized mechanized vehicles (mountain bikes) was restricted to designated roads and trails. Trails offer hiking, backpacking, horseback riding, and mountain biking. In the winter, high elevations accommodate

cross-country skiing and snowshoeing. Snowmobiles and off-highway vehicles (OHVs) are used on designated roads.

Within the Monument, 196 miles of system trails, including 12 miles of the Summit National Recreation Trail, are available for trail users. Twelve developed trailheads offer parking, information, and restrooms; 10 other trailheads only have parking for trail users. Two pack stations provide outfitter-guide services.

Some trail facilities are located within the current administrative boundaries of giant sequoia groves. Two interpretive trails (Indian Basin Trail and Trail of 100 Giants), about 23 miles of trail, and seven trailheads (Chicago Stump, Boole Tree, Cherry Gap, Evans, Little Boulder, Freeman Creek, and Needles) are located in groves.

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 265 miles of roads are designated for OHV use in the northern portion of the Monument, including about 3.8 miles of motorcycle routes, 25 miles of challenging 4-wheel-drive roads that are also available for motorcycles and all-terrain vehicles, and high-clearance unpaved roads. The southern portion has OHV recreation opportunities that offer approximately 250 miles of high-clearance unpaved, designated roads.

Northern Portion

The Hume Lake Ranger District forms the northern portion of the Monument. In the Stony Creek area, trail activities include hiking and horseback riding. A trailhead to the Jennie Lakes Wilderness is adjacent to Upper Stony Creek Campground. A lakeside trail accessible to persons with disabilities is located at Hume Lake, and Grizzly Falls Picnic Area has a short interpretive trail.

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, which permits 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 (Clinton 2000) that created the Monument, which 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 3.8 miles of trails.

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 forest) and is an eligible state scenic highway. The scenic byway nomination report states that this travel corridor is internationally significant with two extraordinary features: towering giant sequoia trees and Kings Canyon.

Winter recreation activities are primarily snowmobiling, cross-country skiing, snow play, and some snowshoeing. In the northern portion of the Monument, 39 miles of marked roads are available for over-snow vehicles, 21 miles of which are groomed; and an additional 50 miles of unmarked roadbeds are open to snowmobiles. These roads 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 it 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 both snowmobilers and skiers. Montecito Lake Resort, authorized under special use permit, offers 20 miles of groomed trails used exclusively by cross-country skiers. Snow play typically occurs near winter trailheads and road turnouts opened by plows.

Southern Portion

The Western Divide Ranger District forms the southern portion of the Monument. Major trail activities include hiking, mountain biking, and cross-country skiing. Snowmobiling is popular on designated roads. The Middle Fork Tule River and North Fork Middle Fork Tule River, a major attraction with year-round flow, draws hikers, especially during the fall, winter, and spring.

Winter recreation activities are primarily snowmobiling, cross-country skiing, snow play, and some snowshoeing. The southern portion of the Monument features 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 state highway 190 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 winter trailheads are located and road turnouts are opened by plows.

Partnerships

The Sequoia National Forest and Monument maintain numerous and diverse partnerships for the mutual benefit of the forest and its partners. The Forest Service relies heavily on all its partners, without whom the forest would not be able to function. Not all these partnerships involve money; some provide in-kind contributions—such as labor, equipment, supplies, or services—while others involve collaboration toward a mutual goal. Without partnerships, the forest would not be able to provide nearly the variety or quality of trail and motorized recreation opportunities that these partnerships enable.

Law Enforcement

Law enforcement includes the protection of government property, employees, and forest resources and users. It is a management concern because of the potential for injury to employees and visitors, and the potential for losses of and damages to natural resources and property. Claims against the government for damages or losses sustained by the public will continue to increase, requiring extensive investigation.

Highly concentrated recreational use in several locations, and at particular times, often causes significant problems that require law enforcement. Vandalism, theft, destruction of government property, threats, intimidation and assaults on forest officers, occupancy trespass, wildland arson, and large-group activities are growing problems.

There has been an increase in the illegal use of national forest system lands for the cultivation of marijuana. Employees are subjected to threats and possible violence by the growers. The Forest Service works closely with state and county law enforcement agencies to investigate and eradicate marijuana gardens on National Forest System lands.

Use of the Monument's resources and facilities by the forest visitor will accelerate in the years to come in proportion to the increase in population. This will have an effect on the forest law enforcement program. The frequency and complexity of violations of laws, rules, and regulations will be directly affected. The Forest Service, in its administration of the Sequoia National Forest and the Monument, will be faced with a challenge in maintaining an effective law enforcement program sensitive to visitor and management needs.