Natural and Cultural Resources Management Plan

Sequoia and Kings Canyon National Parks

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INTRODUCTION

PURPOSE AND SIGNIFICANCE OF THE PARKS

Sequoia and Kings Canyon National Parks protect a variety of landscapes, biological and cultural resources in the southern Sierra Nevada of California. They are two separate national parks that were created by acts of Congress fifty years apart. Today these parks are administered as a single unit.

Established September 25, 1890, Sequoia National Park is the second oldest national park in the United States. The campaign to create the park – initiated and executed by San Joaquin Valley residents – focused on the scenic and inspirational values of the region's giant sequoia (California Big Tree, *Sequoiadendron giganteum*) groves. The park's original boundaries were drawn to protect what local supporters believed were the largest and best of the unclaimed sequoia groves remaining in the world. One week later, under circumstances that have never been fully explained, Congress tripled the size of the new park, adding to it several sequoia groves already under the nominal control of logging enterprises. Eventually these groves were all preserved. Because the two acts of 1890 established boundaries along section lines, Sequoia National Park included not only giant sequoia forestlands but also considerable tracts of both foothill and High Sierra. The October 1, 1890, act also created four-square-mile General Grant National Park to protect the General Grant Tree and immediately surrounding forest. Since 1890, Sequoia National Park has undergone two major enlargements, both of which added High Sierra lands to the park.

In 1926, Congress added the Great Western Divide, Kern headwaters, and Sierra Crest regions. This enlargement, which more than doubled the park's acreage, made it clear that Sequoia National Park would be not only a forest park, but also a superlative alpine park. Included within the enlargement areas was Mt. Whitney, then the highest mountain in the contiguous United States. In 1978, Congress again enlarged Sequoia National Park, this time adding to the park the Mineral King area, which previously had been a part of the Sequoia National Forest. Alpine and subalpine in character, the Mineral King basin had been proposed by the Forest Service for development as a major downhill ski resort. Congress added the basin to the national park with the specific instruction that it would be preserved undeveloped.

Today, the best known and most appreciated features of Sequoia National Park remain the sequoia groves and the high country. In recent years, however, a new appreciation has developed which suggests that the park's "buffer lands" are far more important than previously thought, and that the park's greatest value is in its wholeness. These themes are explored in more detail in the sections that follow.

The small General Grant National Park existed unchanged for fifty years. In 1940, however, responding finally to a two-decade-long political campaign, Congress created Kings Canyon National Park. In addition to incorporating the four square miles of General Grant National Park and several other adjacent sequoia groves, the new Kings Canyon National Park also featured the great glacial canyons and scenic alpine headwaters of the South and Middle Forks of the Kings River. Because the new park contained two separate tracts, one featuring giant sequoia trees and the other canyons and alpine scenery, Kings Canyon's dual nature was readily apparent from the beginning. In 1940, as a political compromise, the floors of the park's two great glacial canyons were left outside its boundaries as possible reservoir sites. This situation was rectified in 1965 when Congress added the floors of Kings Canyon and Tehipite Valley to the park.

DESCRIPTION OF THE PARKS

Sequoia and Kings Canyon National Parks are located in east-central California. Park headquarters at Ash Mountain (in Sequoia National Park) is located 175 air miles (282 km) north of Los Angeles and 215 air miles (346 km) southeast of San Francisco. Both parks occupy the western slope of the Sierra Nevada, the four-hundred-mile-long (640-km) mountain range that forms the eastern edge of the California biological and cultural province. Combined acreage for the two parks is 863,741 acres (349,544 ha).

Kings Canyon is the northern of the two parks and consists of two sections. The small, detached General Grant Grove Section of Kings Canyon National Park preserves several groves of giant sequoia including the General Grant Grove, with the famous General Grant Tree, and the Redwood Canyon/ Redwood Mountain Grove, which is the largest remaining natural giant sequoia grove in the world. This section of the park is mostly mixed-conifer forest, and is readily accessible via paved highways.

The remainder of Kings Canyon National Park, which comprises over 90% of the total acreage of the park, is located to the east of General Grant Grove in the subalpine and alpine region that forms the headwaters of the South and Middle Forks of the Kings River and the South Fork of the San Joaquin River. Both the South and Middle Forks of the Kings Rivers have extensive and spectacular glacial canyons. One portion of the South Fork canyon, known as the Kings Canyon, gives the entire park its name. The Kings Canyon, and its developed area, Cedar Grove, is the only portion of the main part of the park that is accessible by motor vehicle. Both the Kings Canyon, and its Middle Fork twin, Tehipite Valley, are glacial "Yosemites" – deeply incised glacial gorges with relatively flat floors and towering granite cliffs thousands of feet high. To the east of the canyons are the high peaks of the Sierra Crest culminating in 14,242-foot-high (4,341 m) North Palisade, the highest point in the park. This is classic high Sierra country – barren alpine ridges and glacially scoured, lake filled basins.

Usually snow free only from late June until late October, the high country is accessible only via a rugged system of foot and horse trails. The Sierran crest forms the eastern boundary of the park. Altogether, Kings Canyon National Park contains 716.9 square miles (185,683 ha).

Sequoia National Park lies south of Kings Canyon and adjoins it. The park consists of a single unit that rises from the low western foothills to the crest of the Sierra at 14,495-foot-high (4,418-m) Mt. Whitney, the highest point in the forty-eight contiguous states. The western third of the park consists of two natural regions – a zone of foothill vegetation below 5,000 feet (1,524 m), and an extensive band of mixed-conifer forest between 5,000 and 9,000 feet (1,524-2,743 m). This later forest contains 32 separate giant sequoia groves, including the famous Giant Forest, which covers three square miles and contains the world's largest tree – the General Sherman. Both the Generals Highway and the Mineral King Road provide vehicular access to this western third of the park. Immediately east of the forest belt is the Great Western Divide, a north-south ridge that runs through the middle of Sequoia National Park. Peaks in the vicinity of the Divide rise as high as 13,802 feet (4,207 m).

The eastern half of the park consists of the alpine headwaters of the North Fork of the Kern River, the glacial trench of Kern Canyon and the Sierra Crest itself, which runs north-south and forms the eastern boundary of the park. All of this area, which comprises approximately two-thirds of Sequoia National Park, is designated wilderness. Like the eastern highlands of Kings Canyon National Park, the eastern portion of Sequoia is a high cold land of stark beauty. Sequoia National Park contains 632.7 square miles (163,861 ha).

DESCRIPTION OF RESOURCE VALUES

Sequoia and Kings Canyon National Parks contain resources of geological, biological, cultural, and sociological value. In addition to national park status, the two reservations have also been designated as a unit of the International Biosphere Preserve Program and 85% of the parks has been designated wilderness.

The geological significance of the parks results primarily from the composition and structure of the Sierra Nevada, the highest mountain range in the 48 contiguous states. Geological resources include river-cut canyons more than a mile deep, extensive and spectacular examples of glacial erosion including hundreds of alpine lakes, and several superlative examples of glacially eroded canyons. The most famous of these – the Kings Canyon – was once described by John Muir as a *rival of the Yosemite*. Within these canyons flow the largest remaining undammed rivers in the Sierra Nevada. Igneous rocks of Mesozoic origins underlie the majority of the two parks, but extensive bands of Paleozoic metamorphic beds also occur. Within the latter, beds of marble are common, as are caves.

The two parks contain over 200 known karst features. Several major cave systems have been located, including Lilburn Cave, which is the most extensive in California with over 17 miles of measured passages. The two parks contain some of the wildest and least-impacted caves in the United States.

Sequoia and Kings Canyon National Parks contain biological resources of the highest possible level of significance. Congress created Sequoia and General Grant National Parks in 1890 expressly to protect the giant sequoia. The General Sherman Tree, growing in Sequoia National Park's Giant Forest, is generally recognized as the largest sequoia and the largest living tree on earth. Three other trees in the Giant Forest and the General Grant Tree in Kings Canyon National Park complete the list of the world's five largest single organisms (excluding giant fungus and aspen clones).

Sequoia trees do not grow continuously through the mixed-conifer forest belt, but rather in geographically limited areas called groves. In the Sierra Nevada, the only present natural home of the sequoias, the trees grow in 75 separate groves. While only thirty-seven of these groves are within the two parks, these groves contain more than 65% of all the naturally occurring sequoias.

The biological resources of the two parks are not limited to the sequoias. Extensive tracts of Sierran mixed-conifer forest surround the sequoia groves. This forest belt, which generally clothes the mountains at altitudes between 5,000 and 9,000 feet (1,524 and 2,743 m), covers much of the southern Sierra. On surrounding lands, however, the great majority of this forest zone is being managed for multiple use. As a result, Sequoia and Kings Canyon National Parks now contain the largest remaining old growth forest in the southern Sierra. This forest is a very significant resource because its largely pristine nature gives it both a high recreational value and a very critical scientific value. Below the conifer forest, in the western portions of the Sierra, are the various plant communities and environments that together constitute the foothill region. Kings Canyon contains very little land within this natural zone; but in Sequoia National Park, the lower canyons of the several forks of the Kaweah River include extensive foothill lands. This environment, typified by blue oak savanna, chaparral, and oak woodland, covers much of lowland Central California outside the parks. However, very little of this non-park land is receiving any protection. In the Southern Sierra Nevada, the foothill lands of Sequoia National Park are the only foothill tracts currently designated for long-term preservation.

The remainder of Sequoia and Kings Canyon National Parks, most of it above 9,000 feet (2,743 m) in altitude, can be described as "High Sierra." This environment, which covers nearly as much acreage as the other two parks' environments combined, is a spectacular land of rugged, ice-sculptured alpine

ridges and sparsely wooded lake-jeweled basins. As the heart of the largest wilderness area in California, these lands are of very high recreational and scientific significance.

The preservation of native wildlife within the two parks results naturally from the habitat protection that the parks afford and adds yet another level of biological significance. While the wildlife found within the parks does not differ significantly from that found naturally on surrounding lands, those lands are mostly undergoing profound change. As a result, the wildlife protection function of the parks is becoming increasingly important. The regional survival of a number of species may ultimately be largely dependent upon the protection the parks provide.

In addition to the rich natural diversity, the parks preserve a unique cultural and historical record. Eighteen sites or structures within the parks have been listed in the National Register of Historic Places and another six are formally determined to be eligible. Known sites include 312 prehistoric sites and 110 historic sites. Site types include prehistoric villages, bedrock mortars and basins, rock art panels, campsites, hunting blinds, cattle and sheep camps, logging camps, sawmills, mines, dams, ranger stations, and CCC-era buildings and structures. The archeological evidence dates back at least five thousand years and indicates a wide-ranging presence throughout the Sierra Nevada of Native American peoples. Local logging, mining, and hydroelectric enterprises, closely related to the formation of the parks, illustrate a particular current of Western settlement and industry. Of the former, the Kaweah Colony, a Bay Area utopian collective which sought to log the sequoias, is unique in representing at once the confidence of industry and the idealism of the early labor movement. Finally, the historical primacy of Sequoia National Park and its unique course of development provides an invaluable and specifically shaded account of the emergence of the preservation ethic and the evolution of the National Park Service.

At present, the collections contain approximately 320,000 items. Of these, some 250,000 comprise the parks’ archives. 46,000 items are included in the history collection, 12,000 in biology, and 11,000 in archeology. Smaller collections include geology, consisting of around 400 items, ethnology, some 100 items, and paleontology, consisting of 20 examples of fossilized sequoia wood.

The collection contains material from the disciplines of archeology, ethnology, and history and includes documentary material, photographs, fine art, and historic objects.

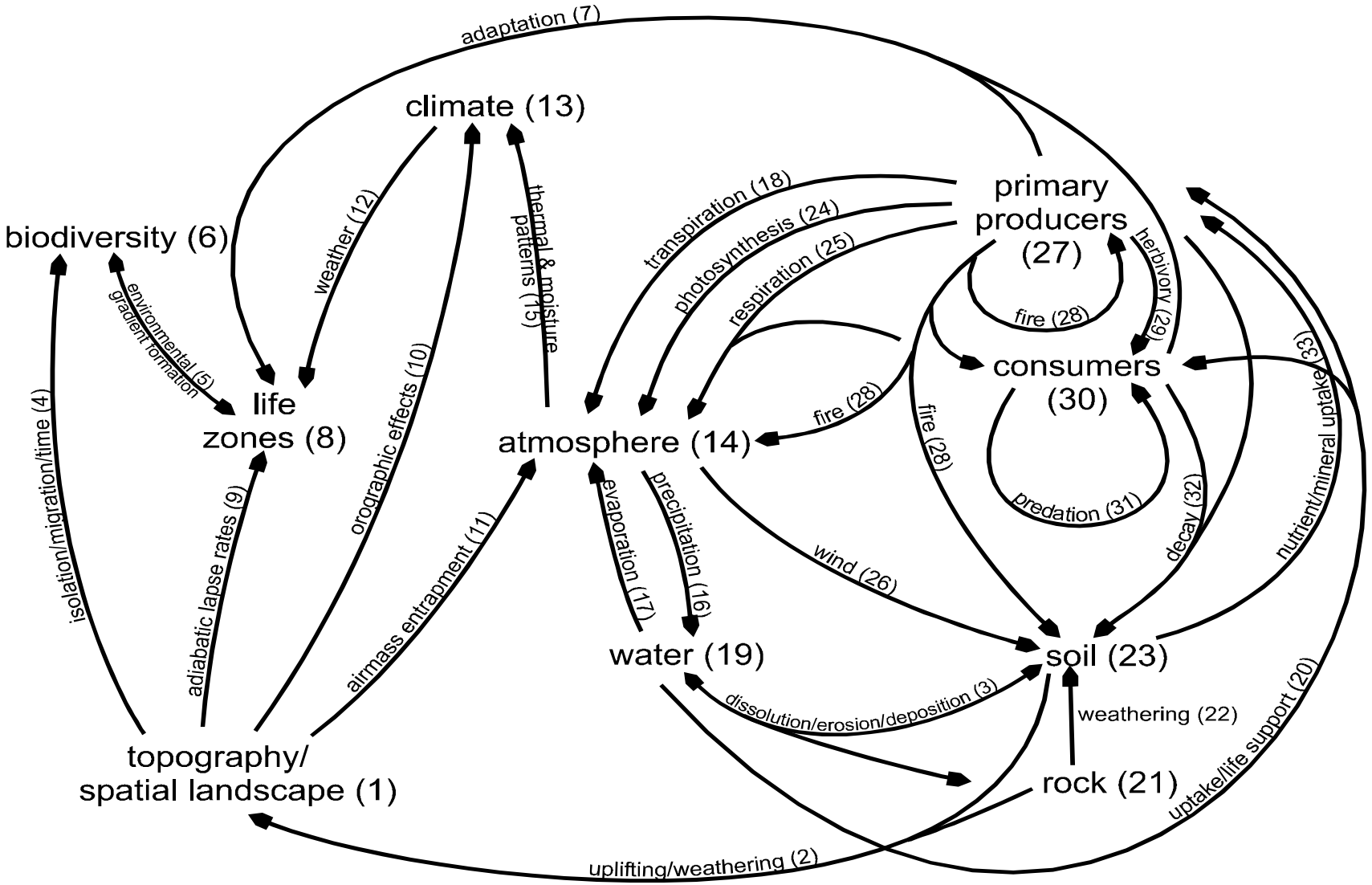
The sociological values and significance of Sequoia and Kings Canyon National Parks result directly from the quality of the natural and cultural resources. The preeminent value of all the parks' resources is that they remain relatively unaffected by modern humans; or in the case of the parks' cultural resources, tell of the historical relationship between humanity and the natural environment. In all descriptions of the parks' resource values, the words "wild" and "natural" appear repeatedly. The value to humanity of the parks' many natural environments is greatly enhanced by their largely unimpaired nature. Both visitors and scientists come to the parks seeking a natural environment unaffected by modern humans. Recent legislation, including the 1978 Mineral King addition to Sequoia, the California Wilderness Act of 1984, the Chimney Rock Wilderness addition, and the addition of the Kings and Kern Rivers to the Federal Wild and Scenic River System, reinforces this theme. The ultimate value of the parks' archaeological resources derives from their ability to help modern humans understand early human's relationship to the natural world.

Ecosystem Model

The following conceptual ecosystem model was developed to illustrate the parks' primary resources and natural processes influencing those resources. The text on the arrows describes natural processes like evaporation, uplifting, and erosion. The print to which the arrows point are our primary resources

and derivatives of the interaction between resources and processes. The primary resources are things like rocks, water, animals (consumers). Biodiversity is an example of a derivative from the interaction of resources and processes. This model was not intended to be all-inclusive or to show differences in the significance of the various processes. However, removal of any component could have dire consequences. For instance, eliminate topography, and you no longer have conifers or alpine areas. This park would then look like the Central Valley. Eliminate water, and you have a desert. Eliminate decay, and you have no nutrient recycling. Everything is important, and the appearance and composition of the parks' landscape is the product of how all of these components continually interact.

Conceptual Ecosystem Model for Sequoia and Kings Canyon National Parks



ELABORATION OF TERMS ON GRAPHIC

(1) Topography/spatial landscape: Probably the single most important ecosystem influence. The combination of elevation gradient, distance, and landform is responsible for diversity of climate and biota.

(2) Uplifting/weathering: The glacier-carved and water eroded landscape is uplifted and tilted forming high crests with many peaks exceeding 14,000 ft. (4,267 m).

(3) Dissolution/erosion/deposition: Glaciers carved deep canyons. Ice is the primary weathering force at alpine/subalpine elevations, ice and water in the montane zone, and water in the foothills. Dissolution and erosion form caves in marble. Dissolution contributes chemical species to aquatic environments.

(4) Isolation/migration/time: Isolating mechanisms include alpine ridges, deep canyons, discontinuous habitat, and aridity. Gene flow varies with each organism's mobility, habitat specificity, and reproductive strategies. Time provides opportunities for genetic change.

(5) Environmental gradient formation: Changes within environmental gradients (primarily elevation, aspect, and moisture) facilitate development of distinct diverse communities which in turn contribute to the area's overall biodiversity.

(6) Biodiversity: Biodiversity is the product of environmental gradients (especially elevation and moisture), isolation, and time. Groups known to exhibit high levels of local endemism include cave invertebrates and terrestrial salamanders.

(7) Adaptation: Biota utilize the landscape in accordance with their ecological needs.

(8) Life zones: Physical processes interacting with biota over an extended elevation gradient have produced distinctive life zones that vary from Upper Sonoran to Alpine.

(9) Adiabatic lapse rates: Temperatures decline as elevation increases.

(10) Oragraphic effects: Mountains cause precipitation and rain shadows.

(11) Airmass entrapment: Mountains capture airmasses when inversions occur. This is most common in the summer.

(12) Weather: Variations in moisture and temperature provide the climatic diversity of the different life zones.

(13) Climate: Varies along the elevation gradient. Foothills have hot dry summers and cold wet winters with occasional freezing temperatures. Mid-elevations have warm summer days with cold nights, occasional summer rain, and deep winter snow with freezing night temperatures. Alpine areas have cool summer days, cold to freezing nights, occasional summer rains, and deep winter snow with temperatures generally well below freezing.

(14) Atmosphere: In pristine times, the air was probably clear except for smoke from frequent fires and perhaps humidity from the San Joaquin Valley. Inversions are a common structural component.
(15) Thermal and moisture patterns: Temperature and moisture vary with elevation.

(16) Precipitation: Precipitation is highest at mid-elevations and lowest in the foothills.

(17) Evaporation: Evaporation is probably highest at lowest elevations where temperatures are highest and humidities are lowest. The lower atmospheric pressure, wind, and numerous lakes and ponds at higher elevations probably cause significant alpine/subalpine evaporation. Some alpine loss is through sublimation.

(18) Transpiration: Plants lose moisture directly to the atmosphere. This loss can be sufficient to effect stream flows.

(19) Water: Surface water occurs primarily as rivers and streams in the foothills and lower montane zones. Surface water occurs primarily as lakes, ponds, and streams in the upper montane, subalpine, and alpine zones. Except in metamorphic areas (especially marble), water contains very low concentrations of dissolved constituents. Groundwater tends to be shallow and variable due to shallow soils. Groundwater is often rich in dissolved minerals, occasionally forming mineral seeps at the surface.

(20) Uptake/life support: Except for water which biota generate metabolically, plants and animals rely on water for their survival. For aquatic biota, it is an essential habitat requirement.

(21) Rocks: The majority of the park is igneous (granite and its relatives). Much of the west side of the park and scattered areas elsewhere is metamorphic (primarily marble and schist).

(22) Weathering: Rock breaks down into soil.

(23) Soil: Sierran soils tend to be shallow and young, showing little development.

(24) Photosynthesis: Photosynthesis uses energy from the sun to build the chemical fuel from atmospheric CO_2 and water that directly or indirectly supports nearly all biota.

(25) Respiration: Respiration generates CO_2 and water.

(26) Wind: Generally light in the Sierra Nevada, but capable at times to blow soil and snow. Wind also aids in dispersion of pollen and at least one spider.

(27) Primary producers: In the foothills, these are primarily deciduous woodland (blue and black oak, north slope), evergreen hardwoods (canyon and interior live oak), chaparral (mixed and chamise), deciduous riparian forest (alder). The mid-elevations are primarily fir forest (white and red), mixed conifer (fir and various pine), montane chaparral (green-leaf manzanita), and montane meadows. Alpine and subalpine areas are pine (foxtail, whitebark, and lodgepole), cedar, wet meadows, graminoid alpine prairies, fell field vegetation, and lichens. Aquatic and moist communities have algae, bryophytes, and some photosynthetic protists.

(28) Fire: This is a primary force that affects the composition and structure of the park's vegetation and wildlife in foothill, montane, and some subalpine areas. Fire affects air quality, soil transport, and soil chemistry, which in turn effects water chemistry. Next to elevation and photosynthesis, fire is probably one of the most significant influences to the area's ecosystem dynamics.

(29) Herbivory: Herbivory is another significant force that affects the structure and possibly the composition of vegetation. The major large herbivore is mule deer. Other major herbivores include rodents and various invertebrates.

(30) Consumers: Herbivores and predators vary in size from mountain lion and bighorn sheep to daphnia and some protists. Also included are fungi and slime molds.

(31) Predation: Predation controls the structure and potentially the composition of faunal populations. Predators vary in size from the mountain lion to microscopic protists.

(32) Decay: Bacterial decay returns the basic constituents of biota to the soil.

(33) Nutrient/mineral uptake: Soil provides the basic nutrients and minerals for plant growth.

ECOSYSTEM STRESSORS

Ecosystem stressors differ in the pervasiveness of their effects on Sequoia and Kings Canyon National Parks. Local stressors, such as trampling by livestock or visitors, are those whose effects are generally limited to relatively small areas. At the opposite extreme, systemic stressors, such as air pollution, have pervasive effects that can cascade throughout an ecosystem. Because of their disproportionate importance to the ecosystems of Sequoia and Kings Canyon National Parks, systemic stressors receive the bulk of the attention in the overview that follows. However, local stressors can also be of extraordinary importance, such as when they threaten the existence of a threatened or endangered species, or alter the structure or function of rare ecosystems. These local stressors are discussed in the natural resources section beginning on page 33.

The Sierra Nevada Ecosystem Project (SNEP 1996) and decades of research in Sequoia and Kings Canyon National Parks have identified five important systemic stressors to park ecosystems. Based on our best current knowledge, these stressors are:

- Loss of pre-Euroamerican fire regimes
- Exotic species
- Air pollution
- Habitat fragmentation
- Rapid anthropogenic climatic change

Of course, these stressors all interact in complex ways. It is worth noting that, if projections are correct, climatic change could both exacerbate and dominate all other stressors in importance in the coming decades.

Loss of Pre-Euroamerican Fire Regimes

Between 1891 and 1967, Sequoia, General Grant, and Kings Canyon National Parks attempted to suppress all fires, and met with a fair degree of success. Consequently, several park ecosystems that evolved in the presence of frequent fires have experienced an unprecedented period without fire (Caprio and Lineback, *in press*; Caprio et al., *in press*; Caprio and Graber, *in press*). This lack of fire has resulted in important ecosystem changes. In the foothill grasslands, lack of fire encourages dominance by exotic grasses (Parsons and Stohlgren 1989). Additionally, due to a buildup of dense vegetation along foothill streams and in their upper catchments, lack of fire apparently has reduced annual streamflow in the foothills, probably to the detriment of aquatic communities. In foothill chaparral, richness of fire-dependent chaparral species seems to be unusually low following prescribed fires, perhaps due to the exhaustion of the soil seed bank during the long preceding fire-free period (Keeley, *personal observation*).

The consequences of fire exclusion have been characterized best in the mixed-conifer zone. Both stream chemistry (Williams and Melack 1997) and stream flow (Moore, *unpublished data*) in the mixed-conifer zone have been altered by the lack of fire, with unknown consequence for aquatic ecosystems. Giant sequoia reproduction, which in the past depended on frequent fires to expose mineral soil and open gaps in the forest

canopy, has effectively ceased, and reproduction of other shade-intolerant species has been reduced (Harvey et al. 1980, Stephenson 1994). Today more area is dominated by dense intermediate-aged forest patches, and less by young patches, than in the past (Bonnicksen and Stone 1978, 1982, Stephenson 1987). Forests have become denser in many areas, with increased dominance of shade-tolerant species. Shrubs and herbaceous plants are probably less abundant than in the past (Kilgore and Biswell 1971, Harvey et al. 1980). Perhaps most importantly, dead material has accumulated, causing an unprecedented buildup of surface fuels (Agee et al. 1978, van Wagtendonk 1985). Additionally, "ladder fuels" capable of conducting fire into the crowns of mature trees have increased (Kilgore and Sando 1975, Parsons and DeBenedetti 1979). One of the most immediate consequences of these changes is an increased hazard of wildfires sweeping through the mixed-conifer forests with a severity that was rarely encountered in pre-Euroamerican times (Kilgore and Sando 1975, Stephens 1995, 1998).

Lack of fire has also reduced habitat critical for certain wildlife species. In the absence of fire, the number and extent of forest openings has been reduced, with an accompanying reduction of key herbaceous and shrub species (particularly nitrogen fixers such as *Ceanothus*) (Bonnicksen and Stone 1982). Wildlife that depend on these plants, such as deer, now have less habitat available to them. Black-backed woodpeckers have declined in the absence of fresh fire-created snags. The effects of fire exclusion also can extend to higher trophic levels. For example, rodents are less abundant in areas within these parks where fire has been excluded (Werner, *unpublished data*), almost certainly leading to a reduction in the carnivore populations that depend on them.

Beginning in 1968, the parks recognized the importance of fire in the parks' ecosystems and began an aggressive prescribed fire program. However, after more than thirty years of prescribed fires, the parks still are far from restoring natural fire regimes to the entire park landscape, though significant inroads have been made (Caprio and Graber, *in press*). The inability of the parks to maintain a natural fire regime continues to result in changes to the nature of the parks' vegetation, aquatic ecosystems, and wildlife populations.

Exotic Species

Hundreds of exotic species have become established within the parks, and invasions are ongoing. More than 120 exotic vascular plant species are presently known within park boundaries, and new ones are discovered yearly. Plant invasions have severely altered some park ecosystems. For example, about 99% of herbaceous biomass in foothills grasslands is due to exotic species (Parsons and Stohlgren 1989). These foothill exotics may have altered soil water dynamics, stressing native species, and perhaps increasing the probability of invasion by particularly noxious species, such as star thistle (Gerlach, *in review*).

Blister rust, an exotic fungus that attacks members of the white pine subgenus, continues to reduce the number of sugar pines in the parks, and over time may effectively eliminate the species from the ecosystem. Sugar pine is one of the most important food sources for seed-eating animals in the mixed-conifer zone, and the potential consequences of its decline are largely unknown. Additionally, new and destructive exotic pathogens, such as pine pitch canker, have become established in California and seem likely to invade the parks in the future.

Even before the parks were created, humans moved fish into waters that were originally barren of fish and also introduced new species. As a result, most aquatic communities above about 9000-ft elevation have been altered, sometimes severely. Impacts have included a decline in both native invertebrate and vertebrate species, with the precipitous decline of the mountain yellow-legged frog being one of the most notable (Bradford 1989; Bradford et al. 1993; Knapp and Matthews, *in press*). (Other factors, such as air pollution, are also likely contributors to the decline of the frog.) Additional damage has been caused by hybridization. For example, the Little Kern golden trout was almost lost due to hybridization with exotic rainbow trout, and the

status of the Kern rainbow remains to be determined. Native rainbow trout genotypes were contaminated by genotypes from other geographic areas.

Mostly at lower elevations within the parks, domestic species (especially cats) and other exotic wildlife periodically establish themselves. These animals eat native species and compete with native wildlife for resources. Exotic bullfrogs now occupy low-elevation streams, and threaten the future of the western pond turtle (a California species of special concern) in the parks by preying upon their young. Wild descendants of domestic pigs have been discovered in the parks, and have the potential to become a major threat to native vegetation. Portions of Sequoia National Park have been severely grazed in the recent past by trespass cattle and now harbor numerous exotic plants. Human developments in the parks (especially residential areas and pack stations) have created conditions suitable for significant numbers of brown-headed cowbirds. The cowbird is a nest parasite, which attacks a number of rare native warbler species.

Air Pollution

Sequoia and Kings Canyon National Parks periodically experience some of the worst air quality in the United States (Peterson and Arbaugh 1992, Cahill et al. 1996). Perhaps the most damaging pollutant is ozone. Ozone-sensitive individuals of ponderosa and Jeffrey pines show extensive foliar injury at present ozone levels (Peterson and Arbaugh 1992; Duriscoe and Stolte 1992; Stolte et al. 1992; Miller 1996). For example, Patterson (1993) found that nearly 90% of Jeffrey pines in or near the Giant Forest in Sequoia National Park showed visible signs of ozone injury. Compared to ozone-resistant individuals, ozone-sensitive pines have lower photosynthetic rates, lose their needles earlier, and have diminished annual ring growth (Miller 1996). In contrast to pines, mature giant sequoias seem to be relatively resistant to present ozone levels (Miller et al. 1994). However, newly emerged sequoia seedlings are more vulnerable to ozone injury (Miller et al. 1994; Miller 1996).

Research in southern California suggests that chronic ozone pollution can lead to shifts in forest structure and composition (Miller 1973). If ozone concentrations in the Sierra Nevada remain relatively constant into the future, they may affect the genetic composition of pine and sequoia seedling populations, and significantly contribute to increased death rates and decreased recruitment of ponderosa pine and Jeffrey pine (Miller 1996). If pollution increases beyond present levels, adult ozone-stressed pines may become more susceptible to fatal insect attacks, as they have in the Los Angeles basin to the south (Miller 1973; Ferrell 1996; Miller 1996). Additionally, sequoia seedling establishment, survival, and recruitment might be reduced. The effects of chronic ozone pollution on other species are less well known.

High elevation lakes and streams in the parks are very dilute and potentially sensitive to human-induced acid deposition. While chronic acidification presently is not a problem, episodic depression of acid-neutralizing capacity occurs during the snowmelt period (Melack and Sickman 1995, Melack et al. 1998), and episodic acidification occurs during the "dirty" rainstorms of summer and early fall (Stohlgren and Parsons 1987). If acid deposition increases in the future – a likely scenario given the tremendous population growth in the San Joaquin Valley – episodic acidification will become more frequent, and can be expected to alter aquatic communities.

Additionally, there has been a slow, continuous increase in atmospheric nitrogen deposition in park watersheds (Lynch et al. 1995), a local manifestation of a global phenomenon (Vitousek 1994, Vitousek et al. 1997, Moffat 1998). However, in spite of increasing nitrogen deposition, there has been a decrease in dissolved nitrogen leaving watersheds (Melack et al. 1998). These changes parallel a shift in the phytoplankton community of the heavily studied Emerald Lake, from one dominated by phosphorus limitation to one dominated by nitrogen limitation. Mixed-conifer watersheds in Giant Forest have also shown net retention of

nitrogen, with stream concentrations often below detection limits (Williams and Melack 1997). The consequences of increased nitrogen deposition and retention on terrestrial plant communities are unknown.

Sequoia and Kings Canyon National Parks are downwind of one of the most productive agricultural areas in the world, the San Joaquin Valley. Every year, tons of pesticides are applied to the crops – over 24,000 tons of active ingredient in 1997 just in Fresno and Tulare Counties (Department of Pesticide Regulation 1999). The parks are exposed to pesticides that become volatilized or suspended in the atmosphere as particulates, then drift into the parks on prevailing winds. Consequently, organophosphates are found in precipitation as high as 6,300 feet (1,920 meters) in Sequoia National Park (Zabik and Seiber 1993). Other synthetic chemicals, such as PCBs, are also finding their way into the parks. Some of the synthetic chemicals drifting into the parks can have estrogenic or other effects as hormonal imitators in concentrations of parts per trillion. They can cause changes in wildlife reproductive capacity, longevity, intelligence, and behavior, or can lead to cancer or mutations. They are inconspicuous – but potentially insidious – impacts to humans.

While studies have not yet been conducted to establish cause-and-effect links between synthetic chemical drift into the parks and effects on park ecosystems, circumstantial evidence suggests that such effects may be occurring. For example, the parks' peregrine falcon aerie at Moro Rock has never been able to produce offspring, even after replacement of the female. Abandoned eggs contained high quantities of DDE (13 mg/kg wet weight), and eggshells averaged 15% thinner than they should be. More recently, the pair produced eggs that lacked the normal smooth waxy brown-spotted shell; instead the shells were white and chalky. Additionally, the foothill yellow-legged frog completely disappeared from these parks in the 1970s, and today exists in the Sierra only in a handful of widely scattered populations along the western foothills. The frog is much more common on the opposite side of the San Joaquin Valley (in the foothills of the Coast Range), upwind from pesticide drift. Synthetic chemical drift may also be playing a role in the ongoing decline in mountain yellow-legged frogs in these parks (Fellers, *unpublished data*), although other factors, such as fish introductions, are also likely to be contributing.

Habitat Fragmentation

Intensifying land use and increasing population on lands adjacent to Sequoia and Kings Canyon National Parks are turning the parks into biological islands, a status that will make the ecosystems of the parks significantly more difficult to preserve with their biodiversity intact. Several species have either already disappeared from this part of the Sierra Nevada, or are surviving here in very small numbers (e.g., black-tailed hare, foothill yellow-legged frog, California condor), most likely as a result of habitat loss on adjacent lands that leaves park habitat insufficient to support metapopulations over the long term (Graber 1996). This problem is most serious for foothill species, including seasonal residents, because most of the adjacent lands are privately held and substantially altered through development, grazing, agriculture, hydrological diversions, introductions of exotic plants and animals (including pets and feral animals), and altered fire regimes.

The coniferous forested lands to the north and south of the parks – mostly public lands – have been altered by timber harvest, grazing, water diversions, exotic introductions, and loss of fire regime, although to a much lesser extent than the foothills. The decline of forest mesocarnivore populations in the region, including wolverine, fisher, and red fox, as well as some bat and owl species, has been attributed to forest structural changes by many authorities (DeSante 1995; Graber 1996). Fishers – which once occurred throughout the Sierra Nevada and whose populations were continuous with those in the Pacific Northwest – today are isolated from other populations, meaning that opportunities for gene flow are now absent.

Loss of natural fire regime and exotic plants and animals *within* as well as outside of the parks' foothill zone may be exacerbating this regional problem. For example, exotic bullfrogs – which have benefited from water

impoundments near the parks – may be an important predator on young western pond turtles, while exotic predatory brown trout and overshading of foothill streams as a result of fire suppression may have led to the extirpation of foothill yellow-legged frogs (pesticides may also have played a role). Settlement outside the parks prevents re-establishment of the extirpated grizzly bear (*Ursus arctos*), because a durable population requires more low-elevation habitat than can be provided by the national parks.

Along the crest of the Sierra Nevada, domestic grazing on public lands east of the crest has prevented re-establishment of healthy metapopulations of Sierra Nevada bighorn sheep (*Ovis canadensis* ssp. *nova*) in the parks, leading to their endangerment. This is an example of functional habitat fragmentation.

Animals that routinely cross the park boundary (e.g., deer, bear, and band-tailed pigeons) become legal game species once outside the park boundary. As a consequence, management of those animals outside the park could affect the age structure and abundance of those species within these parks. It is also likely that the unhunted park populations are a reservoir of source material for hunted and less dense populations outside these parks.

Rapid Anthropogenic Climatic Change

There is no serious doubt that the average global temperature has been rising in this century, and that the world is now warmer than at any point during the last several centuries (Mann et al. 1998). Internationally, there is a near-consensus among climatologists and atmospheric scientists that at least part of this warming is due to human-caused increases in atmospheric greenhouse gases (Houghton et al. 1996). Global temperatures are projected to rise by another 1.0 to 3.5°C (2 to 6°F) over the next century, at a rate that is probably unprecedented over the last 10,000 years (Houghton et al. 1996).

Currently, much uncertainty surrounds the details of how global climatic change will manifest itself locally in the Sierra Nevada. However, the last several decades in the Sierra have been among the warmest of the last millennium (Graumlich 1993), and model projections call for Sierran temperatures to continue rising.

The paleoecological record is one of our best tools for understanding the possible magnitude of biotic changes that might result from future climatic changes. The early and middle Holocene (about 10,000 to 4,500 years ago) was a period of generally higher global summertime temperatures (perhaps by up to 2°C) and prolonged summer drought in California. In this warmer climate, both the species composition and fire regimes of Sierran forests were quite different from those of today, sometimes including species combinations that no longer exist (Anderson 1990, 1994; Anderson and Smith 1991, 1994, 1997). For example, early Holocene forests growing on sites that are presently occupied by sequoia groves were much more heavily dominated by pines, including lodgepole pine (which no longer occurs in sequoia groves; Anderson 1994). Firs were less abundant than today and sequoias were quite rare (Anderson 1994; Anderson and Smith 1994); probably existing only along creek and meadow edges where present groves exist. While the past is an imperfect analog of the future, these and other paleoecological records clearly indicate that climatic changes smaller than or comparable to those projected for the next century can profoundly alter Sierran ecosystems.

Increasing temperature over the next several decades will probably result in higher snow lines, earlier snowmelt, and prolonged summer droughts (Vaux 1991). Unless precipitation increases substantially, an immediate effect on aquatic ecosystems could be the summertime drying of formerly perennial streams, with consequent effects on aquatic communities. In forested ecosystems, there could be a widespread and continuing failure in reproduction of certain species, such as giant sequoia, whose seedlings are highly vulnerable to drought (Harvey et al. 1980; Mutch 1994). Death rates would likely increase among adult trees as drought stress makes them more vulnerable to insects, pathogens, and air pollution.

Global warming is also likely to increase the probability of destructive wildfires in the Sierra Nevada. Models predict that global warming will be accompanied by increased lightning strikes at the latitudes spanned by the Sierra (Price and Rind 1991). Compounding the potential increase in wildfire ignitions, extreme weather conditions are likely to make individual fires burn more total area, be more severe, and escape containment more frequently (Torn and Fried 1992; Miller and Urban 1999).

In the face of global warming, most Sierran organisms will have their habitats move out from under them, with their appropriate habitats most likely shifting to higher elevations. Organisms with limited mobility may not be able to track these habitat shifts, and may go extinct locally. Consequently, species diversity is likely to decline. For example, subfossil records from the Pleistocene-Holocene transition in the Grand Canyon (spanning a global warming comparable in magnitude to that which is expected over the next century) indicate that rapid habitat displacement due to climatic change can lead to several millennia of depressed species diversity (Cole 1985). Finally, some habitats, such as high alpine habitats, are likely to disappear entirely. This will lead to the irreversible loss of some species.

Rapid anthropogenic climatic change has the potential to become the greatest stressor on the ecosystems of Sequoia and Kings Canyon National Parks. Climatic change undoubtedly will interact with other stressors, with unexpected consequences. While there is little that park managers can do to prevent global warming, they can take some steps to mitigate impacts on park ecosystems. For example, the resilience of forests to climatic change and consequent extreme wildfire behavior can be increased by restoring a more open structure to the forests.

LEGISLATION

In a century of legislative activity, Congress has created a clear record of intent with regard to the management of Sequoia and Kings Canyon National Parks.

Sequoia National Park, by its establishing Act of September 25, 1890, was *dedicated and set apart as a public park, or pleasuring ground, for the benefit and enjoyment of the people.* The primary purpose for establishment - the preservation of forests, especially sequoia forests - is set out in the preamble:

> *"Whereas, the rapid destruction of timber and ornamental trees in various parts of the United States, some of which trees are the wonders of the world on account of their size and limited number growing, makes it a matter of importance that at least some of said forests should be preserved...*

The act also designated that the reservation was to be managed *for the preservation from injury of all timber, mineral deposits, natural curiosities or wonders* and *their retention in their natural condition.*

An Act of October 1, 1890 enlarged the park and extended the same protection to the new areas.

The Act of July 4, 1926, which again enlarged Sequoia National Park, instructed the Secretary of the Interior to establish regulations aimed at *the freest use of said park for recreational purposes by the public and for the preservation from injury or spoilation of all timber, natural curiosities, or wonders within said park and their retention in their natural condition... and for the preservation of said park in a state of nature so far as is consistent with the purposes of this Act. Such rules and regulations shall permit the taking of fish by hook and line from the streams or lakes in said park...*

The National Parks Recreation Act of November 10, 1978 added the lands of the Sequoia National Game Refuge, previously managed by the USDA - Forest Service, to Sequoia National Park. This addition was to *assure the preservation... of the outstanding natural and scenic features of the area commonly known as the Mineral King Valley ... and enhance the ecological values and public enjoyment of the area...*

None of the enabling legislation for Sequoia National Park specifically cites the Act of August 25, 1916, which created the National Park Service and defined the purpose of national parks. This act, however, defines the *fundamental purpose* of *areas known as national parks* as *to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations*.

General Grant National Park, which was established as a separate national park by the same Act of October 1, 1890 that enlarged Sequoia, was to be managed in such a manner as to *provide for the preservation from injury of all timber, mineral deposits, natural curiosities, or wonders within said reservation, and their retention in their natural condition.*

Kings Canyon National Park was established by the Act of March 4, 1940. This Act abolished General Grant National Park, adding its lands to Kings Canyon National Park, and provided that the new park be *dedicated and set apart as a public park... for the benefit and enjoyment of the people*. The Act also provided that the administration, protection, and development of the park be *subject to the Act of August 25, 1916, entitled* ***An Act to Establish a National Park Service...***

An Act of August 6, 1965 added the certain lands in the Kings Canyon and Tehipite Valley areas to Kings Canyon National Park and instructed that the lands be managed *subject to all the laws and regulations applicable to such park*."

Other legislative provisions affecting the two parks include:

Kaweah Hydroelectric Plant No. 3: Kaweah No. 3 is a hydroelectric project operated by Southern California Edison. The project diverts water from 4½ miles (7.2 km) of the Middle Fork of the Kaweah River inside Sequoia National Park. Preliminary surveys were conducted from 1902-1904 and a permit to construct was granted in 1907. Operations began in May of 1913.

On June 19, 1986, Public Law 99-338 authorized the Secretary of the Interior to issue a new ten-year permit for the continued operation of hydroelectric facilities in Sequoia National Park. The act also authorized one ten-year renewal, but only after a required 120-calendar day review period by Congress. Under this authorization, the National Park Service issued a ten-year special use permit for the continued operation of the facilities on September 9, 1986. The permit was renewed for ten more years through September 20006.

Designated Wilderness Areas: The California Wilderness Act, enacted September 28, 1984, designated 736, -980 acres (298,256 ha) of Sequoia and Kings Canyon National Parks as wilderness. This is eighty-five percent of these parks. The same legislation designated an additional 97,750 acres (39,559 ha) as potential wilderness. By designating this acreage as wilderness, these lands became subject to the provisions of the Wilderness Act of September 3, 1964. This act specifies that wilderness is defined to mean *an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions...*

Chimney Rocks: In 1984, as part of the California Wilderness Act, 1,500 acres (3,707 ha) identified as the Jennie Lakes Addition was added to Kings Canyon National Park. This Act designated 736,980 acres of these

parks as wilderness and directed the Secretary of the Interior to review the 1,500-acre (3,707-ha) Jennie Lakes Addition parcel (that included the Chimney Rocks area) for suitability for wilderness designation

Wild and Scenic Rivers: The Wild and Scenic Rivers Act specifies that designated rivers *shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations*. Public Law 100-150 (November 3, 1987) modified the Wild and Scenic Rivers Act of October 2, 1968 to designate the Middle and South Forks of the Kings River, from their origins in Kings Canyon National Park to the point where they cross a point 1,595 ft (486 m) above sea level, as being subject to the provisions of the original act. Public Law 100-174 (November 24, 1987) applied the same provisions to the North Fork of the Ken River from its head to the point where it crosses the Tulle/Ken County Line.

RESOURCE GOALS

The following goals are consistent with the draft NPS Strategic Plan (2000-2005), the parks' General Management Plan (currently in preparation), the parks' Strategic Plan, and the Pacific West Region Resource Stewardship Strategic Plan. The parks' mission goals in the Strategic Plan provide broad direction to the more specific resource management goals identified in the Resources Management Plan.

Mission goals are statements based on the parks' purpose and significance. They describe what success would be like for the resource. Essentially they are visions for the future; a list of desired conditions that should exist to fully accomplish the parks' purpose and maintain its significance. The resource goals elaborate on the mission goals.

MISSION GOAL Ia: Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context

Natural Resources

Vegetation - Native plants are preserved as part of natural functioning ecosystems

- Native plant species and threatened/endangered and sensitive plant species are inventoried, monitored, protected, and restored/maintained over time
- Native plant species extirpated from the parks are restored, where feasible
- Exotic plant species and exotic plant diseases are controlled/contained, where feasible
- The giant sequoia groves – particularly Giant Forest – and the ecosystems they occupy are restored, maintained, and protected
- Plant communities that have been altered by fire suppression are restored/maintained through restoration of the natural fire regime to the maximum extent possible
- Plant communities that have been altered by domestic grazing are restored to natural conditions
- Areas disturbed by administrative/visitor use, past developments and construction, were feasible, are restored to natural conditions
- Vegetation in the parks' Development Zone is restored and/or maintained as a healthy, vigorous vegetative community that approximates the "natural" state, given the constraints of past and present human intervention, while providing a safe environment for human use and enjoyment
- Recreational pack and saddle stock will be allowed within guidelines that protects the parks' natural resources and values, the processes that shape, and the quality of experience distinctive to them

Aquatic/Water - Aquatic and water ecosystems are restored/and or maintained so that physical, chemical, and biotic processes function uninfluenced by human activities

- Aquatic environments are inventoried and classified by physical and chemical characteristics and biotic communities present
- A long-term monitoring program is developed to record ambient conditions and to document changes and trends in physical and chemical characteristics and biotic communities
- Changes within the aquatic environments that are caused by facilities, management activities or visitor use patterns are located and documented and unnatural changes are mitigated
- Park waterbeds meet state water quality standards or applicable federal standards
- Impacts of acid deposition and contaminants from external influences are detected and evaluated
- Lakes with exotic trout are restored to natural conditions
- Extant native species or genetically unique groups are restored to their former range
- Waters incapable of sustaining fish populations through natural reproduction will be allowed to become barren

Wildlife - Natural populations of wildlife in which animal behavior and ecological processes are essentially unaltered by human activities are perpetuated

- Native animal species and threatened/endangered and sensitive animal species are inventoried, monitored, protected, and restored/maintained over time
- Native animal species extirpated from the parks are restored, where feasible
- Exotic animal species are controlled/contained, where feasible
- Interactions between wildlife and people are mitigated, where feasible
- The natural distribution, ecology, and behavior of black bears are restored and free of human influences

Air Resources - Air quality is restored to natural conditions

- Facilities and management activities are in compliance with the Clean Air Act and state and local air quality policies
- Impacts and levels of park air pollution are monitored.
- Park staff, visitors, the public, and regulatory agencies are educated about park air quality
- The parks participate in Federal, State, and Local Regulatory actions that affect the parks
- Effects of anthropogenic climatic change on ecosystems are minimized.
- The natural ambient appearance of the night sky is unimpaired in all areas of the parks' Natural Zone. No native flora or fauna are adversely affected by artificial lights within the entire area of the parks.
- The natural ambient soundscape (the absence of human-caused sounds) is unimpaired throughout the parks' Natural Zone. Within developed areas or areas of primary park features, human-caused noise is limited to daytime hours and of a level, frequency, and duration that does not adversely impact national park values. No native flora or fauna are adversely affected by human-caused sound within the entire area of the parks.

Geological, Soils, and paleontological Resources - Geological resources, including cave natural and cultural resources and karistic processes, which are of scientific, scenic and recreational value, are restored, protected, and maintained

- Geological processes and soils are not impacted by human change
- Scientific studies and research concerning caves and karst resources and systems are conducted to increase the parks' scientific knowledge and broaden the understanding of its cave resources
- Cave natural and cultural resources, and karistic processes are preserved, restored protected, and maintained.
- Opportunities for the scientific study of cave resources and systems are provided and promoted to better understand and document park cave resources and caves in general
- Educational and recreational opportunities to explore park caves are provided for the parks' visitors

- Known paleontological resources are in good condition
- Abandoned mined lands are closed

Cultural Resources

Prehistoric and Historic Archeological Sites
- Archeological sites are inventoried and evaluated following current standards
- Significant sites are nominated for listing in the National Register of Historic Places
- Archeological sites are inspected and monitored, with a priority given to National Register-listed or eligible sites
- Actions are taken to protect threatened or adversely impacted significant sites from threats or on-going impacts

Historic Structures
- Historic structures are inventoried and evaluated following current standards
- Significant structures are nominated for listing in the National Register of Historic Places
- Historic structures are inspected and monitored, with a priority given to National Register-listed or eligible structures
- Actions are taken to protect threatened or adversely impacted historic structures from threats or on-going impacts
- Eligible structures are added to the List of Classified Structures (LCS)

Objects and Archival and Manuscript Collections
- Museum objects are added to the National Catalog of Museum Objects within the parameters of the parks' Scope of Collections
- Archival and Manuscript Collections are increased within the parameters of the parks' Scope of Collections
- Material weaknesses are addressed in a timely fashion

Cultural Landscapes
- A Cultural Landscape Inventory is undertaken for all developed areas within the parks
- All cultural landscapes are evaluated for National Register of Historic Places eligibility
- National Register-eligible cultural landscapes are submitted for nomination and listing.
- Cultural landscapes are inspected and monitored
- Actions are taken to protect threatened or adversely impacted significant cultural landscapes from threats or on-going impacts

Ethnographic Resources
- An Ethnographic Overview is prepared
- Ethnographic sites are recorded in the Cultural Sites Inventory once the component is established
- Ethnographic sites are inspected and monitored
- Actions are taken to protect threatened or adversely impacted significant ethnographic resources from threats or on-going impacts

MISSION GOAL Ib: Legally designated and protected wilderness is managed to meet the standards and ideals of the Wilderness Act and as a component of a larger regional wilderness area

- Natural resources within wilderness areas are restored to natural conditions.
- Natural resources within wilderness areas are managed to preserve wilderness character.
- Cultural Resources within wilderness areas are managed so as to not adversely affect their known or potential National Register status, while preserving wilderness character.

MISSION GOAL Ic: The parks contribute to knowledge about natural and cultural resources; management decisions about resources

Natural Resources

Knowledge about Park Natural Resources: A thorough knowledge of the state of the parks' natural resources is known

- Scientific research that promotes an understanding of the parks' resources and the impacts that affect those resources is encouraged
- The general ecosystem elements and processes of the parks, the natural forces controlling them, and the potential for human activities to affect them is understood
- A Long-Term Ecological Monitoring Program, including vital signs and a complete inventory of the parks' natural resources, is implemented
- Giant sequoia ecology and the impacts of human activities on the trees and the ecosystem they inhabit are known
- Current and potential effects on the parks' natural resources from external stressors, including exotic organism invasions, air pollution, anthropogenic global change, and boundary/island effects are known and understood
- An information storage and analysis system than effectively and efficiently provides the parks with accurate and comprehensive parks' natural resources information is developed
- Significant natural resources information is made available to the visitor, the public, and the park staff

Cultural Resources

Knowledge about Park Cultural Resource: A thorough knowledge of the state of the parks' cultural resources is known

- Scientific research that promotes a better understanding of the parks' cultural resources and museum collections is encouraged
- A long-term monitoring plan for the parks' cultural resources, including recognition of vital signs, is developed
- Current and potential impacts that adversely effect, or have the potential to adversely effect, the parks' cultural resources or museum collections are known and understood
- Data bases involving the parks' cultural resources and museum collections are maintained and updated
- All research affecting the parks' cultural resources or museum collections is published or made available to the public through other appropriate media

WHAT RESOURCES MANAGEMENT IS ALL ABOUT

Natural resources management is the function by which the parks strive to:

- understand natural processes and human induced effects
- mitigate the existing and potential effects
- monitor for ongoing or future trends

- protects existing natural species, populations, communities, systems and processes
- interprets these organisms, systems, and processes to the park visitor and interpretation/education

It also includes management actions that fit none of these categories, such as exercising legislative or legal authority to prevent a potentially harmful land use practice from occurring near the park boundary.

Cultural resource management is the range of activities aimed at understanding, preserving, and providing for the enjoyment of cultural resources. It includes research related to cultural resources, planning for actions affecting them, and stewardship of them in the context of overall park operations. It also includes support for the appreciation and perpetuation of related cultural practices, as appropriate.

PURPOSE OF THIS PLAN

The Resources Management Plan (RMP) serves as the foundation for the parks' resource stewardship programs. The RMP flows from the General Management Plan, which includes the broad park mission goals related to resource stewardship. The RMP further defines these goals, describes existing resource conditions and how they differ from the desired future conditions envisioned in the goals, identifies major issues and stressors that are causing divergence from the desired future conditions, and outlines a long-term, comprehensive strategy for addressing each major issue. The parks' Strategic Plan then identifies which of the actions outlined in the RMP are implemented during the next five years.

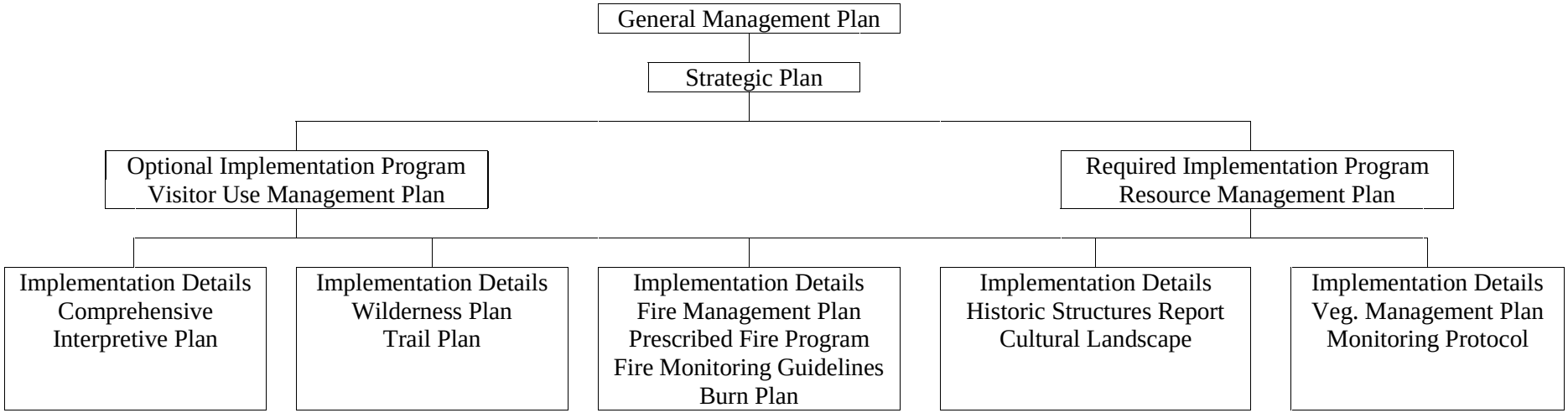
The purpose of Sequoia and Kings Canyon National Parks' Natural and Cultural Resources Management Plan is to propose and justify a coordinated program to identify, protect, preserve, and enhance the natural and cultural resources of these two parks. This plan draws upon appropriate legislation and National Park Service policy as well as on knowledge of the resources of these parks and their special needs.

RELATIONSHIP OF THIS PLAN TO OTHER PLANS

It is the role of the General Management Plan (GMP) to prescribe desired future conditions. The GMP does not assess whether it is feasible to achieve those prescribed conditions within the life of the plan. That's because the GMP is a conceptual plan. It identifies what the parks should ultimately look like. The GMP *suggests* the types and kinds of actions needed to reach the desired condition, but doesn't specify a course of action. The GMP is not a flexible enough tool to specify the methods for achieving the prescribed conditions; that's the role of the strategic plan, implementation plans, and the annual performance/work plan. The determination of *whether* each of the prescribed conditions will be achieved is also left up to subsequent plans.

The GMP is not intended to be a programming or budgeting document; it does not include budget priorities or implementation schedules. The GMP isn't an appropriate tool for budgeting because it is on an indefinite time scale. Funding sources and issues are so fluid from year to year that it is more realistic to set priorities for funding and to schedule work on a shorter time, closer to when the work will actually be done. Priority setting is the role of the strategic plan and implementation plans and the annual performance/work plan. The strategic plan, augmented by implementation plans, determines what actions will actually be taken during the next five years. The annual performance/work plan determines what actions will be taken during a given year

The following diagram shows the general relationship of the Resources Management Plan to selected other plans.



NEPA COMPLIANCE AND CONSULTATION

Some actions called for in this plan are continuations of existing programs and have thus already been the subject of environmental compliance actions. If not implemented under previous plans, actions called for in this plan are only proposals and thus not subject to environmental compliance actions under the National Environmental Policy Act (NEPA) at this time. However, before any non-ongoing actions proposed in this plan can be implemented, they must be subjected to separate and specific environmental compliance actions.

NEPA requirements ensure that any proposal to implement a previously non-operative portion of this plan will include an opportunity for public comment and input.

As required by the National Historic Preservation Act of 1966 the cultural resources aspects of this plan will be developed in consultation with the California State Historic Preservation Officer. This consultation will take the form of a draft re view of this document by appropriate state officials.

RESOURCE CONDITIONS AND STRATEGIES

NATURAL RESOURCE BASELINE INFORMATION

Sequoia and Kings Canyon National Parks contain a rich array of terrestrial, aquatic, and subterranean ecosystems mostly as a result of the southern Sierra Nevada's diverse topography. The descriptive and analytical information is needed to protect and manage this diversity, however, is far from complete.

The current status of our natural resources is mostly poorly known. In general, we have a poor understanding of the response of most species and biological communities to ecosystem influences. We believe the most profound anthropogenic influences are disruption of the natural fire regime, visibility impairment and biological damage caused by air pollution, degradation of park resources due to exotic animals and plants, and lack of basic data on the natural resources and impacts of global climate change. This knowledge is particularly critical in the generation of a definition of natural or pristine conditions and vital signs monitoring. Without information on these pre-Euroamerican baseline conditions, it is difficult to describe changes, which occur due to human interference, or methods to mitigate such changes.

There are a few areas, which have concentrated research and monitoring activities, such as those for prescribed fire, acid precipitation, local fish populations, black bears, and ozone injury on conifers. Lack of basic data on the condition of natural resources affects the management of these resources in at least four ways.

Baseline monitoring or research information on a parkwide level is inadequate or nonexistent to permit development of science and natural resource management planning activities or to guide science and natural resource management operations. Key areas in need of information are grazing impacts in wilderness meadows, fisheries and water quality, caves and associated karst features, and the successional effects of fire and fire suppression.

Many types of operations performed by the Division of Fire and Visitor Management and Maintenance are considered to be natural resource management or natural resource protection activities, such as backcountry trail rehabilitation, meadow restoration, and the trailhead permitting system. The monitoring of their effectiveness and results, and therefore the refinement of procedures, is very limited.

Various types of natural resource management operations are inadequately funded to deal with the issues significantly. This includes removal of tree hazards and revegetate/restore disturbed sites, inventory/monitor natural resources, measure water quality in backcountry locations, monitor the effect of air pollution on natural resources, and mitigate exotic species.

Research design and execution are hindered by the absence of baseline ecological data upon which to base hypotheses, and to parameterize models. Basic questions of species abundance and distribution, and correlative species-environment relationships cannot be approached with the existing knowledge base.

One of the most significant challenges facing these parks is thorough inventory of both biotic and abiotic features and development of a systematic monitoring program to detect change so that park managers can be proactive and manage appropriately.

Status of Natural Resource Information Based on NPS-75 Inventory and Monitoring Guidelines

Table 1 below is a summary table of natural resources baseline information and whether the parks' current information base meets NPS-75 *Natural Resource Inventory and Monitoring Guidelines.* Following the table are descriptions of individual inventory components.

Table 1: Availability of Natural Resources Baseline Information

Meets, does not meet, or exceeds the recommended minimal set of natural resources information in the Natural Resources Inventory and Monitoring Guidelines for the NPS		
Inventory Components	**Meets**	**Does Not Meet**
Historical Database	✓	
Natural Resource Bibliography	✓	
Air Quality	✓	
Climate	✓	
Base Cartography	✓	
Vegetation Map		✓
Soils Inventory		✓
Geologic Features		✓
Disturbed Lands		✓
Water Resources Inventory		✓
Water Quality		✓
Species Inventories:		
Amphibians/Reptiles	✓	
Birds	✓	
Fish	✓	
Mammals	✓	
Plants (Vascular)	✓	
Invertebrates (Insects)	✓	

Historical Database and Automated Bibliography

Does meet minimum guidelines.

Much of the collections of historical scientific material are accessed and digitally catalogued. In the parks' museum collection, there are three pertinent classes of catalogued natural resource objects: a) biologic, b) paleontologic, and c) geologic. There are 12,919 natural resource objects currently in the museum collection (1999). Of this total, approximately 23 percent is accessioned, but not yet catalogued. Significant voucher specimens exist outside of these parks with the estimated number being between 1,000-2,000 specimens. These specimens are owned and managed by the following institutions: Los County Museum of Natural History, University of California Museum of Vertebrate Zoology at the University of California Berkeley, Jepson Herbarium at University of California at Berkeley, and the California Academy of Sciences in San Francisco. The majority of these specimens have been catalogued with some accessible databases.

The parks' have a bibliography database developed through the NPS Natural Resource Bibliography program (NRBIB). This database is available online through the NPS Web Site and also available via a local database and PROCITE software. This database includes: printed material like journal articles, books and technical reports plus non-print material like maps, photo collections and specimens collections. This database currently lists 3,182 bibliographies in its database that are directly or indirectly related to Sequoia and Kings Canyon National Parks. The completeness of this bibliographic database is unknown, but probably exceeds 80 percent. A spot survey of the database found some missing professional papers that were presented during the past three years.

Species Information

Does meet minimum guidelines.

The NPS-75 Inventory and Monitoring Guidelines recommend that 90 percent of all species in major taxa lists be identified. Generally, we are confident that we know 80 percent or more of the major fauna and flora taxa occurring in and around the parks. Some questions still exist about possible deficiencies with our amphibian, fish and small mammal lists.

Vascular Plants

1,493 taxa of vascular plants have been discovered thus far in the parks, representing 1,393 different species. From 1994 to the present (1999), 62 taxa were added. The rate of discovery of species has declined from the previous period (1980s – 1994), but the parks' systematic plant surveys through the Natural Resource Inventory (NRI) program ended in 1996. The NRI program (Graber et al. 1993) was begun in 1985 and continues today, but beginning in 1996 the program shifted from systematic plant surveys to targeted exotic plant surveys. In 1999, the NRI plot inventory database contains 636 one-tenth hectare plots scattered throughout both parks' over a one square kilometer sampling grid. At a sampling density of one 0.10 hectare plot per square kilometer (0.1% sampling density), only 18 percent of the parks' area has been systematically surveyed for vascular plants. Approximately 89 percent of the vascular taxa on the Sequoia and Kings Canyon National flora are represented by specimens in the park herbarium. Surveys for lichens and mosses have been conducted only in a very small (< 1%) portion of the parks. Much of this data currently reside in digital databases. The species list of flora occurring within the parks is contained in Appendix K. Individual larger-stemmed Sequoia trees inside these parks were inventoried and mapped over more than a 10 year period (Hammon et al. 1964, 1970, 1975, 1976) (Western Timber Services 1970), but were never converted to digital geospatial layers and have limited use to resource managers.

Our knowledge of exotic vascular flora has dramatically improved since 1996 with the initiation of directed exotic plant surveys throughout both parks. Approximately 75 of these directed surveys have now been completed (through 1999) in and around both disturbed areas and along natural corridors such as streams. The flora database now has 188 recorded exotic species of which 28 are waif exotics and 160 are naturalized exotics. A report summarizing the present scope and intensity of these species distributions will be completed in the year 2000.

Fauna

The species list of vertebrates occurring within these parks is large and diverse (See Appendix L). Wildlife observation databases exist for amphibians, reptiles, fish, birds, and mammals. Over 57,000 individual observation records are in these combined databases. These are dynamic databases

constantly being updated and exist as both tabular and geospatial information. The spatial accuracy of this database is one-kilometer horizontal accuracy. These database records extend as far back as John Muir and some of his early observations.

Our current available information on species classes and numbers are as follows (1999):

Table 2: Vertebrate Species Summary

Faunal Group	Total Species Known to Presently Occur*	Known Extirpated	Known Exotics	Number of Federal Rare, Threatened, or Endangered	Documented Wildlife Observations**
Amphibians	11	1	1	6	948
Birds	205	0	7	9	39,868
Fish	10	0	7	3	1,882
Mammals	76	1	7	14	12,531
Reptiles	24	2	0	3	1,925
Total	326	4	22	35	57,154

*Count totals do not include extirpated species
**Source: Wildlife Observation Databases (1999)

The lists of these taxonomic groups are generally complete with the notable exception of small mammals (rodents and insectivores) and amphibians. Species completeness exceeds 80 percent for all major taxonomic groups. Recent contemporary sampling has increased our knowledge of bat species, but old records suggest there may be small terrestrial mammals present that have not been collected. Distribution data for nearly all species and locales is the result of non-systematic reporting by mostly casual observers, and is both highly incomplete and moderately unreliable. In 1999, work was initiated to develop potential habitat suitability or distribution maps for numerous vertebrates using GIS modeling. Although preliminary results are often unreliable; we are optimistic that, for selected species, we will be able to develop geospatial distribution models of key species that will be useful to park managers. Less than 25 percent of the parks' vertebrates are represented by specimens in the parks' museum. It is unknown how many vertebrates are represented at outside museums, but may be considerable.

In 1977, Fish were surveyed in less than five percent of the alpine lakes (Zardus, 1977). About 25 percent of these parks have had amphibian surveys completed during the past five years through several research initiatives.

Limited surveys of several invertebrate groups by extra-mural researchers have yielded specimens and lists representing less than 10 percent of all the invertebrate species present in the parks; distribution data is incomplete and unreliable with weak database designs. The Lepidoptera database is the most complete insect database with approximately 75 percent of the species represented. Most of this data is difficult to access because of a lack of standardization and reporting.

Table 3 is a summary of the status of the parks' biologic species inventories, followed by detailed explanations of the codes used in the table. This is an approximation that reflects our current taxonomic, geographical, and ecological knowledge of the major flora and fauna groups. Our weakest link is species distribution of the different taxa and their locational occurrence.

Table 3: Status of Biologic Species Inventories in the Parks as of 1999 *

Biological Groups**	Num Spec	Tax Comp	Geo Comp	Eco Comp	Seas Comp	Inv Hist	Numb Vouch
Amphibians	11	2	4	2	2	1	0

Biological Groups**	Num Spec	Tax Comp	Geo Comp	Eco Comp	Seas Comp	Inv Hist	Numb Vouch
Birds	205	1	4	3	2	1	75
Fish	10	2	4	2	2	1	0
Mammals	76	2	4	3	2	1	192
Reptiles	24	1	4	3	2	1	13
Vascular Flora	1393	2	4	1	2	1	1253
Invertebrates - Insects	2000	4	4	2	2	1	1000

***** Key to column definitions on following page
** Includes exotic species, but not extirpated species

Biological Inventory Status Codes

Taxonomic Completeness

1. Inventory probably taxonomically complete, covers all group within this biological group
2. Inventory > 80% taxonomically complete, for this biological group
3. Inventory 50%-80% taxonomically complete,
4. Inventory < 50% taxonomically complete,
5. Inventory contains good information about a few taxa such as Families, or Genera,
6. Inventory poor or nonexistent,
7. Inventory status unknown,

Geographic Completeness:

1. Inventory has been generally throughout the park and adjacent lands for this biological group
2. Inventory has been throughout > 80% of the park,
3. Inventory has been throughout 50%-80% of the park,
4. Inventory has been limited to only a relatively few areas in the park,
5. Collection has been sporadic with no areas being inventoried well,
6. Status of geographical completeness in inventory is unknown.

Ecological Completeness:

1. Inventory has been completed in all major ecological/community types, in the park, for this biological group
2. Inventory has been completed in > 80% of the major ecological/community types
3. Inventory has been completed in 50%-80% of the major ecological/community types
4. Inventory has been limited to only a relatively few of the major ecological/community types,
5. Collection has been sporadic with no major ecological/community type being inventoried as well,
6. Status of ecological completeness in inventory in unknown.

Seasonal Completeness:

1. Inventory has been completed over all appropriate seasons, in the park for the biological group
2. Inventory has been completed in some of the appropriate seasons,
3. Inventory has been completed in only one of the appropriate seasons of the year,

4. Collection has been sporadic with no season being inventoried well,
5. Status of seasonal completeness in inventory is unknown,
6. N/A

History of Inventory:

1. Inventory/observations have been ongoing over the history of the park
2. Inventory/observations have been ongoing over the last 10-20 years
3. Inventory/observations have been ongoing over the last 5-10 years
4. Inventory/observations have been ongoing over the last 5 years
5. Inventory/observations have occurred more than once
6. Inventory/observations have occurred only once
7. Inventory/observations have never occurred
8. Inventory/observations status is unknown
9. Scattered observations over time

Voucher Specimens

2,533 specimens

Number of Species

3,719 species are listed on the park's checklist for this biological group.

Digital Maps of Vegetation Associations

Does *not* meet minimum guidelines.?

The floristic classification of park vegetation consists of a detailed, but geographically uncertain survey of Sequoia and Kings Canyon National Parks. The digital conversion of vegetation to a GRASS format was completed in 1994 and is mostly based on aerial photography from the 1970s. The contractors Hammond Jensen and Wallace for Kings Canyon National Park and Natural Resource Management Corporation for Sequoia National Park completed the original vegetation mapping. The vegetation classification was inconsistent in many cases between the two companies and their classification schemes. Different vegetation categories have been aggregated to improve classification accuracy resulting in a digital coverage with 14 vegetation associations. Although the level of spatial and attribute detail has been reduced, the accuracy has increased because of the category lumping that has occurred. The only attribute in the vegetation digital coverage is vegetation class or name. The existing digital vegetation layer has locational uncertainties of up to 0.5 kilometer limiting its value for most science-based applications. Historical and modern metadata exist and are on file for the vegetation layer.

In 1997, the following changes were made to the original GRASS digital vegetation layer:

- The vegetation layer was converted to Arc/Info (ESRI) format.
- All Red Fir in the Kern Canyon drainage was converted to Subalpine Fir.
- Giant Sequoia Groves from a separate data layer were merged into the original GRASS data.
- Topological problems in the Volcano Lakes area were fixed.

- Vegetation data was mapped in the Mineral King area using older US Forest Service vegetation maps.

Although these efforts have improved the accuracy of the vegetation map, many spatial problems still exist and limit its application and use. Further, there is inconsistent or unreliable information on other important vegetation attributes such as pole density and size, canopy density, understory, etc. The limited information available resides in its original GRASS format.

Maps of meadow locations have been digitized and attributed. Much revision work was completed in 1999 including addition of attributes relating to stock use, stock regulations, forage quality and quantity, size, and name.

Cartographic Maps

Does meet minimum guidelines.

Topography. The U.S. Geological Survey (USGS) 1:24000 (7.5 Minute) maps covering the region were completed in 1990. Digital elevation models at 30-meter spatial resolution have a 7-15 meter Root Mean Square (RMS) error and cover an area of 56 USGS 7.5-minute quadrangles inside the parks and their vicinity.

Transportation. Digital roads and trails data exist for all areas inside the parks. This data originated from the 1:24000 USGS Digital Line Graph (DLG) databases. Much time has been spent enhancing and modifying these original DLG layers.

Administrative Boundaries. Numerous administrative boundary layers have been created or acquired from other sources including: parks' boundaries, designated and proposed wilderness boundaries, inholdings and adjoining land ownership jurisdictions.

Digital Orthophoto Quads. One-meter resolution USGS digital orthophoto quad is available for both parks as either black and white or color infrared imagery.

Digital Raster Graphics. All USGS 7.5-minute quads have been scanned as digital images and georeferenced and can be used as basemaps for GIS work.

Soils Maps

Does *not* meet minimum guidelines.

Portions of the Marble Fork and Middle Fork of the Kaweah River have been mapped to Order 4 resolution. This accounts for only about eight percent of the parks total acreage. This mapping was completed as part of an Acid Rain Study in the mid-1980s.

Geology Maps

Does *not* meet minimum guidelines.

Approximately 85 percent of the surficial geology within Sequoia and Kings Canyon National Parks has been mapped at a 1:62500 scale. The Mineral King USGS 15-minute quadrangle has some limited

mapping information available but has not been converted to digital. No bedrock geology has been mapped.

Water Resources Inventory

Does *not* meet minimum guidelines.

The 1:24000 hydrography layer has been digitized, and labeled only to principal type (lake, stream, canal, and reservoir). There are numerous topological errors in the existing spatial database that should be fixed. Park scoping has identified numerous attribute information classes that need collection for individual water body segments.

The United States Fish and Wildlife Service (USFWS) has developed wetlands data for all parks' areas through the National Wetlands Inventory (NWI) program. However, less than 50 percent of this mapped data has been converted to digital and little spatial and attribute accuracy validation has occurred.

Detailed wetlands mapping was completed in the early 1990s for most of the Middle Fork sub-watershed within the Kaweah Watershed (approximately 5 percent of parks). Digital data collected included vascular flora, vertebrate fauna, soil, hydrology, and water chemistry (NPS, 1997).

Water Quality Data

Does *not* meet minimum guidelines.

There has not been a systematic comprehensive effort to identify key water bodies for vital signs monitoring based on size, uniqueness, representativeness, or threats.

There are some ongoing monitoring projects for specialized needs and selected areas. The Sequoia Watershed Project, managed by the Western Ecological Research Center of the Biological Resources Division (BRD) of the USGS, is actively monitoring changes in stream chemistry along an elevation gradient within the Kaweah Watershed. Additionally, the BRD is monitoring stream chemistry within the East Fork Watershed as part of the Mineral King Risk Reduction project. The Western Lakes Survey is examining temporal change in some scattered park lakes along with other alpine lakes throughout the Sierra Nevada range. There are detailed records of flow and chemistry for the Emerald Lake (Subalpine) basin of the Marble Fork of the Kaweah River (with continued monitoring), for two small montane mixed conifer stream systems feeding the Middle Fork of the Kaweah, and sporadic records for an intermittent foothill chaparral stream system. The University of California at Santa Barbara manages a monitoring effort to collect snow chemistry information in the Emerald Lake area. Southern California Edison (SCE) has been collecting stream flow information along various branches of the Kaweah River since the early 1900s. The Pacific West Regional Office of the NPS, through a contract with the USGS, is collecting stream flow and chemistry data for the Environmental Protection Agency's (EPA) STORET program.

There are no rapid bioassessment baseline efforts underway for fish or microinvertebrates.

Air Quality Stations

Does meet minimum guidelines.

There are four air quality stations located within Sequoia and Kings Canyon National Parks located at Ash Mountain, Grant Grove, Lookout Point, and Lower Kaweah (1999). These stations are sponsored by a variety of sources, depending on the type of data being collected.

Air Quality Data

Does meet minimum guidelines.

Sponsors for data collection at the air quality stations are variable, but include the parks, California Air Resources Board (CARB), Environmental Protection Agency (EPA), Air Resources Division (ARD) of the NPS, and Western Ecological Research Center of the Biological Resources Division (BRD) of the USGS. All of these stations are collecting both ozone and particulates (Dry Deposition and/or visibility) data that goes as far back as 1982. The Ash Mountain and Lower Kaweah Stations are also collecting Wet Deposition data that began in 1983. CARB also collects Wet Deposition data at several other higher elevation sites.

Precipitation and Meteorological Data

Does meet minimum guidelines.

The parks have relatively rich meteorological data. There are currently five Remote Area Weather Stations (RAWS) collecting weather data during fire season and available as digital information through the National Interagency Fire Center (NIFC). The RAWS current locations (1999) are Cedar Grove, Park Ridge, Sugarloaf, Rattlesnake Canyon, and Wolverton Point. Several of these RAWS collect data all year. Additionally, two other *manual* fire National Fire Danger Rating Systems (NFDRS) stations are collecting weather data that can be accessed as digital data (Ash Mountain and Cedar Grove). The RAWS stations collect temperature, precipitation, relative humidity, wind speed, and wind direction and provide in a digital format.

Additionally there are meteorological stations being operated and maintained through a variety of other sources including those listed in Table 4.

Table 4: Other Meteorological Data Collection Stations

Location	Duration	Primary Sponsors
Atwell Mill	1975-Present	US Army Corp of Engineers
Crescent Meadow	1984-Present	BRD
Elk Creek	1983-Present	BRD
Emerald Lake	1985-Present	CARB
Lower Kaweah	1988-Present	CARB, ARD, SEKI
Topaz (“Dome”) Lake	1995-Present	NASA-EOS
Wolverton	1986-Present	NOAA/BRD
Lookout Point	1997-Present	EPA, ARD, SEKI

Nearly all of this data is digitally available from through a variety of sources.

Continuous daily temperature and precipitation data have been collected for Ash Mountain since 1948, Grant Grove since 1949, and Lodgepole Campground since 1969.

NATURAL RESOURCES

Vegetative Resources

Overview

Park vegetation includes terrestrial and aquatic species. Vegetation management in these parks falls into four general categories; management of native plant communities, restoration of disturbed lands, exotic plant management and management of ongoing impacts to the vegetation resource due to visitor or administrative uses. General guidance for the management of native flora, disturbed area restoration, and exotic species management are contained in National Park Service Management Policies Chapter 4 (Draft-2000).

Native Plant Communities:

The general natural systems policy of the NPS applies to all vegetation resources of the park. In summary, "…resource specialists will not attempt to solely preserve individual species (except threatened or endangered species) or individual natural processes; rather, they will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of the plants…"

To achieve this end requires a program of resource inventory, monitoring for changes, and an understanding of the natural processes and stressors that affect the resource. Protecting native vegetation from human caused impacts such as poaching, felling, or harvest is an important part of the program. Equally important is the maintenance of the natural ecosystem functions and processes that sustain and shape the floral diversity.

Within the general context of native plant management, exceptions to the general policy apply to; special status plant species (threatened, endangered, rare or sensitive), and to the management of giant sequoia as a species of distinct social concern and unique scientific value.

Disturbed Lands:

Restoration of disturbed park lands includes those areas actively disturbed by past park management activities or other human actions (e.g., the Giant Forest development area), as well as the restoration of natural conditions to areas where the natural process has been disrupted through human actions (e.g., the widespread disruption of the natural fire regime through suppression).

Where necessary for restoration of actively disturbed sites, restoration will include: reforming the land to natural contours, reestablishing soil properties and nutrients, and stimulating natural vegetation growth or the use of direct planting to establish native plant species.

When attempting to restore conditions where the natural process has been disrupted such as locations

where the natural fire regime has been interrupted, the park will strive to carefully reintroduce or simulate the process to achieve natural outcomes and effects.

Exotic species:

Exotic species management is necessary to protect both park ecosystems and their natural function as well as to prevent the spread of such species outward onto adjoining agricultural and residential lands, and to downstream waterways.

The exotic plant management program focuses on three major areas; monitoring for new occurrences and for trends in existing populations; prevention strategies and local policies for reducing the introduction and establishment of new populations, and eradication of existing exotic populations where practical and feasible.

Ongoing impacts to vegetation resulting from visitor or administrative uses:

Alteration to native vegetation or fundamental processes that influence vegetation occurs throughout the park to accommodate site specific visitor and administrative use needs. Native plants communities in developed areas may be managed differently and more actively from those in the surrounding area in order to meet developed area objectives such as aesthetics and visitor and employee safety. In wilderness meadows, consumptive use of the plant resource is condoned within constraints to facilitate administrative and visitor use of pack and saddle stock. Actions included in this category are: a tree hazard management program that mitigates risk to visitors in developed zones by removing dead or dying trees, grazing and meadow management programs that attempt to minimize the impacts of administrative and visitor pack stock use, and the selective management of certain scenic features or specimen trees including vista maintenance and featured sequoia tree protection to meet aesthetic rather than ecological objectives.

Native Plants

Summary

Native plant communities within the parks are comprised of over 1,200 species including the largest living organisms, the giant sequoia. Extreme topographic differences create a variety of habitat types and conditions that range from xeric low elevation oak woodlands to high elevation alpine communities. Within elevation and precipitation bands there is an additional complex of species and communities that are affected by relatively static physical influences such as aspect, slope position, soils and the effects of past glacial action, as well as by dynamic process such as variable moisture regimes and fire.

While many of the parks native vegetation communities are considered essentially intact, with the foothills herbaceous component a large exception, most have been altered to some degree by post-settlement disturbance. Past anthropogenic influences on the native plant communities include logging in some areas in the late 1800’s, extensive domestic sheep and cattle grazing in all areas during the same period, and continued cattle grazing into the 1970’s in a few areas. Other impacts on the native vegetation resource include the suppression of natural fire events through the first half of the twentieth century and the invasion of exotic plant and plant pathogens, a process that continues to the present. Exotic herbaceous plants in the elevations below 4,000 feet are so pervasive that they have displaced

most of the native herbaceous component.

All plant communities are subject to the landscape scale systemic stressors discussed in another section of this document. Specific issues regarding the management of native plant communities and their stressors, or exceptions to general policy regarding such resources, are also discussed in other sections of this document. Examples include the management of the native giant sequoia, management of exotic plants, and the management of pack and saddle stock grazing.

Related Planning Documents

Various other implementation plans and documents provide detailed strategies for the management of the native vegetation resource of these parks. These plans respond to and implement the direction set in this Resources Management Plan and other higher level planning documents.

- Fire Management Plan for Sequoia and Kings Canyon National Parks – 1989 (in revision)
- Backcountry Management Plan – 1972 (in revision to become the Wilderness Management Plan)
- Stock Use and Meadow Monitoring Plan - 1986 (to be incorporated into the revised Wilderness Management Plan)
- Vegetation Management Plan for Developed Zones - 1987

Baseline

Vascular Plants. 1,431 taxa of vascular plants have been discovered thus far in the parks, representing 1,252 species. From field survey work began in the mid-1980s until 1994, 103 taxa were added. Only 17% of the parks' area was been systematically surveyed for vascular plants in that effort. Since the rate of discovery from the survey declined only slightly before it was curtailed, the present list is considered incomplete. Surveys for lichens and mosses have been conducted only in a very small (<5%) portion of the parks. Few surveys have been conducted on the parks aquatic flora. Approximately 80% of the vascular taxa on the Sequoia and Kings Canyon Flora (1991) are represented by specimens in the park herbarium. All these data reside in digital relational databases.

The floristic classification of park vegetation consists of a detailed but geographically uncertain survey of Sequoia National Park and General Grant National Park (now part of -King Canyon National Park) to the boundaries of 1939 when the work was completed (Frost 1939). This map is to the sub-association level and contains minimum map units as small as 2 ha. In 1994 it was transferred to a modern base prior to digitizing as a GIS layer. However, locational uncertainties of up to 0.5 km make its value as an historical baseline questionable.

Traditional timber type maps of the parks were produced by contractors for Kings Canyon in 1968 (Hammon Jensen and Wallen) and for Sequoia in 1974 (Natural Resources Management); they do not include recent additions to the parks, such as Mineral King. These are drawn at a scale of 1:15,840 and based on aerial photography and field checking. In forest lands, they map dominant and subdominant species, stand size, cover class, and decadence rating. Treatment of other vegetation is cursory. The accuracy of these maps is somewhat below average for their type and era, and not sufficient for park management or research purposes. These maps have been digitized as a series of GIS layers, in the absence of contemporary maps.

Maps of the locations and size classes of all sapling and larger giant sequoias in the parks were completed by contractors in the 1970s. Some of these maps have been digitized into a spatial database, though most

still exist only in paper form. Meadows in the parks have been mapped, and entered as an unclassified GIS map layer.

Stressors

Note: Major systemic stressors on park resources are discussed in a previous section. Their effects are discussed here in the context of specific issues and problems related to the native vegetation of the parks.

Loss of natural fire regime:

Successful fire suppression beginning in the late 1800's has significantly altered stand structure and species composition throughout many of the parks vegetation communities. Fire history studies show most forest communities have missed an unprecedented 5-20 fire events in the last century. Fire exclusion from these forest communities has resulted in increased stand density, increased fire fuels on the ground, lack of adequate gaps, a decrease in reproductive success for shade intolerant species such as giant sequoia, and an overall change in species composition at the stand level. Similarly, fire exclusion in the parks chaparral and oak woodland communities has resulted in changes to those resources, though the extent and impact of those changes is less well understood.

Exotic pathogens:

White pine blister rust (*Cronartium ribicola*) has had a significant effect upon the native white pines, particularly sugar pine (*Pinus lambertiana*) and western white pine (*Pinus monticola*) within the parks. A recent survey has shown the disease to be widespread, and in localized areas has resulted in the decline and mortality of a significant number of individual trees, especially saplings. Sugar pine is a major component to the forest structure of the giant sequoia groves, and some of the most severe blister rust infections are seen in the Redwood Mountain and Atwell sequoia groves. Active management of the sugar pine population may be necessary to maintain its historic importance in the composition of these mixed conifer forests. Foxtail pine (*Pinus balfouriana)* and whitebark pine (*Pinus albicaulis*) each make up the primary structural component to subalpine forests comprising a large percentage of the parks subalpine zone. Almost no effect upon these species from blister rust has been observed to date. However, if the infection were to spread to these ecosystems the disease could have catastrophic effects.

Invasion and displacement by exotics:

Invasion by exotics began in the 19th century with the advent of extensive agriculture in the San Joaquin valley and the extensive grazing of what are now parklands by domestic sheep and cattle. By the early 20th century, the displacement of the native herbaceous component of the foothill vegetation communities by exotics was virtually complete. Restoration of a semblance of the native foothill herbaceous plant communities present before settlement is generally considered technically infeasible at this time. The near-complete replacement of the native herbaceous component in the lower elevations of the park has implications for shifts in wildlife habitat, fire frequency and seasonality, and hydrologic regimes.

Exotic species have recently been detected in other areas of the park through focused inventory efforts. Some of these are probably recent arrivals while others may have been present but undetected for

longer periods of time. A full discussion of exotics and their management are included in a separate section of this plan.

Air Pollution:

Tropospheric ozone air pollution has been observed to have an effect on some sensitive species within the parks. Ponderosa pine (*Pinus ponderosa*) and Jeffrey pine (*Pinus jeffreyii*) are particularly sensitive, and are the primary indicator species for this abiotic pathogen within the parks. Surveys and studies on these species have shown that a small percentage of the population of each is significantly affected in the most severely polluted areas of the parks, resulting in reduced vigor and increased susceptibility to other pathogens. Other less sensitive species include the emergent seedlings of giant sequoia (*Sequoiadendron giganteum*), black oak (*Quercus kellogii*), mugwort (*Artemesia douglasiana*) and blue elderberry (*Sambucus mexicana*). Visible symptoms of ozone injury have been observed on these species within the parks, but no effect upon their physiology has been shown. Activities include long term monitoring of ponderosa and Jeffrey pines in plots throughout the parks, research on the effects of air pollution on these species, and ecological monitoring of vegetation associations of which ponderosa pine, Jeffrey pine, giant sequoia, and black oak are components.

Visitor and Administrative Use:

While past human activity has altered and shaped the native vegetation resource at the landscape scale, present and future visitor and administrative use of the parks will continue to affect the vegetation on a local scale. Park developments such as campgrounds and lodges require modification of the local environment to provide for safety and aesthetics. The maintenance and use of roads and trails have direct impacts as well as provide corridors for the introduction of new exotic species. Direct compaction and trampling by visitors in high use areas will modify local stand structure and composition over time. Grazing by administrative pack and saddle stock in wilderness meadows creates localized impacts to the native vegetation, as well as provides a potential vector for the introduction of exotic plant species into new areas. The infrastructure that supports park developments such as the withdrawal of water and the discharge of sewer alter local to sub-watershed hydrology, change local species composition, and change nutrient availability.

Desired Future Conditions:

Condition	Source
The preservation from injury of all timber… in their natural condition.	Act of September 25, 1890 – Establishing Sequoia National Park

Condition	Source
- NPS-managed natural systems, and the human influences upon them, will be monitored to detect any significant changes. Action will be taken in the case of such changes, based on the type and extent of change. - Maintain all the components and processes of naturally evolving park ecosystems. - Fire management activities conducted in wilderness areas will conform to the basic purposes of wilderness. - Intervention in natural biological or physical processes will be allowed only (1) when directed by the Congress, (2) in some emergencies when human life and property are at stake, or (3) to restore native ecosystem functioning that has been disrupted by past or ongoing human activities. - The Service will re-establish natural functions and processes in human-disturbed natural systems in parks unless otherwise directed by Congress.	NPS Management Policies – 2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from NPS Strategic Plan (1997-2002)
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from NPS Strategic Plan (1997-2002)
2.8% of the burnable ecosystems (particularly giant sequoia groves), based on the 1997 burnable acreage, are restored and/or maintained by fire.	Long-Term Goal Ia1 from Sequoia and Kings Canyon National Park - Strategic Plan (1997-2002)
At least 25% of all new potentially invasive alien species, as of 1997, are controlled.	Long-Term Goal Ia2 from Sequoia and Kings Canyon National Park - Strategic Plan (1997-2002)
At least 5% of known non-significant disturbed or abandoned sites; including abandoned roads, trails, campgrounds and picnic areas, and disturbed backcountry meadow sites etc.; as of 1997, are restored.	Long-Term Goal Ia3 from Sequoia and Kings Canyon National Park - Strategic Plan (1997-2002)
At least 90 % of the disturbed sites at Giant Forest, as of 1997, are restored	Long-Term Goal Ia8 from Sequoia and Kings Canyon National Park - Strategic Plan (1997-2002)
90% of the biological and physical resource components and their vital signs, as of 1997, are known	Long-Term Goal Ic1 from Sequoia and Kings Canyon National Park - Strategic Plan (1997-2002)

Condition	Source
Vegetation – Native plants are preserved as part of naturally functioning ecosystems 1. Native plant species and threatened, endangered and sensitive plant species are inventoried, monitored, protected, and restored/maintained over time. 2. Native plant species extirpated from the parks are restored, where feasible	Resource Goals from RMP (1999)

Constraints on Desired Future Conditions:

Developments. Planned and existing developments and managed human occupation within the park (including inholdings) will continue to constrain the range of vegetation and processes that may be allowed within and around these developed sites. Water withdrawals and sewage disposal will locally alter conditions for native vegetation at the sub-watershed level.

Smoke management may constrain use of prescribed fire. Fire is both a powerful natural process and an effective resource management tool for restoring and maintaining the park natural vegetation communities. It is the preferred management tool in most instances. The primary limiting factor on the use of fire is the production of smoke. Legal constraints on the production of particulate matter contained in smoke and social tolerance for the smell and appearance of smoke in local communities reduces opportunities for maximum use of this tool and process.

Pathogen mutation. The ability of some exotic pathogens to adapt to control actions (e.g., white pine blister rust mutations) make control of some of these organisms technically infeasible at this time.

Continued introduction of exotic pathogens and plant species. The parks will continue to be susceptible to the introduction of exotics through wildlife movement across borders, visitor use of all kinds, and administrative actions such as new construction and ongoing maintenance activities.

Displaced native communities. The low elevation grasslands of the parks have been so completely altered that little hope exists for restoring those areas to represent native species density and composition. Other areas in the park may experience similar changes over time. The recent discovery of cheatgrass (*Bromus tectorum*) on numerous mid-elevation sites is an example of the continuing changes that may be expected.

Current Management Actions

Know the resource

- Inventory and map park vegetation. In FY 1999 a vegetation and fire fuels mapping project was funded by FIREPRO. FIREPRO funding will continue through FY 2000. The NPS Inventory and Monitoring program will fund the remaining work in 2001 and beyond. Map units will be labeled at the community element, or association level. However, given a minimum-mapping unit of 0.5 hectare we anticipate that many will be labeled at the next level up in the hierarchy, the alliance. The map scale will be 1:24,000 and rendered in digital format. The classification and description

of ecosystem units are critical first steps in building the framework for ecosystem management planning. A consistent classification of ecological communities will allow the mapping of vegetation patterns across the landscape and evaluation of vegetation relationships to ecological processes. Identification of the patterns of biological diversity within a landscape and ecosystem context provides the context for the development of sustainable management plans for these ecosystems.

- Monitor fire effects. The park will continue the 15 year old fire effects monitoring program as outlined in the "Western Region Fire Monitoring Handbook". Additional studies beyond the scope of the standard handbook will continue to evaluate park and resource specific issues of concern such as the mortality and reproductive success of giant sequoia following fire.
- Monitor and evaluate the effects of stock use on park resources.
- Continue the long term monitoring of all white pines in plots throughout the parks and the collection of seed from candidate rust-resistant trees within the Development Zone. Provide subsequent screening for major gene resistance.

Protect t the Resource and Mitigate Stressors

- Promote design and construction standards that will protect existing vegetation and reduce opportunities for introduction, invasion or encroachment of exotic species.
- Monitor ground disturbing activities to prevent unintended disturbance.
- Provide oversight to projects through involvement in the Environmental Management Committee review process.
- Develop and enforce standards for grazing impacts.

Maintain the Pieces

- Promote ecosystem function by managing natural fire events to the maximum extent possible considering safety and resource conditions.
- Use prescribed fires where necessary to supplement or simulate the natural process and function in areas where natural ignitions cannot be used due to hazards or proximity to boundaries, or where suppression of natural ignitions outside parklands alters the fire regime of park vegetation communities.

Restore

- Use prescribed fire as the primary tool to restore fuel conditions and forest structure in areas that have been altered due to past fire suppression.
- Use active restoration techniques in the Giant Forest developed areas that have experienced disturbance from human activities in the past. Restoration techniques will include restoring landforms to natural contours, restoring soil properties and nutrients, direct transplanting or planting of local genotypes and irrigation.

Inform and Educate the Public and Others about the Resource

- Publish relevant monitoring and research.
- Promote continued studies and research.
- Transfer accurate information to park staff, visitors and other interested publics.

Strategies for Achieving Desired Future Conditions:

Know and Understand the Resource

- Develop and implement and ecosystem-level inventory and monitoring program that will assess conditions and trends in native plant community health and function.
- Identify and implement inventory and monitoring of key indicator species.
- Conduct focused inventories for threatened, endangered or rare plant species and communities.
- Conduct comprehensive inventories of aquatic and non-vascular plant species.
- Continue and expand the fire effects monitoring program to include other elements of the system affected by fire. Expand the program to assess landscape level change.
- Model the outcomes of different management strategies such as fire, and the implications of future resource conditions due to systemic stressors such as air pollution and global climate change.

Protect the Resource and Mitigate Stressors

- Actively protect park vegetation from the introduction of exotic species through actions such as clean feed requirements for pack stock and management of construction zone impacts.
- Assure all plant material used in the park is derived from local genotypes.
- Continue the current fire management program.

Maintain the Pieces

- Promote fire and other natural process to the maximum extent possible in relatively natural and restored portions of the park.
- Use prescribed fire as needed to maintain the natural fire regime where natural fire events may not be possible or may have been intercepted by suppression actions outside park boundaries.
- Manage natural forest insect and pathogen outbreaks as natural processes.

Restore Impaired Parts

- Use prescribed burning as the primary tool for restoring areas degraded by the effects of past fire suppression.
- Conduct active revegetation in all areas where past human disturbance has altered conditions such that the areas will not successfully blend or reintegrate with surrounding natural environments and processes within a human life span. Areas where the past human disturbance or evidence is considered a cultural resource and requires preservation are exempt from this action.
- Manage occurrences of exotic plants and pathogens to maintain natural condition and function. Actions may include active control and eradication.

Inform and Educate the Public and Others about the Resource

- Publish relevant monitoring and research.
- Promote continued studies and research.

- Transfer accurate information to park staff, visitors and other interested publics.

Threatened, Endangered, and Sensitive Plants

Summary:

Sequoia and Kings Canyon National Parks support a remarkably rich and diverse vascular flora composed of over 1,400 taxa. Of these, 40 taxa have been identified as 'sensitive'. The term sensitive is applied generally here to include those species that are state or federally listed, are rare or endemic in California, or have a limited distribution. Little is known about the status and habitat requirements of most sensitive species within the two parks. What we do know about sensitive plants is largely derived from a single systematic survey conducted during the early 1980s (Norris and Brennan 1982), and .more localized surveys carried out in conjunction with major construction projects. Additional occurrences are compiled from other, unrelated surveys that have encountered sensitive species serendipitously.

As only two plant taxa from these parks are state listed, and none are federally listed, management of threatened and endangered species has not been considered a high priority. In part, this may be due to a tendency on the part of park managers to regard sensitive taxa as a small but interesting subset of the flora as a whole. An assumption might be made that if natural processes are allowed to function at the ecosystem and community levels, sensitive species will flourish or decline as natural conditions dictate. The danger of making such assumptions without adequate survey data, however, is the increased risk of inadvertently impacting populations of sensitive plants, and thus violating state and federal law as well as NPS policy.

Baseline

Surveys targeting sensitive plant species parkwide were last conducted during the early 1980s by Norris and Brennan (1982). A list of species was developed from available literature (e.g., state and federal rare species lists, California Native Plant Society and Natural Diversity Database lists). Although surveys were conducted in both parks, they were largely limited to trail corridors within Sequoia National Park and parts of Kings Canyon National Park; much of northern and central Kings Canyon National Park remain completely unsurveyed. Out of this work came a detailed two-volume report containing references, site locations, habitat descriptions, color photographs and slides, and line drawings of XX species. Databases that came out of this work have been updated regularly with state and federal designations and the California Native Plant Society *Inventory of Rare and Endangered Vascular Plants of California.*

Directed surveys for sensitive plants have also been conducted prior to major construction-related ground disturbing activity in both parks. In 1988, L. Norris conducted a corridor survey as part of the environmental assessment for the Generals Highway construction project. Similarly, Jones and Stokes, a Sacramento-based consulting firm, completed a survey for sensitive plants for the Giant Forest restoration project. The Cedar Grove sewer plant project site was surveyed by park plant ecologist C. Schelz.

Forty species of sensitive vascular plants are known to occur within the two parks. Of these, two (Tompkins' sedge, *Carex tompkinsii*; and Congdon's lewisia, *Lewisia congdonii*) are state-listed as rare. Although they have no state or federal standing, California Environmental Quality Act (CEQA) consideration is mandatory for northern spleenwort (*Asplenium septentrionale*) and meadow sedge (*Carex praticola*). CEQA consideration is recommended for an additional fourteen taxa. The

remaining twenty-two taxa have no state or federal status, but are considered sensitive because they are rare, endemic, endangered or of limited distribution in California. An additional fifteen are known to occur on lands adjacent to the parks; these are kept on a watch list as they are suspected of occurring within the park boundaries as well.

Stressors and Resource Preservation Issues:

Many of the sensitive species are rare because we are at the fringes of their distribution and their habitat is poorly represented. Others may have become scarce or extirpated because of anthropogenic activities. The impacts of grazing, fire suppression, pollutants, global climate change and other anthropogenic stresses on sensitive plant species in these parks are almost entirely unknown.

Desired Future Conditions

Condition	Source
NPS-managed natural systems, and the human influences upon them, will be monitored to detect any significant changes. Action will be taken in the case of such changes, based on the type and extent of change.	NPS Management Policies – 2000; Chapter 4 (Draft)
Maintain all the components and processes of naturally evolving park ecosystems	NPS Management Policies – 2000; Chapter 4 (Draft)
The Park Service will, within park boundaries, identify, conserve, and attempt to recover all federally listed threatened, endangered, or special-concern species and their essential habitats. As necessary, the Service will control visitor access to and use of essential habitats, and may close such areas to entry for other than official purposes. Active management programs (such as monitoring, surveying populations, restorations, exotic species control) will be conducted as necessary to perpetuate, to the extent possible, the natural distribution and abundance of threatened or endangered Species, and the ecosystems upon which they depend.	Endangered Species Act (16 USC 1531, et seq.); NPS Management Policies – 2000; Chapter 4 (Draft)
The Service will identify all state and locally listed threatened, endangered, rare, declining, sensitive, or special concern species and their essential habitats that are native to and present in the parks. These species and their essential habitats will be considered in Park Service planning and management activities.	NPS Management Policies – 2000; Chapter 4 (Draft)
Plant and animal species considered to be rare or unique to a park will be identified, and their distributions within the park will be mapped.	NPS Management Policies – 2000; Chapter 4 (Draft)

Condition	Source
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan
At least 100% of the 1997 identified park populations of federally listed threatened and endangered with critical habitat on park lands or requiring NPS recovery actions have an improved status, and an additional 100% have stable populations	Long-Term Goal Ia6 from Strategic Plan
Native plant species and threatened/endangered and sensitive plant species are inventoried, monitored, protected, and restored/maintained over time	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

A lack of basic information regarding the occurrence, distribution, abundance, and ecological requirements of sensitive plant species prevents the ideal conditions listed above from being realized. Survey effort has been inconsistent at best, resulting in an incomplete list of sensitive species. The relative scarcity of special status plants in these parks is more likely a reflection of inadequate search effort than of real conditions.

Studies are needed to investigate possible effects of fire, fire suppression, climate change, air pollution, competition from exotic species, visitor use, developments and other management actions on sensitive species. A focus is needed on threats to species distribution and status, identifying basic ecological requirements of species, reproductive biology, fire adaptations, movements, evaluation of potential threats, and restoration feasibility.

The desired future conditions for rare, threatened, or endangered plant populations include the following:

- Distribution and abundance is maintained within the natural range of variation.
- Populations of sensitive plants are maintained unimpacted by human influence; where such influences are unavoidable, impacts are mitigated through active restoration of habitat
- Distribution and abundance is documented through systematic surveys.
- Species known to be at risk from either direct or indirect anthropogenic actions are identified, and populations monitored to detect changes in size, vigor or extent.

Current Management Actions to Meet Desired Future Conditions

- Information management. Sensitive vascular plant species and their legal status are documented according to the California Native Plant Society *Inventory of Rare and Endangered Vascular Plants of California (5th ed. 1994)* and current postings of the California Department of Fish and Game *State and Federally Listed Endangered, Threatened, and Rare Plants of California (1998 revision).*
- Inventory. An observation database is maintained that includes all known locations of sensitive plant populations within the parks. Data are derived from diverse park vegetation databases, including Natural Resource Inventory, fire monitoring, meadow monitoring, and gradient analysis plots. A GIS layer has been created to provide easy access to these data and to allow users to

integrate sensitive plant data into the planning process. A limited amount of survey work is conducted prior to major construction or ground disturbing activities, such as trail reroutes, on an as needed basis. As no other formal surveys for additional populations are currently being conducted, field personnel gather additional distributional information only through chance encounters while carrying out other fieldwork.

- Monitoring. No formal monitoring efforts are currently being implemented. Field personnel confirm the presence or absence of known populations only through chance encounters.

Strategies for Achieving Desired Future Conditions

Know and Understand the Resource

- Complete the inventory of threatened, endangered and sensitive plants occurring in the parks by conducting systematic searches in those areas not visited by Norris and Brennan during the 1980s.
- Develop an inventory of non-vascular plant species, and identify those known to be sensitive, of limited distribution, or having special legal status.
- Regularly monitor the distribution and condition of sensitive plant species within the parks.
- Support research that would contribute to knowledge of sensitive plant species, including their distribution, population biology and habitat requirements.
- Identify which species are rare because of human influences.
- Determine which species could become extirpated by existing or future anthropogenic factors.

Restore the Impaired Parts

- Identify and mitigate anthropogenic impacts to sensitive species.
- Restore populations of sensitive species impacted by management activities (e.g., road and trail construction).

Maintain the Pieces

- Identify and implement management actions that are consequences of vital signs monitoring.
- Perform Section 7 consultations on any management actions that could affect federally listed species.
- Evaluate proposed management actions on all sensitive species that may be affected.

Protect Resource and Mitigate Stressors

- Enforce regulations that limit impacts to plant populations.
- Evaluate proposed management actions on all sensitive species that may be affected.

Inform and Educate the Public and Others about the Resource

- Provide managers with current information regarding the distribution and abundance of special status plant species to inform planning and construction efforts.

- Maintain an active GIS layer of the distribution of special status plant species that is readily available to park staff.
- Actively participate in regional discussions with adjacent land managers about the distribution, abundance and legal status of sensitive plant species in the southern Sierra Nevada.

Giant Sequoias

Summary

More than 30 giant sequoia groves are protected in namesake Sequoia and Kings Canyon National Parks, about one-third of the total sequoia acreage in existence. Prior to inclusion in the parks, several groves (Atwell and Big Stump) were partially logged for commercial timber. The impending addition of the heavily logged Dillonwood Grove will extend the range of grove conditions managed within these parks. Initial NPS efforts to preserve the groves included the strict protection of all giant sequoia specimens from damage, including damage from natural processes such as fire. The long term results of this absolute protection strategy included the buildup of dangerous levels of fire fuels, overstocked stands of white fir with an attendant increase in forest pathogens, and the virtual lack of giant sequoia reproduction.

Since the advent of ecologically based management in the 1960's, protection and management of natural grove conditions and fundamental natural processes have been emphasized over strict protection of individual specimen trees. Natural processes such as fire and native forest insect outbreaks have been reintroduced or managed to preserve the groves' ecological integrity. Threats from damaging fire have been reduced and giant sequoia reproduction has been stimulated.

Park developments at Grant Grove, Atwell Mill, and Giant Forest were constructed in and among the sequoia trees to provide direct visitor access to the prime resource. Beginning in the 1920's, park management recognized the inherent conflict between intensive development and the protection of the trees. In the 1980's the park began the process of removing overnight lodging and other commercial facilities from the Giant Forest grove. The project is expected to be substantially complete by 2005. Intensive commercial and administrative developments persist at Grant Grove with unknown consequences to the health of those sequoia resources. A campground development remains in a second-growth portion of the Atwell Grove.

Stressors and Resource Preservation Issues

Note: Many of these stressors are common to all park natural resources, and are discussed in more depth a previous section. The following is intended to highlight the impacts of those stressors on the giant sequoia resource.

Loss of natural fire regime.

The park has long identified the loss of the historic fire regime as a primary stressor and threat to the integrity of the giant sequoia resource. The Sierra Nevada Ecosystem Project (SNEP 1996) identified the loss of the natural fire regime as one of the dominant negative effects on the greater Sierran ecosystem.

Giant sequoia as a species are particularly affected by the loss of the natural fire regime since frequent

fire both reduces competition for scarce resources and prepares an ideal set of conditions necessary for giant sequoia reproduction. Due to fire suppression over the past century, giant sequoia reproduction has virtually ceased in unburned groves and the ingrowth and accumulation of shade tolerant, but fire intolerant species such as white fir, have resulted in conditions hospitable to widespread intense and damaging fire events.

Degraded air quality.

Degradation of regional air quality has several potential effects on the giant sequoia resource. In fumigation chamber experiments high ozone levels produced visible symptoms of damage in sequoia seedlings (Miller et al. 1994; Miller 1996), though no significant difference was found in short term seedling survival. Long term seedling mortality and differential genetic selection due to the observed effects of air pollution is unknown, but is a possible source of impact to the sequoia resource (SNEP). Ozone and other pollutants have been shown to be a factor in the decline of several tree species that are part of the giant sequoia grove structure (ponderosa and Jeffrey pine) (SNEP 1996). Severe impacts to those species could result in significantly altered grove conditions over time.

Visitor use.

Direct impacts of visitor use are generally localized and site specific. Impacts include trampling and soil compaction in high use areas. Indirect impacts are more widespread and difficult to detect and manage. They occur as a result of the development of visitor services and related support services. Indirect visitor use impacts include the withdrawal of surface and subsurface water for visitor services at Grant Grove, and the interception of natural fire ignitions by roads and trails throughout the giant sequoia zone.

Desired Future Conditions

Condition	Source
The preservation from injury of all timber… in their natural condition.	Act of September 25, 1890 – Establishing Sequoia National Park
Plant and animal species considered to be rare or unique to a park will be identified, and their distributions within the park will be mapped.	NPS Management Policies – 2000; Chapter 4 (Draft)
Maintain all the components and processes of naturally evolving park ecosystems	NPS Management Policies – 2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, and maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia. from NPS Strategic Plan (1997-2002)
2.8% of the burnable ecosystems (particularly giant sequoia groves), based on the 1997 burnable acreage, are restored and/or maintained by fire.	Long-Term Goal Ia1 from Sequoia and Kings Canyon Strategic Plan
At least 5% of known non-significant disturbed or abandoned sites; including abandoned roads, trails, campgrounds and picnic areas, and disturbed backcountry meadow sites etc.; as of 1997, are restored	Long-Term Goal Ia3 from Sequoia and Kings Canyon Strategic Plan

Condition	Source
At least 90 % of the disturbed sites at Giant Forest, as of 1997, are restored	Long-Term Goal Ia8 from Sequoia and Kings Canyon Strategic Plan
The giant sequoia groves – particularly Giant Forest – and the ecosystems they occupy are restored, maintained, and protected	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

Most giant sequoia groves are managed as integral parts of the surrounding ecosystem, and natural process are allowed to shape the communities. However, because of their long life and immense size, individual giant sequoia trees tend to generate strong emotional reactions and attachments from many visitors and admirers. A number of large specimen trees have been imbued with additional significance by being named (e.g., the General Grant tree which is also, by proclamation, the Nation's Christmas Tree) or by their particular attributes (e.g., the General Sherman tree, named and recognized as the largest living tree on earth). Due to the strong social connections to certain specimen trees (along with an assortment of sequoia snags, stumps, and logs) such featured specimens are managed to perpetuate their condition and appearance substantially unchanged through time. To achieve these ends requires localized and active manipulation of fire fuels, understory growth, and nearby viewsheds. The actions and activities below describe both special treatments for protection and management of specimen trees of interest as well as additional actions and activities that are specific to giant sequoia management parkwide.

Strategies for Achieving Desired Future Conditions

To reach the desired future conditions within the constraints, the parks' will need to perform the following actions:

Know and Understand the Resource

- Convert paper maps and tree inventory database to current digital and spatial (GIS) standards.
- Conduct an extensive inventory of the giant sequoia resource in these parks in the period 1964-1974. The maps are paper documents and not easily referenced or retrievable. The database of tree inventory information has substantially been converted to digital format, but the information is not tied to a spatial representation of such trees.
- Inventory and map the sequoia resource on newly acquired lands, and for newly discovered groves.
- Inventory sequoia resources that have been added to the park since the inventories were completed (e.g., portions of the Deer Creek grove). The impending addition of the Dillonwood Grove to the park will require extensive fieldwork to map. Additionally, several groves within the parks have been discovered or relocated in recent years. These sequoia resources need to be accurately mapped and recorded.
- Continue monitoring the effects of management actions on the sequoia resource.
- Continue the reintroduction of fire in the groves as a natural process. The fire effects monitoring program and related studies should continue to establish a long-term trend for grove response to fire. Another dramatic management action is the removal of all commercial activity and overnight accommodations from the Giant Forest grove and its restoration to natural conditions and day use. Removal of developments and restoration of disturbed areas will continue through about 2003. In

the giant forest developed area restoration, long term monitoring of the recovery and response of the resource to various restoration strategies should be continued to assess the achievement of restoration objectives.

- Monitor general health of the sequoia resource.
- Develop and implement a parkwide monitoring program that would monitor stressors to and impacts on the giant sequoia resource in the larger ecological context.
- Conduct research to increase understanding of giant sequoia ecology and physiology.
- Support the Giant Sequoia Research Cooperative. While much is know about giant sequoias, their relative rarity and significance warrant continued study. Efforts and priorities established through the Interagency Giant Sequoia Research Cooperative should be supported.
- Investigate the hydrologic linkages between water developments and affected sequoia groves.
- Determine ground and surface water extraction impacts on the giant sequoias. Ground and surface water conditions are significant to the reproduction and maintenance of the sequoia resource. Park developments and inholdings at Grant Grove and park developments at Atwell Mill extract water from the grove hydrologic systems with unknown effects. Peak water demand for developments tends to coincide with peak moisture stress on vegetation.

Protect Resource and Mitigate Stressors

- For trees with high social importance, strict protection from damage will occur.
- Protect specimen trees and their settings from damage from all sources to the extent possible. These limited areas will be manipulated and managed to preserve a relatively static scenic and resource condition with the objective of maintaining specimen tree health and scenic qualities. A variety of tools will be used including selective thinning of competing vegetation, and low intensity prescribed fire.
- Enforce park regulations.
- Enforce existing regulations that prohibit the collecting of cones and cutting or otherwise damaging park trees.
- Plan and manage park developments and visitor use to protect the sequoia resource.
- Plans for all developments within the giant sequoia grove influence zone will be assessed and implemented to prevent direct and indirect damage to sequoia grove systems. Visitor use will be managed in high use zones to minimize impacts to sequoias.

Maintain the Pieces

- Maintain and manage natural process including fire and native forest insect outbreaks within grove systems to the extent possible and considering the constraints above.
- Conduct ongoing monitoring of management actions and effects on giant sequoia health, reproduction, and mortality.

Restore the Impaired Parts

- Continue the direct restoration of grove areas impacted by past park development at Giant Forest.
- Inventory the nineteenth and twentieth century human disturbances to other grove areas (i.e., Atwell, Big Stump, Giant Forest, and Dillonwood). An assessment of such impacts should include an evaluation of the practicality of implementing total or partial restoration in those areas. Restoration in non-wilderness groves may include recontouring of altered landforms, removal of exotic or overstocked native species, and active planting and irrigation as appropriate.

- Restore fire as a restoration tool and as a natural process in all sequoia groves. Where fire has been absent for numerous cycles, prescribed fire will be the primary tool used to reduce unnatural fuel loads and restore reference conditions.

Inform and Educate the Public and Others about the Resource

- Provide accurate information on giant sequoia ecology to other park divisions and the public through publications, public and internal presentations, and through field trips.
- Publish significant research and monitoring results in appropriate literature.

Exotic Plants

Summary:

Exotic plants have the potential to displace native plants and alter the structure and processes of native plant communities. Research biologists at Sequoia and Kings Canyon National Parks have recently completed baseline surveys identifying 154 exotic, naturalized species within its boundaries. No funded exotic plant management program yet exists. With several highly invasive species currently forming discrete populations within the parks and several poised along the parks' boundaries, a comprehensive management program focused on early detection and eradication will prevent many species from becoming widespread, ecologically damaging, and expensive problems.

Sequoia and Kings Canyon National Parks have recently obtained detailed information about the distribution, abundance, and potential risks of exotic plants within its boundaries. Prior to 1996, surveys of exotic plants were limited to data collected from systematically located inventory plots, which tend to undersample linear landscape features such as stream and road corridors, common avenues for introduction of exotic plants. To supplement the inventory plots, in 1996 the Western Ecological Research Center of the Biological Resources Division (BRD) of the USGS initiated directed surveys in habitats likely to harbor exotic species, such as riparian corridors, developed areas, roads and trails, pack stations, campgrounds, abandoned settlements, sewer spray fields, and other disturbed areas. Field surveys were completed in 1998; these 50 directed surveys resulted in the addition of 34 exotic naturalized plant species to the park flora since 1996.

Field surveys are being followed by the creation of a comprehensive database consisting of ecological information for each species (summarized from available literature) and themes within a geographical information system (GIS) showing documented occurrences. This database will be used to rank the management and control priority of each species using the system developed by Hiebert and Stubbendieck (1993). This system ranks species according to their innate ability to become pests (based on such factors as reproductive potential, germination requirements, dispersal ability, mode of reproduction, and competitive ability) and the current level of impact (current distribution and abundance of plants and propagules within and adjacent to park boundaries). This ranking is then weighed against the feasibility or ease of control. The result gives managers an objective set of decision-making criteria for where to focus their management and control efforts: on those species most likely to infest natural habitats and displace native plants, that can also be effectively controlled. This ranking will be completed by June 2000.

Stressors and Issues to Resource Preservation:

Priority exotic species for which monitoring or control is desirable include:

Arundo donax (giant reed): This species is listed as a "Most invasive and damaging wildland pest plant" in California (California Exotic Pest Plant Council 1999). Giant reed inhabits moist places and riparian areas, and has been documented in several very small, discrete populations in the Ash Mountain maintenance yard and Sycamore Creek. The plant is a large perennial grass with fleshy, creeping rootstocks that must be completely removed, most successfully by a combination of mechanical and chemical treatments (Benton et al. 1999). Eradication would currently constitute a small project.

Bromus tectorum (cheatgrass brome): This annual grass is listed as a "Most invasive and damaging wildland pest plant" in California (California Exotic Pest Plant Council 1999). Cheatgrass has become widespread in scattered locations throughout the parks, and recently has expanded dramatically in Cedar Grove as a result of late season, high intensity fires. Direct, mechanical control is not feasible. Annual spring burning, followed by seeding of competitive native plants, is a promising strategy. Management of this species in Cedar Grove would constitute a large project.

Centaurea solstitialis (yellow-star thistle): This highly invasive and damaging thistle is listed as a "Most invasive and damaging wildland pest plant" in California (California Exotic Pest Plant Council 1999). The first known introductions, consisting of a few plants along a recently reconstructed segment of the Generals Highway, were detected in 1998. In 1999, a few plants were again found on the Generals Highway and one plant in Wuksachi Village. Annual, early detection patrols and eradication to keep this plant from establishing populations within the parks are the best strategy.

Cirsium vulgare (bull thistle): This noxious thistle has been the focus of intense control efforts in Yosemite Valley. Although it is not yet widespread in these parks, it has been identified in a number of montane meadows within the Giant Forest, Dorst, and Roaring River areas. Early control efforts focused primarily on hand-pulling and digging have been shown to be effective at limiting the spread of this plant. Addressing all of the known populations would constitute a medium project.

Genista monspessulana (Scotch broom): This species is widespread throughout the Ash Mountain headquarters area. It is easily hand-pulled, and would constitute a medium project.

Lathyrus latifolius (perennial sweet pea): This ornamental species has escaped from cultivation in the Middle and East Forks of the Kaweah, and has spread through several low elevation stream corridors. Showy blossoms make this plant easily detected, and it can be hand-pulled without difficulty. Early control would constitute a medium project.

Marrubium vulgare (horehound): Common in lowland disturbed areas, horehound has become well established in Potwisha campground. As this plant is a prolific seeder, control efforts will need to be maintained over successive years and would constitute a small to medium project.

Rubus discolor (Himalayan blackberry): This species is listed as a "Most invasive and damaging wildland pest plant" in California (California Exotic Pest Plant Council 1999). Himalayan blackberry has been observed in 7 discrete patches along riparian corridors in Sequoia and Kings Canyon National Parks, including a 1-mile stretch of Yucca Creek. Plants currently coexist amongst dense native vegetation and would probably require a combination of mechanical and chemical treatment to successfully destroy root suckers. Eradication of all or select populations would constitute a large project.

Spartium junceum (Spanish broom): This species has been observed in the Middle Fork of the Kaweah River just outside the park boundary and in one location near Ash Mountain. As the plant sprouts readily from the base if cut or if the rootstock is not removed, large broom-pulling wrenches or chemical treatment may be required. Eradication of the population outside the park boundary would require permission from landowners, and would constitute a medium project.

Vinca major (periwinkle): This ornamental ground cover is common in housing and administrative areas around Ash Mountain, and has been observed in riparian areas in Cricket Hollow, Alder Creek, and Potwisha. Eradication would constitute a medium project.

Desired Future Conditions:

Condition	Source
Management of populations of exotic plant and animal species, up to and including eradication, will be undertaken whenever such species threaten park resources or public health and wherever control is prudent and feasible.	NPS Management Policies – 2000; Chapter 4 (Draft)
Exotic species will not be introduced into the parks (except under special circumstances).	NPS Management Policies – 2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan
At least 25% of all new potentially invasive alien species, as of 1997, are controlled.	Long-Term Goal Ia2 from Strategic Plan
Exotic plant species and exotic plant diseases are controlled/contained, where feasible	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

Many exotic plants are so successful because they have weedy, invasive strategies that also limit control or eradication efforts. Many exotic species have prolific soil seed banks that can maintain viability for several years after mature plants are removed, maintaining their potential for reinvasion. In addition, standard, effective control methodologies have not been established for all exotic species, so experimental control within an adaptive management process may be necessary.

Vectors for new and continued introduction of exotic propagules to the parks are numerous. The parks are undergoing an intense period of construction, with Federal Highways road reconstruction in the foothills steadily moving up toward the conifer forest, demolition of visitor facilities and forest restoration in Giant Forest, and construction of a major lodging complex in Wuksachi, new lodging facilities in Grant Grove, and a sewage treatment plant in Cedar Grove. There is high potential for new introductions of exotic species from construction equipment and materials, and the spread of currently contained populations onto newly disturbed sites.

Although not all exotic plants are invasive or pose a threat to natural ecosystems, many appear to undergo a lengthy period of establishment, remaining restricted to roadsides and disturbed areas for many years before beginning to invade adjacent native vegetation. Populations may then grow exponentially, and a species initially thought to pose little or no threat as a roadside weed can rapidly become a serious pest. The priority ranking system will begin to identify those species that pose a threat but have not yet entered an exponential growth phase. By focusing immediate direct control efforts on these most threatening but still controllable species, the parks are most likely to achieve successful, long-term control or eradication with limited funds. By delaying action, managers may miss the window during which direct control efforts will be ecologically meaningful.

Conversely, the parks must also recognize those species that have entered an exponential growth phase or have become so widespread that direct control efforts will have little long-term, ecologically meaningful effect. These species, which may include such annuals as *Bromus tectorum* (cheatgrass) and *Carduus pycnocephalus* (Italian thistle), need to be distinguished and alternative cultural, biological, or other passive treatments formulated. In order to make these distinctions, more complete population locations and sizes need to be known. While the directed-survey research greatly increased our knowledge of the exotic species present in the parks and their general distribution and abundance, the surveys could not cover all areas likely to harbor exotics. That is, the surveys should be regarded as a sample of susceptible habitats rather than a mapping of each species' distribution.

Strategies for Achieving Desired Future Conditions:

Know and Understand the Resource

- Inventory roadsides, disturbed, and Development Zones regularly and wilderness areas periodically to detect new introductions early and prevent them from becoming problems.
- Monitor the known distribution and abundance of the most threatening exotic species throughout the parks
- Analyze the database created by the directed survey research to indicate which areas or habitat types within the parks are most at risk for invasion.
- Develop an atlas of exotic plant species descriptions, documented occurrences, and priority ranking for use as a reference by field surveyors
- Develop and distribute exotic plant observation cards tied to an exotic plant observation database

Protect the Resource and Mitigate Stressors

- Prioritize the highest risk areas (likely to be recently constructed road segments, construction sites, pack stations, low-elevation riparian areas, and park boundaries adjacent to areas used for cattle grazing) and visit on an annual basis to survey for exotic plants.
- Establish a priority ranking for control of known exotic plants
- Review contract specifications to ensure that construction projects do not introduce exotic pest plants, for example by not using straw products or non-sterile, imported soils, and by requiring use of certified seed.

Maintain the Pieces

- Patrol each area controlled for re-introduction of exotic plants

Restore Impaired Parts

- Accomplish ecologically meaningful direct control of high priority species.
- Use strategies of native plant revegetation when necessary to establish a native plant community in the area disturbed by exotic plants.

Inform and Educate the Public and Others about the Resource

- Post a "most wanted" list of exotic species targeted at individual campgrounds and trailheads
- Develop a handbook of the more common and/or threatening exotics to be distributed to park staff.
- Develop and distribute exotic plant observation cards, to be distributed to informed park visitors and park employees, tied to an exotic plant observation database
- Form partnerships with volunteer groups, the visiting public, and park staff to provide on-going surveillance and eradication efforts

Disturbed Lands

Summary

Terrestrial ecosystem structure and function in Sequoia and Kings Canyon National Parks becomes disturbed by human use in several ways. Long-term, intensive use of campgrounds, lodging facilities, and primary attractions results in soil degradation, soil erosion, trampling of understory, loss of overstory reproduction, and the inability to perpetuate natural processes such as fire. Lands cleared for new development frequently have a remaining overstory that is thinner, may have been mechanically damaged, or possesses an unnatural vegetation structure and composition, altered soil characteristics, higher risk of topsoil erosion, and altered hydrology. Outside of the parks' Development Zone, backcountry areas also experience soil degradation and loss of vegetation in high-use areas and as a result of stock use. These three types of disturbed lands – abandoned developed sites, actively managed developed sites, and backcountry /natural sites – each have a need for human intervention to perpetuate natural soil and vegetation structure and function. The type and extent of revegetation or restoration varies for each category. All of the restoration projects summarized below are funded through project funding, with ONPS base funding being restricted to administrative and technical support.

Abandoned developed sites.

The primary site where visitor facilities have been abandoned, removed, and the site restored is Giant Forest Village in the Giant Forest grove of giant sequoia-mixed conifer forest. In Giant Forest, the removal of visitor facilities and the restoration of landforms, soils, and vegetation began in 1997. From 1997 to 1999, about 300 buildings and associated infrastructure have been removed and 28 acres have become available for restoration; a total of about 60 acres will be restored by project's end. A century of human impact had produced a forest structure where canopy openings, or gaps, were present where groups of trees had been removed to make way for buildings or parking lots, and little to no natural

regeneration had occurred. Compared to soils in surrounding areas of Giant Forest, soils in the Village were two to five times more compact, were depleted in organic matter, and in some cases had a thinner layer of topsoil. Restoration included restoring natural landforms, mitigating soils impacts, and revegetating to mimic natural regeneration following fire in surrounding areas of Giant Forest. This is a pulsed type of restoration, where once soils are stabilized and restored, plantings are established, and irrigation is removed, the site will be managed similarly to surrounding areas of Giant Forest. Other developed sites that have been abandoned include Wolverton ski area and Lodgepole spray field.

List of abandoned sites for restoration

- Yucca Creek/North Fork of the Kaweah
- Wilsonia: abandoned cabin sites
- Hospital Rock Picnic area—old roadbed
- Camp Conifer
- Grant Grove North Loop Area
- Oriole Lake Airstrip
- Wolverton Ski Area/roadway

Note: the above list is not intended to be comprehensive—one of the needs for this program is an inventory of disturbed sites, particularly in the natural zone.

Actively managed developed sites.

Restoration and revegetation in active developed sites is necessary during three conditions: (1) construction of roads and buildings, (2) mitigation of impacts resulting from altered hydrology and/or concentrated drainage from established roads and buildings, and (3) continuous impacts by visitors in campgrounds and other high visitation areas.

Revegetation following construction of roads and buildings is necessary to stabilize soils, facilitate establishment of a native vegetative cover, prevent invasion by exotic species, and provide screening and landscaping. Recent revegetation projects of this type have been conducted at Lodgepole Market, Red Fir maintenance facility, Wuksachi, and in the Generals Highway reconstruction.

Mitigation of erosion and meadow restoration due to altered hydrology is necessary in Halstead Meadow and in scattered locations throughout the park's developed areas. In these cases, the hydrological cause of the erosion must be addressed before restoration of vegetation is attempted. These sites have recently been mapped and inventoried, but no funding exists for further hydrological investigation or restoration.

In campgrounds and other high-use developed areas, heavy human use erodes soil away from existing vegetation; degrades and compacts soils; tramples the grass, forb and shrub understory; and prevents reproduction. As existing trees fail, or are removed as safety hazards, they have not been adequately replaced. The result is a thinning forest with inadequate reproduction to perpetuate the forest type. A park nursery has been established during the past decade to address the problem of revegetation; but it has, as yet, been able to affect only small areas of these parks. In heavily used portions of the Sequoia groves, human-caused erosion has necessitated the installation of fencing to keep visitors away from the trees; but many areas are still suffering both vegetation and soil loss. Restoration of vegetation structure and function in these types of disturbed areas requires an on-going revegetation program, which does not yet exist in these parks.

List of actively managed sites needing restoration

- Potwisha Campground
- Dorst Creek Campground
- Lodgepole Campground
- Crescent Meadow Picnic Area
- Halstead Meadow Picnic Area

Note: the above list is not intended to be comprehensive—one of the needs for this program is an inventory of disturbed sites, particularly in the natural zone.

Backcountry/Natural Sites.

Restoration and revegetation of backcountry sites is necessary where trails have been rerouted away from meadows, where camp sites have been closed or abandoned, and where altered hydrology and extreme weather events have caused erosion problems (Cahoon Meadow). Inventories of these types of disturbed sites are kept by backcountry rangers and by others on an ad-hoc basis. Restoration has been limited to direct transplant of borrowed meadow plugs into abandoned trail treads (conducted by trails crews), and to closing and signing of camp sites that are too close to water (conducted by backcountry rangers). No funding exists for restoring sites where the hydrology has been disturbed (Cahoon Meadow) or for more extensive backcountry restoration.

List of natural zone sites needing restoration

- Dusy Basin
- Pinchot Pass
- Woods Lake Basin
- Center Basin
- Sixty Lakes Basin
- Kennedy Canyon
- Cahoon Meadow
- Summit Meadow
- Dollar Lake
- Taboose Pass Meadow
- Halstead Meadow

Note: the above list is not intended to be comprehensive—one of the needs for this program is an inventory of disturbed sites, particularly in the natural zone.

Stressors and Issues to Resource Preservation:

Visitor use.

Visitors directly impact soils and vegetation as a result of trampling and cone collection. Trampling can kill or reduce the vigor of understory vegetation, including grasses, forbs, shrubs, and tree

seedlings. Trampling often causes accelerated physical breakdown of organic litter and duff, leading to faster decomposition and overall loss of soil organic matter. Soil compaction is produced directly through trampling and vehicular use, and indirectly through loss of soil organic matter, which promotes soil aeration. Visitors in campgrounds often collect conifer cones to use as campfire fuel, reducing the number of propagules available for natural reproduction.

Altered hydrology.

Altered hydrology causes the most severe soil erosion problems in these parks. Improper placement of road culverts in meadow sites can result in accelerated runoff, erosion, and channel incision. Incomplete knowledge of site hydrology prior to construction can lead to inappropriate or insufficient design of drainage structures, or to poor siting of facilities. Roads, roofs, and compacted soils concentrate and accelerate runoff, often resulting in erosion gullies. Soil and vegetation restoration of eroded gullies can be difficult and costly.

Soil degradation resulting from construction.

Despite best efforts to salvage, store, and replace topsoils during construction, post-construction topsoils may be thinner and more compact than undisturbed soils. If topsoils were incorrectly stored or replaced onto a construction site, the native soil seed bank may be depleted or absent, leading to lower potential for natural plant recolonization.

Removal of vegetation during construction.

Overstory and understory vegetation within the work limits of a construction project must be removed for road or building construction or grading. The vigor of mature trees targeted for saving may be impacted by construction activities, directly through root damage by soil trenching or grading, or indirectly through soil compaction or increased exposure to wind due to loss of surrounding trees. Severely impacted trees may die soon after completion of construction.

Tree removal as safety hazards.

Park crews may remove overstory trees when trees with defects such as rot, scars, or pathogens threaten human safety.

Soil erosion during and post-construction.

Bare soils present during and immediately after construction are susceptible to erosion during heavy precipitation. Rill and gully erosion may occur, causing downstream sedimentation and reducing the potential for natural plant recolonization.

Loss of natural fire regime.

Fire suppression and the difficulty of staging management-ignited prescribed fires within developed zones has lead to the loss of natural fire regimes in developed areas of many fire-adapted ecosystems.

Fires provide pulsed regeneration for fire-adapted species, such as giant sequoia and some Ceanothus species, and can produce a pulse of plant-available, mineralized nitrogen in soils.

Introduction of exotic plants

[This may be added in a future revision]

Desired Future Conditions:

Condition	Source
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan
The Service will re-establish natural functions and processes in human-disturbed natural systems in parks unless otherwise directed by Congress . . .The Service will restore the biological and physical components of these systems as necessary, accelerating both their recovery and the recovery of landscape and community structure and function ... The Service will seek to return (human-disturbed) areas to conditions and processes representing the ecological zone in which the damaged resources are situated.	NPS Management Policies – 2000; Chapter 4 (Draft)
Terrain and plants may be manipulated where necessary to restore natural conditions on lands altered by human activity. Management activities may include . . . rehabilitating areas disturbed by visitor use or by the removal of hazard trees.	NPS Management Policies – 2000; Chapter 4 (Draft)
Revegetation efforts will use seeds, cuttings, or transplants representing species and gene pools native to the ecological portion of the park in which the restoration project is occurring.	NPS Management Policies – 2000; Chapter 4 (Draft)
The Service will actively seek to understand and preserve the soil resources of parks, and to prevent, to the extent possible, the unnatural erosion, physical removal, or contamination of the soil, or its contamination of other resources.	NPS Management Policies – 2000; Chapter 4 (Draft)
At least 5% of known non-significant disturbed or abandoned sites; including abandoned roads, trails, campgrounds and picnic areas, and disturbed backcountry meadow sites etc.; as of 1997, are restored	Long-Term Goal Ia3 from Strategic Plan

Condition	Source
Areas disturbed by administrative/visitor use, past developments and construction, were feasible, are restored to natural conditions	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions:

Restoring eroded soils is often limited by the availability of a local topsoil source. In the absence of a local borrow site for topsoil, manufactured topsoils may be used but may not be perfectly matched to surrounding topsoil characteristics. Compacted soils can be mitigated by decompaction strategies, but since scarification or cultivation must not severely impact roots of existing vegetation, mitigation is often only partial.

Active sites—ongoing use

Restoring components of plant communities is often constrained by the difficulty of propagating native species. Some species have complex dormancy requirements and are difficult to propagate by seed. Propagation by cuttings also presents problems for many species. The expense both of collecting within appropriate genetic pools for each restoration project and of propagating plants makes small, poorly funded or unfunded projects difficult to achieve.

Restoring severe erosion gullies where hydrological patterns have been altered is constrained by the lack of in-park hydrological expertise, the necessity for major earth-moving work, and the cost of such projects.

Restoration of backcountry sites is constrained by remoteness of sites.

Strategies for Achieving Desired Future Conditions:

Know and Understand the Resource

- Inventory the condition and extent of the disturbed project area, including soil characteristics and vegetation composition and cover.
- Research the pre-disturbance condition of the sites or an appropriate reference condition for the site.
- Model the restoration project on an appropriate predisturbance condition or reference site, creating soil and vegetation prescriptions.
- Monitor the results of restoration projects so that results can be compared with the reference site, and further action can be taken if necessary
- Monitor the results of experimental restoration strategies within a project so that the iterative process of adaptive management can proceed

Protect the Resource and Mitigate Stressors

- Protect existing vegetation during construction by requiring contractor to install protective fencing, maintain constrained travel routes, and using contract language that assesses monetary damages for causing certain types of injury to trees, roots, and soils.
- Avoid soil compaction during construction by limiting the size of equipment, by designating appropriate work limits, and by designating travel routes.
- Review construction drawings and specifications to ensure appropriate siting of buildings away from thickets of young trees and vigorous overstory trees.
- Decompact soils prior to revegetation
- Apply soil protection measures, such as wood chip mulch or soil retention blanket, to prevent soil erosion.

Maintain the Pieces

- Fence areas to prevent human trampling and maintain processes and components of natural reproduction.
- Use temporary irrigation and weeding as necessary to establish new plantings

Restore Impaired Parts

- Restore natural topography from altered landforms resulting from road cuts, parking lots, building pads, and walkways
- Apply layer of local topsoil to severely eroded sites when borrow site within limits of genetic integrity are available.
- Decompact soils when significant compaction is present
- Add organic amendment to soils that have been highly depleted in organic matter
- Seed or plant with transplants propagated from locally collected plant material if natural reproduction is insufficient to revegetate site
- Restore vegetation using species from the plant community components: grasses, forbs, shrubs and trees

Inform and Educate the Public and Others about the Resource

- Inform and educate the public and park employees of the need for revegetation in sites where natural reproduction has been impaired by heavy visitor use.
- - Educate visitors as to consequences of heavy trampling

Meadows and Grazing

Summary

Meadows and other forage areas, including woodland meadows, forest grasslands, and alpine vegetation, are among the most attractive and important natural resources within Sequoia and Kings Canyon National Parks. They are also relatively scarce: within the two parks, less than 2% of the land area supports meadow vegetation. Meadows and their surrounding camp areas frequently serve as the

principal destinations of backcountry travelers. They are especially important to those visitors who ride and/or pack into the backcountry, both for camping nearby and as places to graze stock. Recreational pack and saddle stock use of the backcountry of these parks is recognized as a long established historically and culturally significant traditional use; it is authorized at the discretion of the Superintendent as long as the effects of such use are kept within acceptable limits.

Meadows are complex ecosystems, varying widely in character and composition (Benedict and Major 1982; Ratliff 1982). Although meadow vegetation in general is highly productive and relatively resilient, meadow systems vary in their sensitivity to impact and in their ability to recover. In some cases, human and stock impacts on meadow ecology are quite obvious; in many cases, however, these impacts are more subtle. Even when grazed meadows are healthy and productive, removal of forage by stock diverts nutrients and energy from the natural system, depriving native herbivores and decomposers, and the predators that feed on these herbivores, of essential resources.

Although meadows in general are considered as a component of the broader native vegetation resource, they also form a special case due to the consumptive use imposed by pack and saddle stock. The current meadow management program evolved in response to issues surrounding the impacts of pack stock on ecosystem structure and function as well as on the experience of other visitors. Personnel in the resources management, research and ranger divisions carried out initial assessments and planning efforts that culminated in the development of the 1986 Stock Use and Meadow Management Plan. Expanding monitoring needs were initially addressed by a temporary position housed within the ranger division, which was later transferred to the division of Science and Natural Resources Management. In 1994, a permanent plant ecologist was recruited to take on responsibility for the program.

The current stock use and meadow management program is focused on the design and implementation of monitoring protocols to evaluate impacts and detect changes due to stock use, the dissemination of information to stock users and park managers, and the development of standards for acceptable impacts that can then be translated into effective management. The program is implemented by the permanent plant ecologist; a few pay periods of seasonal assistance are provided through incidental business permit fees levied on commercial pack stations. Backcountry rangers carry out a significant portion of the field monitoring, and all enforcement of regulations.

As park regulations prohibit camping in meadows, no monitoring of the impacts of other backcountry users on meadows are undertaken. Since the 1980s, the trail program has been working to relocate trails out of sensitive meadows, further reducing direct hiker impacts on meadow vegetation.

Baseline

Within the two parks, 1,082 acres (2705 hectares), or 71% of the 1,528 acres (3,820 hectares) of known meadow vegetation, are open to grazing. In the five years between 1994 and 1998 (inclusive), an average of 112 of 230 named forage areas within the two parks had use reported in them each year. In 1998, a wet year with decreased grazing, use reported for 88 individual forage areas ranged from a low of only two nights to a high of over 400 nights. Thirty-two meadows had at least fifty nights reported, with sixteen having over 100 nights of stock use reported. In general, reported pack and saddle stock use has declined from a high of nearly 45,000 stock use nights in 1955 to only 4,976 nights in 1998. In 1997, a ‘normal’ precipitation year, there were 9,101 nights reported. Stock use is concentrated along well-traveled corridors, such as the John Muir Trail, and in areas traditionally popular with stock users, including the Hockett Plateau, the floor of the Kern Canyon, Rock Creek, Crabtree Meadows, Roaring River, Bubbs Creek, Monarch Divide, Evolution Basin, and LeConte Canyon.

In a majority of park meadows, declining use and increased awareness among stock users of minimum impact guidelines has led to a general improvement in site conditions since the 1970s and 1980s. For those meadows that continue to receive heavy use, persistent hoof prints, stream bank shearing, soil pedestals and other soil impacts can be seen. Although formal standards for residual biomass have yet to be established for Sierran meadows, some heavily used meadows consistently have less residual biomass at the end of the growing season than preliminary guidelines for conservative use recommend (Ratliff 1987). For example, of 27 meadows monitored in 1998, nine had reported use in excess of their preliminary estimated capacity (Haultain 1999).

Stressors and Resource Preservation Issues

Pack and saddle stock can affect the structure and functioning of ecosystems through both direct and indirect impacts. These include impacts to:

Vegetation

Pack and saddle stock can affect vegetation directly through defoliation, trampling and root shearing, and rolling. Vegetation can be affected indirectly through changes in soil structure or nutrient status, shifts in species composition due to differential tolerance to defoliation or trampling, introduction of exotic species and changes in hydrologic regime.

Soils

Soils are directly affected by trampling, including pawing and rolling. Impacts to soils include compaction, shearing, and loosening of soil particles. This can result in decreased water infiltration and oxygen diffusion (Thurow 1991), which in turn may influence plant growth. Decreased water infiltration due to compaction can lead to increased overland water flow and accelerated erosion. Loss of vegetative and litter cover also leads to increased erosion, and under extreme conditions to stream incision, streambank shearing, and lowering of the water table.

Water quality

Although a low percentage of feces are deposited directly in lakes or streams, pack and saddle stock wastes can be carried into watercourses through runoff, which can result in bacterial contamination. Trampling and subsequent soil erosion adjacent to riparian areas can also lead to increased sedimentation and turbidity. Alteration of riparian vegetation and streambank morphology can result in changes in water temperature, which are significant for aquatic biota.

Wildlife

Wildlife can be affected directly through interference with movement or breeding patterns (displacement), or through direct competition for forage. Indirect effects result from changes in habitat resulting from trampling or grazing. These can include reducing the amount of available forage, loss of safe sites or breeding sites, and changes in temperature or humidity associated with changes in vegetation.

Ecosystem processes

Impacts of pack and saddle stock on ecosystem processes include those that affect microclimate, hydrology, energy flow, nutrient cycling, and soil processes. Changes in these processes result from impacts to both biotic and abiotic components of ecosystems, and can occur at different scales and organizational levels. Key influences on ecosystem processes are those that directly effect soils and vegetation, including erosion and defoliation (grazing).

Visitor experience

Some visitors find the presence of pack and saddle stock enhances a wilderness or park visit, affording contact with a traditional use in a park setting. Negative encounters are most likely to result from the presence of manure, insects, and dust in along trails and in areas of concentrated use, such as around hitchrails and in preferred forage areas.

Desired Future Condition

Condition	Source
NPS-managed natural systems, and the human influences upon them, will be monitored to detect any significant changes. Action will be taken in the case of such changes, based on the type and extent of change.	NPS Management Policies – 2000; Chapter 4 (Draft)
Maintain all the components and processes of naturally evolving park ecosystems	NPS Management Policies – 2000; Chapter 4 (Draft)
All approved livestock use must ensure the preservation of wilderness resources and character. Superintendents will be responsible for monitoring livestock use in wilderness to the same degree as human use, and may use the same management tools and techniques, including the application of the minimum requirement concept, to manage livestock use that are available for managing other wilderness uses.	NPS Management Policies – 2000; Chapter 6 (Draft)
Grazing will be managed and conducted in accordance with management objectives and procedures designed to ensure that grazing does not result in the degradation of park resources…Grazing will be restricted whenever necessary to protect natural and cultural resources and values, or whenever there are conflicts with other recreational users.	NPS Management Policies – 2000; Chapter 8 (Draft)
Forage and other habitat requirements of native wildlife populations will be given first priority when determining livestock management priorities.	NPS Management Policies – 2000; Chapter 8 (Draft)
Exotic species will not be introduced into parks.	NPS Management Policies – 2000; Chapter 4 (Draft)

Condition	Source
Management of (existing) populations of exotic plant and animal species, up to and including eradication, will be undertaken whenever such species threaten park resources or public health and whenever control is prudent and feasible.	NPS Management Policies – 2000; Chapter 4 (Draft)
The Service will…avoid, whenever possible, the pollution of park waters by human activities occurring within and outside of parks.	NPS Management Policies – 2000; Chapter 4 (Draft)
NPS and NPS-permitted programs and facilities are maintained and operated to avoid pollution of surface and ground waters; natural and beneficial values of wetlands are preserved and enhanced.	Executive Order 11990, "Protection of Wetlands" (42 USC 4321) and Director's Order #77-1: Wetland Protection. Clean Water Act (33 USC 1344)
Protection of stream features will primarily be accomplished by avoiding impacts to watershed and riparian vegetation, and by allowing natural fluvial processes to proceed unimpeded.	NPS Management Policies – 2000; Chapter 4 (Draft)
Harvesting may be allowed only when it is determined that such harvesting will not jeopardize: Rare, threatened, or endangered plant or animal species	NPS Management Policies – 2000; Chapter 4 (Draft)
Recreational pack and saddle stock will be allowed within guidelines that protects the parks' natural resources and values, the processes that shape, and the quality of experience distinctive to them	Resource Goal from Resource Management Plan (1999)

For those meadows in which stock use and/or grazing is allowed, the desired future conditions include the following:

- Residual biomass at the end of the growing season meets standards established to maintain naturally functioning ecosystems
- Vegetation and wildlife species composition and diversity is maintained within the natural range of variation
- Soil and fluvial processes are maintained such that unnatural losses are prevented

Constraints on Desired Future Conditions

Given that it is not possible to allow grazing in wilderness meadows without sustaining some level of environmental impacts (Archer and Smeins 1991), we must determine in which meadows grazing should be allowed to occur, and under what conditions. Managers are thus faced with the challenge of setting standards for acceptable impacts that will allow for continued pack stock use while maintaining naturally functioning meadow ecosystems.

The current management system has a number of inherent weaknesses that prevent managers from realizing the ideal conditions described above. The lack of a real-time, site-specific tracking system for pack stock use limits the ability of managers to keep use within prescribed capacities. This is compounded by the lack of a system for closing meadows that have reached their capacity during the grazing season. Although party size and length of stay limits are in place for some meadows, the lack of a limit on the number of parties allowed to graze at any given time often leads to intense use of popular areas. Without limits on the number of animals or parties grazing at any given time, use can become concentrated and thus result in greater impacts. In addition, the default party size of 20 head

and unlimited length of stay is inappropriate for many small meadows that do not have specific regulations in place; these broad limits can be misleading to stock users by creating false expectations of the capacity of a given site.

From the outset the meadow management program has attempted to apply traditional range management tools and techniques to reach resource condition goals that are quite different from those used in traditional grazing systems. The essential difference is a focus on the maintenance of natural ecosystem processes as opposed to maximizing production for exotic herbivores. Standards in place for production-oriented operations may not be conservative enough to attain park service goals and objectives.

Although much attention has been focused on Sierran meadow systems, a number of critical information gaps exist that limit our ability to assess and manage impacts effectively. Most work to date has focused on the floristic or vegetation component of meadows. Inadequate information is available on the role of meadows as habitat for native wildlife, and how grazing impacts those species (both vertebrate and invertebrate, aquatic and terrestrial) which utilize meadows for all or part of their life cycle. Without a better understanding of how meadow ecosystems function (e.g., in terms of nutrient cycling, soil processes and hydrologic/fluvial processes) it is difficult to determine what impacts are ecologically significant over the long term. Historical grazing by sheep and cattle during pre-park and early park periods (1860s through 1940s, depending on area) no doubt influenced the systems we manage today, and these historical impacts also complicate our attempts to define natural or baseline conditions.

Current Management Actions To Meet Desired Future Conditions

Monitoring

The current monitoring program is designed to detect long and short-term changes in meadow systems resulting from packstock use.

- Residual biomass monitoring is a central component of wilderness meadow management at Sequoia and Kings Canyon National Parks. Residual biomass refers to the amount of above ground plant material present in a meadow after grazing. In systems dominated by herbaceous plants, adequate residue must be present to protect soil surfaces and plants, to replenish the soil mulch and organic layers, and to trap and hold moisture (Neuman 1991). We presume that retaining adequate residual biomass also provides both shelter and forage for the many animals that depend on meadows for all or part of their life cycles. As such, residual biomass is an important indicator of meadow function and can provide a quantifiable and repeatable measure to guide management. Residual biomass (production) and groundcover data are collected at the end of the growing season from approximately two dozen wilderness meadows that consistently receive moderate to heavy use. These data provide managers with short-term information on site conditions, and in the long term will allow for the development of minimum residual biomass standards for grazed meadows. These standards will then be used to establish appropriate use levels that are directly tied to site conditions.
- Development of residual biomass standards. Seven years of preliminary residual biomass data are currently being analyzed under contract towards the development of minimum standards and appropriate use levels for individual meadows.
- Species composition is monitored on a five-year cycle in five meadow pairs (grazed and ungrazed) selected to represent a range of meadow types.

- Gross changes in meadow vegetation and structure are captured through an extensive collection of repeat photographs.
- Pack stock use levels and patterns are tracked through a system of ranger observations, wilderness permits, and self-reporting forms submitted by private, commercial and administrative users of site specific grazing within the parks.

Use Restrictions and Regulatory Actions

- Opening dates. Opening dates for wilderness meadows are based on soil moisture and vascular plant phenology, which in Sierran systems are closely correlated with late-spring snow pack conditions. Preliminary opening dates are established according to the May 1 snow pack, with adjustments made by rangers in the field as dictated by local conditions. By regulating early season use, meadow soils are protected while they are most vulnerable to trampling effects and plants are allowed to develop during the critical period of early growth.
- Use levels. Traditional methods of adjusting use levels and patterns are employed when appropriate to achieve desired conditions. These include party size and length of stay limits, adjustment of opening dates, and temporary closures of individual meadows or areas.
- A network of meadows that are either too small to sustain grazing, are located in areas receiving disproportional high use, or are otherwise sensitive to pack stock impacts were identified and permanently closed to grazing under the 1986 Stock Use and Meadow Management Plan. A number of these meadows also serve as ungrazed references for establishing baseline conditions.

Strategies for Achieving Desired Future Conditions

Know and Understand the Resource

- Develop more information to fully understand the long-term impacts of repeated herbivory above naturally occurring levels in order for park managers to refine standards for site conditions and appropriate levels of use to meet those standards.
- Regularly monitor both grazed and ungrazed meadows to detect changes in production, species composition and bare ground
- Pursue research that will increase understanding of meadow ecosystem function
- Improve the existing inventory of meadow vegetation

Restore the Impaired Parts

- Actively restore meadows known to have departed significantly from natural conditions due to human influences, and that would not return to those conditions without intervention, to a naturally functioning state to the greatest extent possible. One extreme example is Cahoon Meadow, which continues to show active head cutting and accelerated erosion as a result of a discontinued cattle-grazing allotment. Another example, unrelated to grazing, is Halstead Meadow. Construction of the Generals Highway through this meadow led to significant changes in stream morphology with an attendant drop in the water table in the portion of the meadow downstream from the roadbed. Both of these meadows are targeted for restoration as funding becomes available.

Maintain the Pieces

- Maintain all meadows in a naturally functioning state. Where stock use is allowed the park will maintain the desired future conditions by controlling the timing, intensity, and duration of use and setting area-specific opening dates based on soil moisture and plant phenology.
- Update party size and length of stay limits influence intensity and duration of grazing for individual meadows as new information becomes available.
- Develop the proposed system of residual biomass standards that allows managers to set limits on the amount of use allowed during a given season to assure that adequate residual matter remains on a site each year.

Protect Resource and Mitigate Stressors

- Communicate and enforce stock use regulations to protect meadows and surrounding camp areas from inappropriate use.
- Monitor results used to detect changes in resource condition to inform managers of site conditions so that actions can be taken before degradation occurs.
- Implement temporary use restrictions such as meadow closures, reduced party sizes, or use ceilings to allow meadows a recovery period in order to meet desired future conditions.
- Use drift fences are used when necessary to protect sensitive resources.
- Park staff lead by example through use of best practices by administrative stock users.
- Regulate stock use in order to minimize opportunities for invasion by exotic species.

Inform and Educate the Public and Others about the Resource

- Provide information to managers both during the season and on an annual basis so that appropriate actions can be taken to protect meadow systems from unacceptable impacts.
- Summarize stock use statistics and interim monitoring results each year and distributed internally and to interested members of the public.
- Discuss meadow and grazing related issues, along with action alternatives, by an interdisciplinary park team during a mid-winter meadow management committee meeting.
- Ensure that field rangers receive training in meadow monitoring techniques on an annual basis, and site visits at least every other year.
- Provide information to stock users in the form of the annually updated forage area guide; early spring opening date bulletins, stock use regulation handouts, and minimum impact guidelines.
- Ensure that park staff members participate in meetings of private and commercial stock users at least once each year, to discuss conditions and any upcoming changes in regulations.
- Develop a GIS database that will provide area specific maps of campsites, forage areas, and length of stay and party size regulations for use by visitors and park staff alike.

Vegetation in Developed Areas

Summary:

These parks are classified into four zones (Sequoia and Kings Canyon National Parks Statement for Management, 1976): Natural, Historic, Development, and Special Use. The Development Zone comprises 3,883 - acres, including high density visitor use areas, and administrative, maintenance, and

concessionaire facilities at Giant Forest, Ash Mountain, Lodgepole, Clover Creek (being developed), Grant Grove, Cedar Grove, Mineral King, all frontcountry campgrounds, and along all major park roads. These areas are managed to provide recreational opportunities for visitors and an operation base for park management in as natural a setting as possible. The overall goal of managing vegetation in these areas is to: Restore and/or maintain a healthy, vigorous vegetative community that approximates the "natural" state, given the constraints of past and present human intervention, while providing a safe environment for human use and enjoyment. (Sequoia and Kings Canyon Vegetation Management Plan for the Development Zone, 1987)

The "natural" state of vegetation in the Development Zone differs from the "natural" state in the Natural Zone where natural reproduction and causes of mortality such as insects, disease, and fire freely influence species composition and vegetation structure. In the Development Zone, human impact associated with trampling, development of roads and buildings, and management actions, such as insect and disease control, fire suppression, hazard tree removal, and planting of favored and sometimes exotic species, have significantly altered the "natural" aspect of the vegetation.

The Development Zone is divided into five vegetation management units. Each unit is an area of relatively homogeneous vegetation that contains developed areas and the attendant roadsides where specified management strategies are observed. These units are: 1) Chaparral/oak woodland, 2) Ponderosa pine, 3) White fir mixed-conifer, 4) Sequoia mixed-conifer, and 5) Red fir/white fir.

Management objectives for the Development Zone are to: 1) restore and/or maintain appropriate native vegetation for recreational use and enjoyment; 2) maintain an all-sized vegetation structure; 3) retain old-growth trees as long as the hazard remains at acceptable level; 4) control stocking levels based on "natural" site quality, stand age, and species composition; 5) maintain healthy, vigorous vegetation; 6) maintain as "natural" a stand of age structure and species composition as the above objectives will allow. These objectives are accomplished by the following activities: 1) removing hazard trees and limbs that threaten public safety and property; 2) managing insects and diseases in accordance with National Park Service policy; 3) regulating stand density by revegetating disturbed sites in developed areas with native vegetation and by reducing overstocked stands; 4) removing exotic plants; 5) prescribed burning to achieve approved natural resources management objectives; 6) clearing dense vegetation from roadsides and vistas; and 7) removing selected vegetation in Special Management Areas.

Stressors and Resource Preservation Issues

- Human visitors and residents in developed and high-use recreation areas. This includes the physical alterations to vegetation and the environment brought about by human presence in recreational and administrative sites. Examples include mechanical damage to plants, soil compaction and erosion, and altered hydrology or sunlight availability.
- Native/exotic insects and diseases, including bark beetles and defoliators such as Douglas-fir tussock moth, root rot and dwarf mistletoe. Outbreaks of these may present challenges to maintaining tree cover or a desirable mix of native vegetation species.
- Construction of new facilities and modifications to existing facilities as they interface with the native vegetation.
- Exotic plants that are invasive may present a challenge to maintaining the desired species composition and vegetation structure.
- Hazardous vegetation. Old-growth trees often contain physical or biological structural defects that contribute to their failure and constitute a hazard to continuous human presence nearby. The

preservation of these old trees must be sensitively balanced with the need to provide for visitor safety.

Desired Future Conditions:

Condition	Source
The preservation from injury of all timber… in their natural condition	Act of September 25, 1890 – Establishing Sequoia National Park
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan
NPS-managed natural systems, and the human influences upon them, will be monitored to detect any significant changes. Action will be taken in the case of such changes, based on the type and extent of change.	NPS Management Policies – 2000; Chapter 4 (Draft)
When practicable and not detrimental to Service mandates to preserve park resources, known hazards will be reduced or removed. When providing for persons' safety and health is inconsistent with congressionally designated purposes and mandates, or impracticable, efforts will be made to provide for such safety and health through other controls, including closures, guarding, signing, or other forms of education.	NPS Management Policies – 2000; Chapter 8 (Draft)
The Service will strive to protect the full range of genetic types (genotypes) of native plant and animal populations in the parks by perpetuating natural evolutionary processes and minimizing human interference with evolving genetic diversity.	NPS Management Policies – 2000; Chapter 4 (Draft)
The Service will control pests…under special circumstances (including) … to conserve and protect plants and animals needed and appropriate for developed areas	NPS Management Policies – 2000; Chapter 4 (Draft)
Maintain all the components and processes of naturally evolving park ecosystems	NPS Management Policies – 2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
Vegetation in the parks' Development Zone is restored and/or maintained as a healthy, vigorous vegetative community that approximates the "natural" state, given the constraints of past and present human intervention, while providing a safe environment for human use and enjoyment	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

- Planned developments and human occupation within the park will continue to constrain the range of vegetation and processes that may be allowed within the Development Zone.
- Smoke management may constrain use of prescribed fire.
- Continued introduction of exotic pathogens and exotic plants will require ongoing control and eradication.

Strategies for Achieving Desired Future Conditions:

Know and Understand the Resource

- Complete a vegetation inventory of each developed size including soils and topographic themes should be completed. The condition of the vegetation, including a survey for vegetation hazards, should be monitored at regular intervals to update this information.
- Predict the future vegetation structure and composition of each developed site based upon accepted models of vegetation growth and development to ensure that present vegetation conditions will produce future conditions that meet management objectives.
- Develop vegetation prescriptions based upon research of adjacent natural areas.

Protect the Resource and Mitigate Stressors

- Control and/or eradicate exotic pathogens and exotic plants.
- Control native pathogens where they will result in vegetation structure and/or species composition that is not congruent with management objectives.
- Develop vegetation management plans for each development or recreation site.
- Control the ongoing impacts of human occupation through education and traffic control.

Maintain the Pieces

- Control human impacts through fencing, vegetative structure that is harmonious with human occupation, and erosion control measures.
- Provide care for new plantings through irrigation, weeding, and fertilization where necessary to assist in their establishment.
- Mitigate or remove vegetation that is hazardous to humans in development sites based upon a priority rating system

Restore Impaired Parts

- Restore natural environmental conditions where they have been altered by human occupation to a point where native plant communities have been displaced or severely impacted as a result.
- Revegetate areas denuded by construction or continued human occupation.
- Restore species or whole communities, where human disturbance or deliberate manipulation has resulted in their displacement.

Inform and Educate the Public and Others about the Resource

- Develop publications
- Conduct interpretation
- Prepare signs

Water Resources

Water Quality and Quantity.

Summary

In its natural condition, most of the surface water in these parks is rather pure. The concentrations of major cations, anions, and other dissolved constituents are so dilute that the electrical conductivities are very low. Alpine lakes and streams are generally below 20 µs/cm, and sometimes approach 2 µs/cm, the conductivity of distilled water. One consequence of such pure water is that it is poorly buffered (high lakes generally less than 50 µeq/l). Ionic potential does increase as one goes down in elevation. Conductivities may exceed 100 µs/cm by the time the rivers reach the park boundary. This is partially because marble, schist, and other metamorphic rocks that add significant dissolved constituents form a band along much of the western portion of these parks and at several other scattered locations. The water is very clear with turbidities generally well under 0.5 NTU, though meadow water may exceed 1.0 NTU. The waters are oligotrophic. Nutrients like phosphate or nitrate are generally less than 40 µg/l and ammonia is generally undetectable. Except for mineral springs, thermal springs, and some meadows, the water is normally saturated with oxygen (6.8-8.8 mg/l) and generally quite cold (8-16^{o}C). The pH is normally slightly acidic, but varies from about 5.5 to 8.5, and some sites will exceed those extremes.

Park surface waters contain some biota that can be harmful if consumed. The best known is a protozoan, *Giardia lamblia*. People are cautioned not to drink the water without filtering or boiling the water. Another pathogen is *Campylobacter*, a bacteria. Both are intestinal parasites that cause severe diarrhea. Levels of fecal coliform and fecal streptococcal bacteria are generally very low (0-5 colonies/100 ml), but can become too numerous to count following rain or snowmelt, especially when downstream of meadows. Most of the fecal bacteria appears to come from natural sources.

Not much is known about ground water in these parks. Most of the water consumed comes from surface sources. There are a few shallow wells with good water, but one of the deeper foothill wells contains sulfur and arsenic and is not potable. In general, the ground water has higher ionic potential than corresponding surface water. The water in some wells has conductivity around 400 µs/cm.

The quantity of surface flow follows an annual cycle with the lowest flows typically occurring in August and the highest flows occurring in May or June. Spring flows are primarily snowmelt; and by late August, the source is primarily groundwater. There is considerable annual variation in flows. The largest streams produce peak flows about 82,000 l/sec. These drop to about 1,500 to 2,500 l/sec during August.

The primary stressors are air pollution, loss of natural fire, runoff from park facilities, and runoff from heavy visitor use areas in the backcountry.

Stressors and Resource Preservation Issues

By far, the single biggest threat to the parks' water is air pollution. Air pollution adds acidic deposition, nutrients, and other contaminants to the parks' waters (Cory *et al*. 1970; Melack *et al*. 1985, 1995; Sickman and Melack 1989; Williams and Melack 1991; Zabik and Seiber 1993). Acidic deposition is most acute as episodic events during early snowmelt and during late-summer and fall thunderstorms. Fortunately, at current levels, we are not seeing chronic acidification, but this could change because the waters are poorly buffered. Because the parks' waters are naturally low in nutrients, the addition of airborne nitrates and ammonia is likely to be causing some level of change to the natural system.

The drift of pesticides and other contaminants from upwind agricultural areas is one of our most serious concerns. We know that measurable amounts of pesticides fall on the park (Zabik and Seiber 1993), and that pesticides have been found in the tissues of aquatic fauna (Cory *et al*.1970; Fellers, pers. comm.; Datta *et al*. In press). We suspect that the extirpation of two species may be linked to this phenomena.

The alteration of the natural fire regime by over a century of anthropogenic intervention is another stressor to the parks' waters. Fire affects the quantity of water in streams and its water chemistry. Sediment transport rates are different in burned and unburned watersheds. Fire effects nutrients, buffering capacity, water temperature, and other water characteristics.

Park facilities generate sewage effluent. This water contains high concentrations of nutrients. The only spray fields that have been monitored are the relatively new Red Fir site and the former facility at Giant Forest. At both sites, the treated effluent would leach through the shallow soil and emerge in adjacent streams. Both of these facilities generated nutrient plumes in adjacent streams that extended over three kilometers downstream of the facilities during low flow conditions. Other park sewage facilities have not been investigated for nutrient plumes, but they too could be adding nutrients to the adjacent natural system. Previous work concentrated on nutrients, but sewage effluent could contain other unwanted chemicals such as pharmaceuticals. In addition to sewage effluent, there are probably other unwanted chemicals entering the parks waters from roads and parking lots. These have not been investigated within the parks, but they are known to be serious problems in urban areas (Novotny and Chester 1981).

Backcountry use is another source of anthropogenic chemicals in our natural waters. In areas that routinely see large concentrations of backcountry users, human feces can be a problem. While feces is normally buried, the density around popular campsites can get quite high. Water percolating through the feces-contaminated soil eventually enters the streams and lakes. Monitoring to date has shown no to minimal evidence of human nutrient enrichment, even in heavily used areas (Werner 1984). Those results could be due to rapid assimilation by the flora. One study did find an increase in benthic flora in relation to increased visitation (Taylor and Erman 1979). Perhaps there is not a problem, but with about 77,000 visitor days in the backcountry annually, there is a steady load of human waste being added to this otherwise low-nutrient system. The issue needs to be assessed by a through research effort.

Other ways that backcountry visitors may be adding unwanted chemicals to water include misuse of soap or by swimming in lakes and streams when their bodies are covered in sunblock and insect repellent. Because the water contains so few natural dissolved constituents, the contribution of exotic chemicals on human bodies may be significant.

Desired Future Condition:

Condition	Source
Surface and ground waters are restored or enhanced; water quality meets as a minimum the standard for contact recreation.	Clean Water Act; Executive order 11514; NPS Management Policies
NPS and NPS-permitted programs and facilities are maintained and operated to avoid pollution of surface and ground waters	Clean Water Act; Executive Order 12088; NPS Management Policies
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan
Changes within the aquatic environments that are caused by facilities, management activities or visitor use patterns are located and documented and unnatural changes are mitigated	Resource Goal from Resource Management Plan (1999)
The giant sequoia groves – particularly Giant Forest – and the ecosystems they occupy are restored, maintained, and protected	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions:

To stop episodic acidification or aerial nutrient deposition is to reduce/eliminate air pollution from the Central Valley. We are in one of the dirtiest airsheds in the country. Many people are working to attain improved air, but it is an ominous task. Likewise, to reduce pesticide drift is to reduce or radically alter agriculture in the San Joaquin Valley, one of the largest agricultural areas in the world. There are moves to reduce pesticide drift with new types of equipment the reduce drift and some farmers use organic techniques, but it is unlikely that there will be any radical changes. The one tool we can use to help bring change is to collect high-quality, statistically sturdy data.

Restoring fire is challenged by political and social sensitivity to fire. Many people have traditional beliefs that fire is harmful, and many do not appreciate smelling smoke. Often fire management objectives conflict with air quality objectives.

To eliminate nutrients and other chemicals from park sewage facilities would probably require hauling the waste from the park for processing elsewhere. Economically, this is not likely to happen; though a precedent for this exists in the Lake Tahoe area. We do not know if our roads and parking lots are contributing to stream degradation, but if the park were to eventually go to a mandatory shuttle system, traffic pollutants could be reduced.

To reduce human feces in the backcountry would require people to pack it out with their garbage or accumulate feces in privies designed to be flown out of the backcountry. Currently we do not know that the existing fecal load is a significant resource problem, nor do we know that allowing swimming in backcountry lakes is a problem.

Strategies for Achieving Desired Future Condition:

Know and Understand the Resource

- Design and implement vital signs monitoring of water quality and quantity.
- Implement research on the extent and biological consequences of anthropogenic chemicals that enter the parks' natural waters from sewage treatment facilities.
- Implement research to identify aquatic contaminants generated from roads and parking lots.
- Implement research to evaluate the fate of human feces in the backcountry. Attempt to determine the human biotic carrying capacity of various backcountry habitats.
- Implement research to evaluate whether sunblock or insect repellents on swimmers bodies should be a serious management concern.
- Learn more about the location, concentrations, source, and species of pesticides (and other air pollutants) entering park waters and their biological effects.

Restore the Impaired Parts

- Restore fire as a natural process.
- Prevent sewage effluent from entering natural areas.

Maintain the Pieces

- Identify and implement management actions that are consequences of vital signs monitoring.

Protect Resource and Mitigate Stressors

- Enforce regulations.
- Implement management actions that are consequences of vital signs monitoring.
- Work with the California Air Resources Board to help improve air quality.

Inform and Educate the Public and Others about the Resource

- Publish research.
- Provide public access to the data through the Internet
- Provide data in format suitable for use on GIS.
- Provide information about the condition and threats to water on the parks' Web site.
- Provide press releases and utilize other media to Inform and Educate the Public about threats to the parks' water resources.

Relationship to Other Desired Future Conditions

This section is intricately related to the desired future condition of wetlands and native aquatic wildlife.

Wetlands and Deep-Water Habitats:

Summary

These parks contain a rich array of diverse wetlands and deepwater habitats. The entire area has been surveyed by the Fish and Wildlife Service as part of the National Wetlands Inventory, but only portions of those maps have been digitized. Therefore, summaries describing the surface area covered by the various wetland taxa are not yet available, but we will describe the taxa in general empirical terms. The primary types of wetlands and deep-water habitats are persistent palustrine emergent (wet meadows), deciduous broad-leaved palustrine scrub-shrub (primarily willow thickets), upper perennial riverine (permanent rivers and streams), lacustrine (lakes), and open-water palustrine (ponds), and intermittent riverine (ephemeral streams). Many of the rivers and streams have riparian areas that are either forested palustrine (e.g., alder) or deciduous broad-leaved palustrine scrub-shrub (e.g., spice bush) along their banks.

Wetlands are some of our most important areas ecologically and also among our most fragile areas. In the Sierra Nevada Ecosystem Project, aquatic resources were identified as among the most impacted in the Sierra Nevada (Sierra Nevada Ecosystem Project 1996). On the other hand, wetlands are one of the great cleansers of human nutrients. As such, they help mitigate some of the nutrient impacts discussed above, and it is probably because of the responsiveness of wetlands to absorb nutrients that human nutrient enrichment was not found conclusively at high-use backcountry sites.

Water is a powerful attractant for people, and the interface between water and the terrestrial world is often a wetland. Wetlands and deep-water habitats are the stage for many of our park resource issues, most of which are discussed under the sections on water and native aquatic wildlife. Additional issues not discussed there relate to degradation of biological communities and structural landscapes in wetlands and deep-water habitats. Specific wetland issues include: 1) impacts to wetland flora and fauna as a consequence of grazing recreational pack stock, 2) impacts to riparian areas due to illegal trespass grazing, 3) destruction of wetland flora due to social trails forming around lakes, 4) exotic wetland flora, 5) degradation of stream banks in high-use areas, 6) disturbance of lake and stream bottoms by swimmers, waders, and anglers, 7) floodplain studies need to be completed for all developed areas of these parks, and 8) loss of natural fire as a force that influences the composition and structure of some wetlands.

Stressors and Resource Preservation Issues

Many, if not most, of the grazed meadows contain wetland flora, wetland soil, and wetland hydrology, making those sites jurisdictional wetlands in addition to being pastures for recreational pack stock. While grazing impacts are being monitored and managed with regard to meadow floras, it is likely that the trampling of soil, removal of vegetative biomass (wildlife cover), crushed rodent burrows, and disturbance from the grazing stock are all likely to be having some significant influence on the meadow wetland fauna. Another aspect of grazing wetlands is effects of stock nutrients on the wetland community. These concerns need to be investigated.

Wetlands are impacted by trespass cattle. Cattle not only trample and defecate in the edges of riparian wetlands; they heavily graze riparian sedges and other vegetation. Trespass cattle have been seen grazing in the middle of the North Fork Kaweah.

Visitors also impact wetlands. Even lakes with only moderate visitation usually have social trails around their edges. Often these trails cut through the wetland meadows that grow adjacent to many of

the parks lakes and ponds. In Cedar Grove, there are social trails that cut through wetlands adjacent to the Kings River.

In heavy use locations, upland areas adjacent to rivers are also impacted. Trampled stream banks are often associated with swimming areas. How swimming and wading effects benthic communities is unknown. Because streams are natural disturbance environments, they are unlikely to be damaged. However, waders sometimes leave conspicuous scars on lake bottoms. Whether these effects are biological or just aesthetic is not known. Fortunately, such scars are not commonly observed.

In a few areas, exotic wetland flora (*Elodea* sp.) have virtually completely displaced the native benthic flora (*Isotes* sp.) that normally dominate our lake bottoms. Today, these sites are structural and floristically very different from what a visitor should see when they visit these sites (e.g., Rae Lakes).

Five hundred and 100-year flood plains need to be identified for all areas of these parks and used to help guide management of developed areas and development of future areas.

Fire is not a process that one would normally think of as significant and importance influence to wetlands, but it is. During severe fire conditions, fires will push through riparian areas completing altering the structure and functioning of the vegetation and temporarily influencing the future species composition. During drought conditions, fires sometimes burn the organic soils causing long term changes to the wetland community structure and species composition. In moist conditions, wetlands serve as barriers to fires' spread, but even then fire influences the wetlands by liberating nutrients, altering sediment loads, and changing hydrologic yield.

Desired Future Condition

Condition	Source
Natural floodplain values are preserved or restored.	Executive order 11988; Rivers and Harbors Act; Clean Water Act; NPS Management Policies
The natural and beneficial values of wetlands are preserved and enhanced.	Executive order 11990; Rivers and Harbors Act; Clean Water Act; NPS Management Policies
Management of populations of exotic plant and animal species, up to and including eradication, will be undertaken whenever such species threaten park resources or public health and when control is prudent and feasible.	NPS Management Policies
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia. from Strategic Plan
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan
Aquatic Ecosystems - At least 5% of lakes, as of 1997, are restored.	Long-Term Goal Ia4 from Strategic Plan
Native plant species and threatened/endangered and sensitive plant species are inventoried, monitored, protected, and restored/maintained over time	Resource Goal from Resource Management Plan (1999)

Condition	Source
Plant communities that have been altered by fire suppression are restored/maintained through restoration of the natural fire regime to the maximum extent possible	Resource Goal from Resource Management Plan (1999)
Plant communities that have been altered by domestic grazing are restored to natural conditions	Resource Goal from Resource Management Plan (1999)
Areas disturbed by administrative/visitor use, past developments and construction, were feasible, are restored to natural conditions	Resource Goal from Resource Management Plan (1999)
Vegetation in the parks' Development Zone is restored and/or maintained as a healthy, vigorous vegetative community that approximates the "natural" state, given the constraints of past and present human intervention, while providing a safe environment for human use and enjoyment	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

As far as grazing impacts on wetland fauna go, the most significant challenge is the lack of information. That information needs to be acquired and eventually built into a more comprehensive palette of considerations when managing grazing. Grazing is a traditional use of park meadows. Proposed changes in their management are often received poorly by the users. This work will need to proceed cautiously due to political and social sensitivities.

Removing trespass cattle from riparian areas has been very challenging, and it has not been helped by part of the park boundary being on the west bank of a river. The high cost of fence construction, the difficulty of removing cattle from extremely rugged terrain, and a determination for the park to maintain good relations with its neighbors all contribute to the problem continuing.

Protecting wetlands, stream banks, and stream bottoms from trampling require improved public education and willful compliance. It is an ominous task.

Removing *Elodea* from lake bottoms is another daunting task that needs some feasibility research.

Floodplain studies are expensive, but need to be done.

Restoring natural fire, especially under the full range of natural conditions, is a socially and politically sensitive issue. Efforts to restore fire are hampered further by occasional conflicts between fire management and air quality objectives.

Strategies for Achieving Desired Future Condition

Know and Understand the Resource

- Develop and implement vital signs monitoring for wetlands
- Perform research on grazing effects on wetland fauna

- Perform research to evaluate control strategies for removing exotic benthic flora, specifically *Elodea*.
- Perform research to evaluate the ecological significance of wetlands lost to social trails.

Restore the Impaired Parts

- Restore fire as a natural process.
- Eliminate/control exotic benthic flora like *Elodea*.
- Implement restoration of social trails that pass through wetlands.

Maintain the Pieces

- Identify and implement management actions that are consequences of vital sign monitoring.

Protect Resource and Mitigate Stressors

- Enforce regulations.
- Implement management actions that are consequences of vital signs monitoring.
- Manage stock grazing in wetlands to provide for the natural functioning of the faunal components as well as the flora components of the meadow.
- Provide solid public information to facilitate compliance in protecting sensitive wetlands from the proliferation and perpetuation of social trails through wetlands.

Inform and Educate the Public and Others about the Resource

- Publish research.
- Provide public access to the data through the Internet.
- Provide data in a format that is suitable for use on GIS
- Provide information on the condition and threats to wetlands on the parks' Web site.
- Provide press releases and utilize other media to Inform and Educate the Public about threats to wetlands.

Relationship to Other Desired Future Conditions

This section is intricately related to the desired future conditions for water, native aquatic wildlife, and meadow management.

Wildlife Resources

Terrestrial Animals

Summary

Of the vertebrates, Sequoia and Kings Canyon National Parks are known to have 262 native terrestrial species, and an additional nine species may be present. Of the native vertebrates, four species are extirpated, and 145 are rare or uncommon. The 262 terrestrial vertebrates include four species of amphibians, 21 species of reptiles, 168 species of birds, and 69 species of mammals. Two species are federally listed as "Threatened," and two more are federally listed as "Endangered." Four species are California listed as "Threatened," and six species are California listed as "Endangered." Forty-six species are "Sensitive" species. "Sensitive" species include "Federal Sensitive," "California Sensitive," "California Protected," and "Forest Service Sensitive."

There have been few studies of terrestrial invertebrates in these parks. The most extensive work is the on-going collections made at the end of the flume on the Middle Fork Kaweah River. A Tulare County Entomologist compiled a list of insects from this area. There are no known "Listed" terrestrial invertebrates in these parks though the Fish and Wildlife Service claims that the "Threatened" valley elderberry beetle is present. Specimens that have been collected in the Kaweah drainage match the unlisted subspecies, and it is unlikely that both subspecies would be sympatric in the same habitat.

Many of the parks caves are known to contain invertebrates. While the taxonomic work on cave fauna is far from complete, the available information shows high levels of endemism with some species being restricted to a single cave.

Management challenges involving terrestrial wildlife include: 1) conflicts between wildlife and people, 2) declining populations of some species, 3) ecological impacts from exotic species, 4) changes in the species composition and abundance due to the altered fire regime, 5) bioaccumulation of contaminants, 6) changes to the natural distribution and abundance of native species due to park developments, 7) anthropogenic mortality (both accidental and by poaching), 8) isolation and fragmentation of some species due to differences in land-use practices on adjacent lands, 9) consequences of natural migrations between park and adjacent lands, and 10) insufficient species information.

Stressors and Resource Preservation Issues

Conflicts between terrestrial wildlife and people fall into several categories: 1) Conflicts generated by deliberate or careless human actions; 2) conflicts generated by human planning failing to consider the natural habits and behavior of local wildlife; 3) transmission of hazardous diseases between wildlife and people; and 4) natural risks to public safety. The first category is best characterized by the bear problem. When people either feed bears or carelessly permit bears to get their food or garbage, bears become destructive and potentially dangerous. The outcome is a loss for both people and bears as people lose property and sometimes are injured, and the fed bears usually become dead bears to protect public safety. Bears are discussed in more detail in a separate section below.

The second type of conflict is characterized by the marmot problem at Mineral King. Parking lots and cabins were built in an area occupied by marmots, creating attractants for their desire for cover and new opportunities for their chewing habits and quest for minerals. Their discovery of antifreeze in

automobile engines added to the problem by seeming to cause an addiction to its consumption. The result is disabled vehicles, cabins with holes chewed through them, marmots consuming potentially harmful chemicals (though seemingly successfully), and marmots being transported out of the park within visitors' cars. Moving facilities out of marmot habitat would resolve the problem.

Another example would be the outbreak of the tussock moth in the vicinity of Grant Grove and Dorst Campground in 1998. Those developments were constructed in the habitat in which these outbreaks may occur. Though the outbreak was natural, there was discomfort (due to many people being sensitive to the hairs shed by the larvae) and controversy when the outbreak occurred.

The conflicts between California ground squirrels and people are really a combination of both of these categories. The campground facilities and visitor travel patters appear to improve the structural quality of their habitat and food obtained from campers appears to increase the carrying capacity for ground squirrels. The consequence is denser populations of California ground squirrels in foothill campgrounds than observed in any similar natural areas adjacent to the campgrounds. This results in limited damage to campground facilities from squirrel burrowing (mostly to roads), some risk of visitors tripping on squirrel burrows, occasional damage or loss of visitor property (especially food), and squirrel behavior (stealing food) that some visitors find annoying.

The third area of conflict exists when there is a risk of people becoming infected with diseases transmitted by terrestrial wildlife. The diseases are a mix of naturally occurring and exotic. The primary exotic disease of concern is plague. Naturally occurring diseases include rabies, Lyme disease, and infection by Hantavirus. This is managed primarily through public education and surveillance of dead rodents in developed areas.

Mountain lion issues characterize the fourth area of conflict. Occasionally people have active encounters with mountain lions. These may include mountain lions following people for extended distances, mountain lions entering developed areas, or mountain lions snarling at people on a trail. In a one case, an employee had to throw rocks at a lion to keep it from getting real close to him. One visitor had a mountain lion make bodily contact. There was no injury to the visitor, but the lion was struck by an ice axe. The frequency of these encounters varies from several encounters a year to several years without any encounters. Threats like mountain lion attack can cause both human and agency paranoia even though the actual risk is extremely low compared to other safety risks (e.g., being struck by a car or killed by bees) people face daily. Other examples of naturally hazardous wildlife include rattlesnakes and deer during the rut. Perceptions (either positive or negative) can affect the way naturally hazardous resources are viewed and managed.

Some conflicts between wildlife and people do not resemble any of these categories. Sometimes conflicts just happen for no apparent reason. There was one year that a pair of ravens acquired a habit of removing windshield wiper blades from cars and occasionally breaking car windows.

Declining wildlife populations are a significant concern. For some of our large animals like bighorn sheep, the combination of public and scientific interest resulted in cognizance that there was a problem and sufficient data to facilitate an emergency listing as "Endangered." While we suspect the loss of other groups, there is little to no organized population monitoring for most species within these parks. For most species, we lack inventory and baseline population data. Some of our concerns are based on the apparent rarity of species that are usually commonly seen where they occur (e.g., *Coluber constrictor, Taxidea taxus, and Erethizon dorsatum*). While we have ideas based on listed and sensitive species designations and continental concerns (e.g., neotropical migrants), we lack population trend data for most species. Furthermore (and perhaps more importantly), we lack data on relationships between management practices and fauna populations for most terrestrial wildlife species

and for most management activities. For most species, we do not know which may be declining or the extent and causes that might be attributable to park practices or the management of adjacent lands.

At least eleven exotic terrestrial animals occur in the park and a twelfth species may be present. Two of the most damaging are trespass cattle and feral pigs. They disturb the soil structure, create trails, damage riparian areas, and consume large quantities of native plants. These and most of the other exotic species occur in the foothills, but some of the exotic species occur in alpine areas (e.g., white-tailed ptarmigan and chukar). Most of our exotic species occur around developed areas (e.g., feral cats, house sparrows, starling, rock dove), but others are believed to have penetrated well into natural areas (e.g., opossum) where we are concerned how they may be altering the natural ecology of the habitats they occupy. One species (brown-headed cowbird) is a nest parasite. Recent surveys suggest that they are not significantly impacting riparian birds (Halterman and Laymon, *In draft*), but their presence assures that some group is being impacted.

There is a constant threat of new species being introduced and becoming established at the risk of the native biota. While NPS Policy would prohibit new introductions, most of our existing exotics emigrated from lands adjacent to the park, and there is a constant threat of new species either being introduced or getting here as stowaways. For many years, there has been a small population of exotic Rio Grande turkey in the foothills. Their distribution has always been limited by the habitat requirements for that species. Recently the California Department of fish and Game has done some introductions with Miriam's turkeys, which are capable of living in the conifer belt. While they have been careful not to do any releases near the parks, it seems that it is only a matter of time before they immigrate to the parks and become established in the parks' abundant conifer forests.

Pesticides are impacting at least one species, the peregrine falcon. Three eggs collected in 1991 contained large quantities of DDE (averaged 13 ppm) and several PCBs (averaged 1.6 ppm), and eggshells were averaged 14.6 percent thin. Only once is this site believed to have produced any fledglings, and some years the eggs did not even look like Peregrine falcon eggs. Contaminants need to be surveyed in other predatory birds and mammals across the park.

Over a hundred years of an altered fire regime has resulted in altered wildlife habitats. Conifer forests have expanded and become choked with litter and understory vegetation. Some stands of chaparral have become old and decadent. Fire has a profound influence on the structure and composition of wildlife habitat. Anything that changes the natural fire frequency and intensity, changes the structure and composition of the habitat which in turn affects the species composition and abundance of fauna occupying the habitat. Natural wildlife communities require natural fire regimes driven by natural events and allowed to burn to boundaries controlled by nature.

Like loss of fire, park developments alter the natural habitat. While there is no hard data from park sites, empirical observations suggest that both the abundance and species composition of developed areas differs from adjacent undeveloped areas. Some native species like jays, titmice, and house finches seem to gravitate toward developed areas (especially campgrounds) and many of the exotic species like brown-headed cowbirds, house sparrows, and starlings show a preference for developed zones. The two most likely attractants are: 1) an abundance of structural features that facilitate nesting but which are more scarce in truly natural areas and 2) increased access to food and water. House finches and swallows probably attracted by structural features and titmice and feral cats are probably attracted by food. Because developed areas are inherently not natural, some of these changes are probably acceptable. However, we do not know that the effect does not spill over into adjacent natural areas.

Developments also result in increased losses. Every year, we lose numerous animals of all sizes along road corridors. Lizards are attracted to the roads to sun, and along some roads it is possible to see dozens of road kills during the late spring and early summer. Other common victims include squirrels, mice, and snakes. Commonly, several deer and bears are hit by cars annually. In addition, wildlife is lost through electrocution on high power lines, flying into windows, or when they become pests in someone's home. When hazard trees are removed to protect public safety, there is both direct loss of habitat and sometimes loss of wildlife.

Some park wildlife is lost to poaching. While we have always assumed the actual number of animals lost is minimal because of the amount of time rangers send patrolling. People are occasionally caught poaching.

Animals that routinely cross the park boundary (e.g., deer, bear, and band-tailed pigeons) become legal game species once outside the park boundary. As a consequence, management of those animals outside the park could affect the age structure and abundance of those species within these parks. It is also likely that the unhunted park populations are a reservoir of source material for hunted and less dense populations outside these parks. Meaningful partnerships the California Department of Fish and Game and adjacent land managers are important.

Land management practices outside these parks have caused some species to become essentially isolated from other portions of their gene pool. As an example, fisher once occurred throughout the Sierra Nevada and populations were continuous with those in the Pacific Northwest. Today, the fisher population in the southern Sierra Nevada is isolated from populations to the north.

Desired Future Condition

Condition	Source
Federal- and state-listed threatened and endangered species and their habitat are sustained.	Endangered Species Act; NPS Management Policies
Populations of native plant and animal species function in as natural condition as possible except where special management considerations are warranted	NPS Management Policies
Native species populations that have been severally reduced or extirpated from the park are restored where feasible and sustainable.	NPS Management Policies
Management of populations of exotic plant and animal species, up to and including eradication, will be undertaken whenever such species threaten park resources or public health and when control is prudent and feasible.	NPS Management Policies
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia. from Strategic Plan
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan

Condition	Source
Fishing to be permitted in accordance with regulations.	Act creating Sequoia National Park.
Native animal species and threatened/endangered and sensitive animal species are inventoried, monitored, protected, and restored/maintained over time	Resource Goal from Resource Management Plan (1999)
Native animal species extirpated from the parks are restored, where feasible	Resource Goal from Resource Management Plan (1999)
Exotic animal species are controlled/contained, where feasible	Resource Goal from Resource Management Plan (1999)
Interactions between wildlife and people are mitigated, where feasible	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

Challenges to resolving conflicts between wildlife and people center on education and change. People must understand that feeding wildlife or carelessly allowing them to get your food creates harm. It is equally imperative that the park management provides both the staff to do public education and facilities for storing food and garbage that are inaccessible to any wildlife. Change involves two aspects. First, park staff needs to get out of the mode of thinking that troublesome wildlife need to be eliminated. Instead, we need to be thinking about root causes and eliminate the sources. Second, we need to be prepared to rethink the design and management of some developed zones. We need to either move the development, significantly modify the structures, or in some cases, manage the landscape differently. These changes require getting away from traditional thinking, new attitudes (thinking win-win instead of win-lose) toward resolving conflicts, new planning, and funding to implement the changes.

Mitigation of declining wildlife populations has many challenges beginning with the lack of population data for most species. Second, where declines exist we need to know the cause. Some may be due to habitat loss in Central or South America; others may be because of management practices on or adjacent to the park. We can certainly do much more with issues that are within our span of control. We need to be able to distinguish true declines from population fluctuations. In the case of bighorn sheep, we know the causes of decline and what steps are needed to possibly restore their numbers. Some of the necessary steps are socially controversial and politically sensitive. Some of the recovery actions could cause economic impacts. The park should anticipate social, political, and economic obstacles on all future recovery actions, but first we need to get the raw data on where the problems are and what is needed to fix them.

Managing exotic species requires separate challenges for nearly every species. Getting rid of trespass cattle would seem simple, but the high cost of fence construction, the difficulty of removing cattle from extremely rugged terrain, and a determination for the park to maintain good relations with its neighbors all contribute to the problem perpetuating itself. Some people do not seem to take trespass grazing as a serious resource problem. There is far more enthusiasm for removing the recent invasions of feral pigs, but the best methodology still needs to be resolved. For most of the other exotic animals, we lack data that shows a clear unacceptable resource impact that justifies an expensive control program, or we lack the staff to do a meaningful sustained control program.

Restoration of fire as a natural process is one of our most important needs and it is not limited by funding. However, fire management is challenged by political and social sensitivity. Fire management

objectives are often confronted by air quality objectives that impede restoration of fire as a natural process.

Hard data is needed to quantify the actual impacts of developments. Once that is done, opportunities for mitigation need to be explored. This work needs to include not only developments within these parks, but also explore influences from adjacent land management practices including the implications of fragmentation of some wildlife populations. To accomplish effective regional management of wildlife populations will require effective interagency organizations.

Strategies for Achieving Desired Future Condition:

Know and Understand the Resource

- Work with the county and park records to compile a list of known terrestrial invertebrates. Sources of information include County records and professional expertise, published literature, unpublished reports, and databases of current and previous investigators. When available, additional attributes that need to be captured include habitat, microhabitat, geographic location, date, and abundance.
- Develop a directed inventory to fill in the gaps in the existing terrestrial wildlife inventory. Minimum taxa for which inventory data is required include terrestrial vertebrates (terrestrial amphibians, reptiles, birds, mammals), arachnids, insects, isopods, diplopods, chilopods, pauropods, symphylids, and earthworms. Special emphasis needs to be placed on inventories of bats, cave invertebrates, terrestrial insects and arachnids, and chipmunks (and other associated rodents) along the Sierra Crest and the northern portion of the park. Minimum attributes include habitat, microhabitat, geographic location, date, and abundance.
- Develop and implement vital signs monitoring of terrestrial fauna.
- Survey contaminants in a variety of upper trophic level fauna across the park landscape, evaluate consequences of findings, and evaluate alternatives for mitigation.
- Perform research on restoration strategies for extirpated and declining species. Include consideration of historic corridors and barriers to gene flow.

Restore the Impaired Parts

- Identify and mitigate impacts to declining species.
- Restore fire as a natural process.
- Restore bighorn sheep and any other species whose pristine range has been diminished due to anthropogenic causes as techniques become available.

Maintain the Pieces

- Identify and implement management actions that are consequences of vital signs monitoring.
- Play an active role in opposing any introductions of species that could immigrate into the parks and impact our resources.
- Perform Section 7 consultations on any management actions that could affect federally listed species.
- Evaluate proposed management actions on all sensitive species that may be affected.

Protect Resource and Mitigate Stressors

- Enforce regulations.
- Provide resource information relevant to proposed developments or changes in visitor use monitoring
- Implement management actions that are consequences of vital signs monitoring.
- Eliminate harmful contaminants.

Inform and Educate the Public and Others about the Resource

- Publish research.
- Develop lists of terrestrial species that include information on habitat, distribution, abundance, and status (declining, increasing, status quo, unknown).
- Provide public access to data through Internet.
- Provide data in format suitable for use on GIS.
- Provide information about the condition and threats to the terrestrial wildlife on the parks' Web site.
- Provide press releases and utilize other media to Inform and Educate the Public about threats to native aquatic wildlife.
- Provide public information on wildlife hazards and appropriate precautions to protect oneself.

Relationship to Other Desired Future Conditions

This section is intricately related to the desired future condition of aquatic wildlife, bear management, and air quality.

Aquatic Animals including Fisheries

Summary

For purposes of distinguishing aquatic fauna from terrestrial fauna, aquatic wildlife is defined as species that depend on occupying either lentic or lotic environments for all or portions of their life. These species may be either fully aquatic or amphibious. Aquatic wildlife does not include species that frequent wetlands or deep-water habitats but which are not obligate occupants of (or dependent on) those environments (e.g., *Microtus longicaudus*).

Of the vertebrates, Sequoia and Kings Canyon National Parks are known to have 46 native species that fit this definition, and an additional seven species may be present. Of the 46 native vertebrates, one species (*Rana boylii*) is extirpated, and 33 are rare or uncommon. The 46 vertebrates include five fish taxa, six species of amphibians, three species of reptiles, 30 species of birds, and two species of mammals. One species is federally listed as "Threatened." Twelve are "Sensitive" species. "Sensitive" species include "Federal Sensitive," "California Sensitive," "California Protected," and "Forest Service Sensitive."

While there have been some studies of aquatic invertebrates (Abel 1977, 1984; Kubly 1983; Bradford *et al*. 1998; Kratz *et al*. 1994; Stoddard 1987; Taylor and Erman 1980; and Knapp and Matthews pers. comm.), known invertebrates have not been compiled into a master list. The broad taxonomic groups

studied include both benthic invertebrates (primarily aquatic insects) and zooplankton. There are no known "Listed" or "Sensitive" aquatic invertebrates in these parks though some species merit special attention due to their scarcity.

The primary threats to native aquatic wildlife include competition and genetic introgression from exotic species. Thirteen vertebrate species have been introduced to the parks' aquatic environments and at least nine have become established. At least one aquatic invertebrate and several plants have been introduced into park waters. There is serious concern about the introduction of contaminants, especially biocides and pollutants from internal-combustion engines. Some native aquatic species are declining. There has been some anthropogenic alteration of aquatic habitats and there has been some harvest of select aquatic species.

Stressors and Resource Preservation Issues

Exotic fish are the most serious immediate resource concern. They are a known cause contributing to the decline on mountain yellow-legged frogs (*Rana muscosa*; Bradford 1989; Bradford *et al*. 1993; Knapp and Matthews In press; Vredenburg pers. comm.). Fish introduced into high lakes have altered zooplankton communities (Stoddard 1987), and caused the loss of large micro-crustaceans from high mountain lakes (Bradford *et al*. 1998). Through genetic introgression, planted rainbow trout nearly caused the extinction of Little Kern golden trout (*Oncorhynchus mykiss whitei*; Christensen 1977). Kern rainbow trout (*O. m. gilberti*) may be in jeopardy of future introgression with Volcano Creek golden trout (*O. m. aquabonita*) and rainbow trout planted upstream of them. Where rainbow trout are native to park waters, it is unlikely that pristine genotypes are present due to over a century of planting other genotypes within the range of native genotypes. There is recent evidence that viruses that are carried by fish can be transmitted to native frogs (Jinghe *et al*. 1999). In the foothill streams, there is concern that exotic brown trout may have contributed to the extirpation of foothill yellow-legged frogs (*Rana boylii*); and in some areas, brown trout have largely replaced the native rainbow trout. Either singly or in combination, the introduction of bullfrogs, green sunfish, and brown trout are likely to be complicit in low recruitment of western pond turtles where they are sympatric.

Atmospheric contaminants are a major concern. They are understood more poorly than exotic fish, but their ecological consequences may be more serious – at least in the Kaweah River drainage. Contaminant concerns include pesticide drift from the San Joaquin Valley, nutrient and acidic deposition from polluted air, nutrients and other anthropogenic chemicals from park facilities (especially effluent from sewage treatment plants), nutrient and pathogen contamination from concentrated use of areas without facilities. In 1997, Fresno and Tulare Counties alone used fifty-three million pounds of active pesticide ingredient in agricultural production (Department of Pesticide Regulation 1999). The park is downwind of that source and some pesticides have been measured in park waters and animal tissues (Cory *et al*.1970, Zabik and Seiber 1993, Datta *et al*. In press). Current and historic distribution maps, suggest that pesticide drift may be the primary cause contribution to the extirpation of foothill yellow-legged frogs from the parks in the 1970s. The polluted air contributes nutrients and causes episodic acidification of park waters.

Naturally, most park waters are super-oligotrophic and poorly buffered. While the aquatic systems appear to be handling current inputs, conditions could easily deteriorate if pollution increases. Some park sewage facilities are known to cause nutrient enrichment to nearby streams, but the ecological significance is unknown. Likewise, there is no knowledge of what other anthropogenic chemicals may be introduced to park waters through sewage treatment plants. Every year, human feces are added to the naturally low-nutrient backcountry soils. In some areas, human feces are sufficiently concentrated to be obnoxious. Long-term ecological consequences are unknown.

There is some alteration of habitat within park waters. Surface water is diverted from natural streams and springs in several areas of these parks. While it is assumed that there is no ecological significance to these withdrawals since only a portion of the water is removed, only the SCE diversion for hydroelectric generation has been evaluated and found acceptable. The extraction of drinking water does appear to have affected some wetlands. The vegetation in Wolverton Meadow became more xeric following use of shallow wells in the 1980s. Dams in the Mineral King area altered the shoreline of four lakes.

Some habitat changes are the result of exotic beaver. Beaver are not native to the Kern drainage, but their continued presence there has caused profound local changes in the aquatic habitat, primarily from the damming of streams, but also from consumption and girdling of riparian vegetation. Efforts to eradicate beaver in the 1960s were unsuccessful.

The harvest of select aquatic fauna has had a dramatic impact on native aquatic animals. Enhancing opportunities for angling was the cause of most introductions of exotic fish, the impacts of which are discussed above. If harvest were not an option, there would have been little to no incentive for introducing exotic fish.

The loss of all natural fires burning under the full range of natural conditions is another stressor. Fire affects both the quality and quantity of water in streams. Fire affects sediment transport and availability of woody debris. It affects water temperature and the availability of sunning spots. It affects the structure and composition of riparian vegetation. In short, fire affects the habitat of aquatic fauna, especially in the foothills and in the conifer belt.

There is speculation that aquatic fauna may be impacted by increases in ultraviolet radiation (especially UV-B) caused by the loss of protective ozone in the stratosphere. Other unsubstantiated concerns to some aquatic fauna (particularly declining amphibians) include effects of human disturbance and chytrid fungus.

Desired Future Condition:

Condition	Source
Federal- and state-listed threatened and endangered species and their habitat are sustained.	Endangered Species Act; NPS Management Policies
Populations of native plant and animal species function in as natural condition as possible except where special management considerations are warranted	NPS Management Policies
Native species populations that have been severally reduced or extirpated from the park are restored where feasible and sustainable.	NPS Management Policies
Management of populations of exotic plant and animal species, up to and including eradication, will be undertaken whenever such species threaten park resources or public health and when control is prudent and feasible.	NPS Management Policies
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia. from Strategic Plan

Condition	Source
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan
Lakes with exotic trout are restored to natural conditions	Resource Goal from Resource Management Plan (1999)
Extant native species or genetically unique groups are restored to their former range	Resource Goal from Resource Management Plan (1999)
Waters incapable of sustaining fish populations through natural reproduction will be allowed to become barren	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Condition

The potential removal of exotic fish is politically charged because fishing is an entrenched recreational tradition. Furthermore, the legislation for Sequoia National Park provides that fishing be permitted (41 Stat. 731). The extent of exotic fish throughout the park guarantees the cost of potential control and restoration to be extremely high, adding fiscal difficulty to the impediments to success.

Impediments to successfully cleaning up the contaminants include 1) insufficient information on cause and effect for individual contaminants (especially true for pesticide concerns); 2) the economic significance of pesticide use in the San Joaquin Valley; 3) traditional views to water treatment plants which emphasize health and safety of treated effluent but fail to consider the ecological compatibility of effluent for the recipient ecosystem; and 4) the tendency to treat human feces that is "out of sight" as "out of the ecosystem."

The general lack of ground water for public use and lack of data to show harm from current surface water diversions are the greatest impediments to restoring reduced surface flows.

Beaver are difficult to remove because of their high fecundity, difficulty of finding and removing all beaver present, and public appeal. Beaver removal could become controversial.

Restoration of fire as a natural process is challenged by extreme political sensitivity and conflicts with air quality objectives.

Removing dams from the Mineral King area would be very expensive. These are large structures in remote locations.

Strategies for Achieving Desired Future Condition:

Know and Understand the Resource

- Compile a list of known aquatic invertebrates. Sources of information include published literature, unpublished reports, and databases of current and previous investigators. When available, additional attributes that need to be captured include habitat, microhabitat, geographic location, date, and abundance.

- Develop a directed inventory to fill in the gaps in existing aquatic wildlife inventory information. Minimum taxa for which inventory data is required include aquatic vertebrates (primarily fish and amphibians), zooplankton, and benthic invertebrates (primarily insects and mollusks). Minimum attributes include habitat, microhabitat, geographic location, date, and abundance. Some paleontological surveys may be in order to help establish recent losses from anthropogenic stressors.
- Develop and implement vital signs monitoring of aquatic fauna.
- Perform research to identify contaminants, determine ecological impacts of individual contaminants, and evaluate alternatives for mitigating contaminants.
- Perform research on restoration strategies for extirpated species. Include consideration of historic corridors and barriers to gene flow.

Restore the Impaired Parts

- Develop and implement a plan for selectively removing exotic fish.
- Restore extirpated species and any other species that whose pristine range has been diminished due to anthropogenic causes by either 1) removal of exotic predators, 2) improved environmental quality, or 3) in accordance with other mitigation strategies identified through research.
- Restore fire as a natural process.
- Restore habitats altered by significant diversion or impoundment of water.

Maintain the Pieces

- Identify and implement management actions that are consequences of vital signs monitoring.
- Play an active role in opposing any introductions of species that could immigrate into the parks and impact our resources
- Perform Section 7 consultations on any management actions that could affect federally listed species.
- Evaluate proposed management actions on all sensitive species that may be affected.

Protect Resource and Mitigate Stressors

- Enforce regulations.
- Provide resource information relevant to proposed new developments or changes in visitor use management.
- Implement management actions that are consequences of vital signs monitoring.

Inform and Educate the Public and Others about the Resource

- Publish research.
- Develop lists of aquatic species that include information on habitat, distribution, abundance, and status (declining, increasing, and status quo).
- Provide public access to data through Internet.
- Provide data in format suitable for use on GIS
- Provide information about the condition and threats of aquatic wildlife on the parks' Web site.
- Provide press releases and utilize other media to Inform and Educate the Public about threats to native aquatic wildlife.

Relationship to Other Desired Future Conditions

This section is intricately related to the desired future conditions of wetlands, water quality, and water quantity.

Bears

Summary

Bear management is really a subset of managing native terrestrial wildlife (above), but it is being dealt with separately because of the pervasiveness of the problem and the significant portion of park resources that go into dealing with the problem. In 1998, there were 518 incidents causing $98,053 damage and three human injuries (two were serious). Two bears are known to have died as a result of the bear problem. The one bear had three cubs whose fate is unknown. A third bear died as a result of being hit by a vehicle.

The bear management issue is caused by one simple situation, access to human food and garbage. If we could eliminate that access, we would eliminate the bear problem. Unfortunately, eliminating access to human food and garbage is a daunting task. Every single human that enters these parks and all of the people who come near these parks have the potential to create major bear problems. The bear situation is not a function of the diligence of the many, but the deliberate and careless actions of the few. To be successful, bear management relies on a very high level of compliance for proper storage of food and garbage.

When the bear management program fails, bears become conditioned to foraging for human food. Once bears learn to associate food with people, it is virtually impossible to cancel that conditioning. The consequences include bears routinely breaking into cars, residences, tents, packs, and any other place that may contain food. Some bears learn to bluff charge people to get them to drop their packs or desert their food. Bears often become very bold in their quest for food. Occasionally people are injured. When the risks to public safety become unacceptable, bears are destroyed.

The outcome is not just property damage and risks to public safety, access to anthropogenic food changes bear biology. Bears that get human food produce more offspring and grow larger. Their activity patterns change. Wild bears are normally active early in the morning and late in the afternoon. Bears that are accustomed to obtaining human food have learned to sleep during the day and be active at night after most people have gone to sleep. Once bears make the association between people and food, they begin to go wherever people go. Normally, bears live primarily in the foothills and in the conifer belt with occasional use of subalpine areas. Bears conditioned to obtaining human food sometimes become residents in subalpine areas and occasionally frequent alpine areas. Without access to human food, bears probably could not survive at these elevations because there is little natural food for them.

The consequences of the bear problem are damaged property, spoiled vacations, bears living where they do not normally occur, changes in bear biology, injured people and dead bears. When the bear program fails, neither the resource or the visitors win.

Stressors and Resource Preservation Issues

There is but one stressor causing bear problems. It is access to human food and garbage. The reasons for this stressor are multiple: 1) people deliberately feeding bears, 2) people letting bears frighten them away from their food, 3) people failing to store their food properly, 4) people carelessly leaving some food where bears could get them, 5) people failing to dispose of their garbage adequately, 6) people leaving food in their homes where it entices bears to enter, 7) people leaving food in there cars where bears can see or smell it, 8) people failing to latch lockers or canisters correctly, 9) people being ambivalent about even attempting to protect their food and garbage, 10) insufficient food lockers in campgrounds or trail heads, 11) garbage cans that are not really bear-proof, 12) broken bear lockers, 13) garbage facilities that are overfull, 14) bears chewing through branches where food was hung correctly, and 15) insufficient space in food lockers. Note that human carelessness and attitude cause the first nine of these causes for failure. The remaining six are because of deficiencies in the park providing adequate bear-proof hardware.

Desired Future Condition

Condition	Source
Federal- and state-listed threatened and endangered species and their habitat are sustained.	Endangered Species Act; NPS Management Policies
Populations of native plant and animal species function in as natural condition as possible except where special management considerations are warranted	NPS Management Policies
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia. from Strategic Plan
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan
Visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreational opportunities.	Mission Goal IIa from Strategic Plan
The natural distribution, ecology, and behavior of black bears are restored and free of human influences	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

The constraints to success are effective education, motivation, and funding. We need better ways to educate and motivate people to fix the first nine causes for failure listed above. We need funding to purchase and install more facilities to resolve the next six reasons for failure.

Strategies for Achieving Desired Future Condition

Know and Understand the Resource

- Monitor incidents to know what is happening, trends, and why incidents occur.
- Know when facilities fail.
- Know the food-storage needs of our visitors.
- Be aware of changes in the structure of the bear population, distribution, and relative abundance. Black bears need to be a component of vital signs monitoring.
- Know the compliance rate for proper food storage/garbage disposal.

Restore the Impaired Parts

- Eliminate all sources of anthropogenic food.

Maintain the Pieces

- Use enforcement, education, and facilities to eliminate the problem.

Protect Resource and Mitigate Stressors

- Enforce the food-storage regulations.
- Educate and motivate people to store all food/dispose all garbage correctly.
- Obtain funds to provide adequate facilities for all food storage/garbage disposal needs.

Inform and Educate the Public and Others about the Resource

- Provide bear management information using all available media: signs, brochures, park newspaper, news articles, park Web site, and directly from park staff. Direct contact by Bear Technicians and Campground Rangers are two of the most effective ways to communicate the bear management message.
- Concentrate education efforts as actively on parks staff and contractors as on park visitors.

Relationship to Other Desired Future Conditions

This section is a portion of the desired future condition for native terrestrial wildlife.

Atmosphere and Meteorology

Air Quality

Summary

Air pollution is one of the most serious external threats to Sequoia and Kings Canyon National Parks. The parks have some of the worst air quality in the National Park Service and air pollution threatens the health and welfare of park resources, park staff, and visitors alike. Current research and monitoring indicates that ozone, acidic and nitrogen deposition, pesticide drift, and regional haze pose the most serious threats, though future research may reveal even greater threats as yet unknown. The National Park Service Organic Act and the Clean Air Act mandate that these parks protect park resources and air quality related values from the adverse impacts of air pollution.

Most of the parks' air pollution originates in the San Joaquin Valley and is transported into these parks by prevailing winds (Roberts et. al. 1991). Four factors contribute to the area's high pollution levels: climate, lifestyle, population, and topography. Hot, dry summers create perfect conditions for smog formation. A spread out, car-dependent society with the highest population growth in the state produces increasing numbers of mobile and small stationary emission sources. Bowl-like topography promotes nightly temperature inversions that trap and concentrate pollutants.

Unlike many other states, California has few large stationary sources of air pollution; mobile, area, and small stationary sources emit the majority of the state's pollutants. Mobile sources contribute 60% of the ozone pollution (1999 California Almanac). Mobile sources and agricultural activities together account for most of the direct PM10 emissions (particulate matter ten microns in diameter or less). Nitrate, sulfate, and organic particles formed indirectly through conversion of directly emitted pollutants can contribute the majority of the sulfur dioxide emissions. Vegetation (especially cotton, alfalfa, beans, tomatoes, pines and oaks) emits up to 70% of the hydrocarbons involved in ozone and organic particle formation.

Since most of the parks' air pollution originates outside park boundaries, park staff must work closely with others to improve air quality and protect park resources. Monitoring and research, planning, participation in regulatory activities, partnering, and education are key components of the parks Air Resources Program.

The knowledge gained through monitoring and research allows park staff to plan future actions and provide input into regulatory activities, thereby increasing the likelihood that regulatory decisions will benefit these parks.

Partnerships facilitate communication and help stretch limited funding. Education, both of the general public and park staff, strengthens support for park goals and activities.

Stressors and Resource Protection Issues

Ozone concentrations at the parks regularly exceed 60 parts per billion (ppb) from April through October. Ozone levels during these months frequently climb above the state standard of 90 ppb (up to 78 days or 467 hours/summer) and occasionally exceed the federal standard of 120 ppb (up to 10 days or 25 hours/summer) (SEKI Air Resources Annual Report, 1998). Ozone concentrations at 60 ppb or greater injure sensitive yellow pines. A 1989 survey of 52 Jeffrey and ponderosa pine plots throughout

the parks showed that an average of 45% of survey trees displayed visible ozone injury (Ewell and Gay, 1993). Studies have shown that visible foliar injury results in plant growth reductions and altered metabolism.
Air pollution is responsible for acidic deposition and increased nutrient loading on Sierran ecosystems. Wilderness areas thought of being pristine in regard to air quality are now known to be affected by air pollution. While acid deposition research has not found serious irreversible effects to surface waters and forests in the Sierra Nevada, there is less certainty in the longer-term outlook with the increase of development adjacent to the Sierra.

Past research efforts focused on short-term and visible responses to acute exposures to pollutants. Current concerns are that there is a broader range of subtle effects of air pollution on ecosystems. This brings the realization that the ecological effects of air pollution can be much more complex than previously recognized. It may also indicate that air pollutants may already be important stresses for natural biota, even if obvious, visible effects have not been recorded. While ozone damage to vegetation is well documented, the effects of acidic deposition and accumulated inputs of nitrogen are not well understood and have potential to cause long-term damage to these Sierran ecosystems.

Sequoia and Kings Canyon National Parks are downwind of one of the most productive agricultural areas in the world, the San Joaquin Valley. Every year, many tons of pesticides are applied to the crops. Over 91 million pounds were applied in 1994. Much of the volume is volatile and becomes airborne as aerosols or particulates. Over 15 million pounds of the pesticide applied in 1994 had potential to become volatile organic compounds. We know from previous work that the park is exposed to measurable quantities of pesticides. In the 1960s, Lawrence Cory and W. Serat found DDE in mountain yellow-legged frogs in the Crabtree area of Sequoia National Park (Cory et. al. 1970). More recently, John Zabik and Jim Seiber found measurable quantities of organophosphates in precipitation as high as 1,920 meters (48 pg/ml) in Sequoia National Park (Zabik and Seiber, 1993). Concentrations decreased with elevation and distance from the valley. The parks' peregrine falcon aerie at Moro Rock has never been able to produce offspring, even after replacement of the female. Abandoned eggs collected in 1991 contained high quantities of DDE (13 mg/kg wet weight).

Other synthetic chemicals are also finding their way into these parks. Peregrine falcon eggs at Moro Rock also contained high levels of PCBs (1.6 mg/kg wet weight). About 100,000 synthetic chemicals exist in commercial use today and another thousand are created annually. Few of these have been studied for impact to biological organisms or ecological systems, but we know that some can have estrogenic or other effects as hormonal imitators in concentrations of parts per trillion. They can causes changes in reproductive capacity, longevity, intelligence, and behavior. They can change behavioral and biological processes. They can lead to carcinogenic, mutagenic and teratogenic effects. They are inconspicuous, but insidious. These chemicals can enter the parks with any of the synthetic materials that enter our parks daily (plastics, medications, foods, new equipment, supplies, vehicles, etc.) or more subtly through food chains or atmospheric drift. We don't know what is coming into the park, what species are being affected, or for what we should be watching. We only know the names of the known harmful chemicals, and we certainly don't have the means to monitor thousands of chemicals, especially when they may only be serious at very low concentrations. Some of the park's wildlife is disappearing for unknown reasons. Drift from pesticides and other synthetic chemicals is a leading suspect.

The much-publicized worldwide loss of amphibians is occurring at an alarming rate in these parks and the Sierra Nevada in general. Mountain yellow-legged frogs (*Rana muscosa*) were once widespread and abundant in the high country of the Sierra Nevada. During the last three decades, *R. muscosa* has disappeared from about half of its known localities in Sequoia and Kings Canyon National Parks, and it appears to be doing even more poorly outside these parks. The foothill yellow-legged frog (*Rana*

boylii) completely disappeared from these parks in the 1970s, and today the Sierra population exists as only scattered remnants along the western foothills. The Yosemite Toad (*Bufo canorus*) has disappeared from more than 50% of its range. When comparisons are made to Grinnell and Storer's surveys from the early part of the century, even the more ubiquitous western toad (*Bufo boreas*) and Pacific treefrog (*Hyla regilla*) have declined in some areas (Jennings, 1996). The causative agents are not obvious, though many theories have been proposed: increases in UV caused by ozone depletion, loss of immuno-suppressive abilities, pesticide drift, introduction of predators (especially fish), exposure to new diseases, estrogen mimics, human disturbance, loss of critical populations, and acidic deposition. Some of these have been shown to be unlikely in the Sierra Nevada and others are supported by evidence elsewhere or to have only limited applicability in the Sierra Nevada. Much of the loss occurred in pristine land where there is little evidence of human presence.

There are on-going conflicts between smoke and the need to restore an altered fire regime. Almost a century of fire suppression has led to significant changes in the structure and composition of forested ecosystems. Prior to European settlement, fires were frequent and of variable intensity and size. With atypically high fuel loads, there is a greater risk of large stand-replacing fires. Sequoia and Kings Canyon National Parks have been actively involved in restoring fire as a natural process since 1968, and today we use both management-ignited fires and natural ignitions to achieve fire management objectives. Regardless of the propriety and necessity of fire, fire generates smoke, and smoke generates controversy, therefore complicating air quality objectives. Nearby communities receiving smoke tend to have a short tolerance. Some fires are not allowed to burn because of social and legal constraints, even though resources are available to manage them. The future evolution of the park's fire environments may be influenced more by social than fiscal constraints.

Desired Future Conditions

Sequoia and Kings Canyon National Parks constitute a class I air quality area. Current laws and policies require that the following conditions be achieved in the parks:

Condition	Source
Air quality in the parks meets national ambient air quality standards (NAAQS) for specified pollutants.	Clean Air Act; NPS Management Policies
Park activities do not contribute to deterioration in air quality.	Clean Air Act; NPS Management Policies
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
Air quality in at least 50% of the parks improves or does not degrade from 1997 baseline conditions.	Long-Term Goal Ia5 from Strategic Plan
Facilities and management activities are in compliance with the Clean Air Act and state and local air quality policies	Resource Goal from Resource Management Plan (1999)
Impacts and levels of park air pollution are monitored.	Resource Goal from Resource Management Plan (1999)
Park staff, visitors, the public, and regulatory agencies are educated about park air quality	Resource Goal from Resource Management Plan (1999)
The parks participate in Federal, State, and Local Regulatory actions that affect the parks	Resource Goal from Resource Management Plan (1999)

Condition	Source
Effects of anthropogenic climatic change on ecosystems are minimized.	Resource Goal from Resource Management Plan (1999)

The desired future conditions for air quality are identified parks' Mission Goal of "Natural and Cultural Resources and Associated Values are Protected, Restored, Maintained in good condition and managed within their broader ecosystem and cultural context" and 5-year Long- Term Goal of "Air Quality in at least 50% of the park improves or does not degrade from the 1997 baseline conditions."

Constraints on Desired Future Conditions

To reach these desired future conditions the parks are exploring ways to improving the methodology for managing smoke from prescribed fires. This involves working closely with the San Joaquin Valley Unified Air Pollution Control District in conducting prescribed fires under favorable air quality conditions. But the majority of air pollution still originates from sources outside the parks. By monitoring the impacts of air pollution to park resources and using the information in the regulatory arena, the parks should have a positive impact on improving air quality in the parks.

Strategies for Achieving Desired Future Conditions

Monitoring and Research

- Study the effects of acid deposition on aquatic and terrestrial resources
- Study air pollution impacts on sensitive plants
- Develop a long-term air quality monitoring program as part of vital signs monitoring
- Study the effects of increased nitrogen loading to ecosystems of these parks
- Measure and understand what levels of contaminants are entering these parks and their effects on terrestrial and aquatic ecosystems
- Continued meteorological monitoring to calculate deposition, model smoke dispersal, assess intra-interannual variability, model dry deposition rates, and/or assess meteorological factors affecting visibility

Regulatory Participation

- Ensure compliance with air pollution regulations in all park and concession operations
- Minimize air pollution emissions from park operations.
- Assess impacts of park emissions on air quality.

Education and Public Outreach

- Develop interactive air quality display for the parks' visitor centers
- Provide training to park staff on air quality issues.
- Develop educational materials.
- Participate in programs to promote clean air.

Administration

- Develop a base funded Air Resources Management Program

Soundscapes

Summary

The natural ambient soundscape is the aggregate of all the natural sounds that occur in parks, together with the physical capacity for transmitting natural sounds. Some natural sounds in the natural soundscape also are part of the biological or other physical resource components of the park, such as bird songs or frog mating calls. The preservation of natural ambient soundscapes in parks is especially important in wilderness or remote areas where visitors may travel seeking solitude. Some human-caused noise may be acceptable in and around high-density recreation and/or administrative sites, or along transportation corridors.

Activities contributing to the preservation of natural ambient soundscapes include: enforcing quiet hours (10 PM to 6 AM) in pubic recreation sites, limiting the use of noise-producing machines by NPS employees to daylight hours, especially in wilderness areas, and the use of solar electric generating equipment at remote sites.

Stressors and Issues to Resource Preservation

The primary threat to the preservation of natural soundscapes is noise resulting from heavy equipment or electric power generators. All mechanical gasoline or diesel-driven power generators supporting park operations have now been phased out and replaced by solar or water generators. However, temporary uses still exist, including generators brought in by visitors. The use of noise-producing equipment (chain saws, chippers, excavating machines, snowmobiles, snow removal equipment, etc.) is limited to daylight hours, except in emergency situations.

There is no documented evidence that noise generated by within-park activities routinely performed has an adverse effect on native fauna. However, the noise associated with humans may be an attractant for foraging animals (such as black bears) since such noise may be associated with a food source.

Desired Future Conditions:

Condition	Source
The National Park Service will preserve the natural ambient soundscapes of parks, which exist in the absence of human-caused sound	NPS Management Policies – 2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan

Condition	Source
The natural ambient soundscape (the absence of human-caused sounds) is unimpaired throughout the parks' Natural Zone. Within developed areas or areas of primary park features, human-caused noise is limited to daytime hours and of a level, frequency, and duration that does not adversely impact national park values. No native flora or fauna are adversely affected by human-caused sound within the entire area of the parks.	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions:

In certain areas the use of mechanical and/or electronic equipment is necessary to accomplish mission goals, particularly in and around park developments.

Concentrated recreational use (such as in campgrounds) will inevitably produce noise when large numbers of people are brought together

Strategies for Achieving Desired Future Conditions:

Know and Understand the Resource

- Inventory potential sources of unacceptable human-caused sound
- Monitor frequency, magnitude, and duration of human-caused noise suspected of being incompatible with management purposes of the parks
- Investigate potential effects of human-caused noise on native fauna

Protect the Resource and Mitigate Stressors

- Minimize the use of noise-producing equipment, especially in sensitive areas
- Enforce quiet hour regulations in public recreation sites

Maintain the Pieces

- Conduct a concerted effort to reduce noise from NPS equipment in sensitive areas
- Conduct ongoing monitoring of the effects of noise on visitor experiences and native fauna

Restore Impaired Parts

- Retrofit existing necessary noise-producing equipment with lower decibel producing-equipment where practicable

Inform and Educate the Public and Others about the Resource

- Educate public to respect solitude and peacefulness, especially in campgrounds during quiet hours

Lightscapes.

Summary

The large contiguous natural area within Sequoia and Kings Canyon National Parks allows for the preservation of natural ambient light conditions, or lightscapes. Dark nighttime conditions are important to certain flora and fauna within the parks, and provide visitors with the opportunity to view faint celestial objects not commonly visible in urban or suburban areas. Artificial lighting within or adjacent to the natural area can disrupt the behavior of plants and animals (for example plants that flower only at night or animals that are active only during the day) and causes sky glow that obliterates faint stars. The large wilderness areas of the western U.S. represent some of the very few places left in the 48 states that posses both clean air and an absence or urban sky glow. The Wilderness Act states that areas so designated must be preserved, "…retaining its primeval character and influence…" Existing information on urban and suburban sky glow is limited to anecdotal accounts and a few nighttime photographs. Information on the effect on natural resources of security and safety lighting currently used within the parks' Development Zone is limited to some anecdotal evidence and monitoring in Crystal Cave.

Stressors and Resource Preservation Issues

The primary threat to the preservation of pristine night sky conditions is skyglow from a preponderance of artificial lighting in and around urban and suburban centers adjacent to the parks. The cities of Fresno and Visalia have grown rapidly over the past decade and continue to grow as more farmland is converted to highly populated uses. Shopping centers, outdoor stadiums and recreation parks, and street lighting associated with the increased population result in an illuminated western portion of the sky when viewed from points within the parks. In the more remote backcountry areas, the further east one gets the darker the sky becomes. From points near the Sierra crest, the view of the night sky is nearly pristine. However, it is in these remote areas where wilderness values are most important, and skyglow or a direct view of city lights may be considered to have the greatest impacts.

As yet, there is no documented evidence that within-park security or safety lights have a direct effect upon the behavior or physiology of any park flora or fauna. However, experience with the spotted bat, *Euderma maculatum*, a sensitive species, has shown that they are disturbed by and avoid artificial lights. It is reasonable to expect animals that are attracted to humans as a means of acquiring food (such as black bears) to associate bright outdoor lights with human occupation. Also, lights used within Crystal Cave for safety and to display features have resulted in the growth of algae, moss, and even grasses in some instances. These unnatural additions to the cave's food supply may favor some types of animals over others.

Desired Future Conditions

Condition	Source

Condition	Source
The Service will protect natural darkness and other components of the natural lightscape in parks.	NPS Management Policies – 2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan
The natural ambient appearance of the night sky is unimpaired in all areas of the parks' Natural Zone. No native flora or fauna are adversely affected by artificial lights within the entire area of the parks.	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

In certain areas the use of artificial lighting promotes security and/or basic human safety. In these areas, outdoor lights will continue to be used, but should be shielded to mitigate disruption of the night sky, natural cave processes, physiological processes of living organisms, and similar natural processes where feasible. Growth of urban and suburban centers adjacent to the parks with associated increased use of outdoor lighting cannot be directly controlled. However, participation in local county and community planning efforts and actively informing adjacent communities of the possible degradation of national park values resulting from unshielded outdoor lighting can mitigate such degradation.

Strategies for Achieving Desired Future Conditions:

Know and Understand the Resource

- Inventory artificial light sources within the parks
- Monitor night sky brightness and the effect of within-park outdoor and cave lighting on native flora and fauna
- Model the effects of proposed developments adjacent to the parks on lightscapes within the parks

Protect the Resource and Mitigate Stressors

- Protect natural areas and visitor perception of glare from surrounding within-park outdoor sources through adequate light shielding
- Protect wilderness values from adjacent urban and suburban centers through participation in local planning, education, and presentation of monitoring data

Maintain the Pieces

- A concerted effort to reduced glare and disruption of dark conditions at night from within-park outdoor lights

- Ongoing monitoring of night sky brightness and the effects of lights on native flora and fauna

Restore Impaired Parts

- Retrofit existing necessary artificial lights with efficient and shielded fixtures or fixtures of a wavelength that is less disruptive of natural resources

Inform and Educate the Public and Others about the Resource

- Continue interpretive programs dealing with the night sky, and include information on preserving dark nighttime conditions
- Publish the results of monitoring efforts
- Cooperate with local amateur astronomy enthusiasts to promote the dark sky resource of the parks

Overflights by Military Aircraft.

Summary

Noise associated with low-level military aircraft is a serious issue for the visiting public, potentially impacting hundreds of visitors each year who visit these parks to experience natural sounds. Despite 20 years of working with the military on this issue, there has been little significant change in the number of low-level overflights. Recent efforts, however, have improved interdepartmental coordination and elevated this issue to a national level.

Background

Roughly half of Sequoia and Kings Canyon National Parks underlies a portion of restricted use airspace, the R-2508 Complex. The R-2508 Complex is the largest and most topographically diverse airspace available for military training within the lower 48 states. A small portion of the complex includes areas of designated wilderness within Sequoia, Kings Canyon, and Death Valley National Parks.

In 1977, when the Military Operating Areas (MOAs) within the Complex were established, the Department of Defense agreed to fly 3,000 ft AGL (above ground level) over Sequoia and Kings Canyon National Parks, wilderness portions of what was then Death Valley National Monument, and the Domeland and John Muir Wildernesses. Park Service officials were not consulted about the establishment of the MOAs and – to the best of our knowledge – the Department of Defense or FAA did not address the environmental consequences of their decision in accordance with NEPA.

Every park superintendent since the 1980s has informed the military commanders of China Lake Naval Air Weapons Station and Edwards Air Force Base of public objection to the noise created by military aircraft flying low-level in violation of existing policy. No meaningful downward trend in the number of low-level flights has been achieved. For example, in 1998, out of a 62-day summer reporting period, there were 20 confirmed violations (representing one out of every three days) of the existing policy.

In 1999, Lemoore Naval Air Station implemented an 18,000-ft MSL (mean sea level) restriction. This new altitude restriction raises the overall level at which their aircraft transit the park, and mitigates the noise issue to some extent by reducing the "startle effect" created by low-level aircraft. The National Park Service has asked Edwards Air Force Base and China Lake Naval Weapons System to implement an 18,000-ft MSL altitude restriction across the board over the parks. The purpose of an 18,000-ft "floor" would be to eliminate all low-level flights by putting all aircraft within positive radar coverage while over the parks.

The National Park Service understands and supports the Department of Defense mission in the R-2508 relative to national defense. The National Park Service seeks a resolution that will allow the Department of Defense to maintain combat readiness while allowing the National Park Service to manage the federally designated wilderness of Sequoia and Kings Canyon and provide a quality experience to visitors.

Stressors and Resource Preservation Issues

Reduced Opportunity to Hear Natural Sounds

People visit wilderness in search of contrast with the places where they live. Most of the visitors to Sequoia and Kings Canyon come from San Francisco, Los Angeles and the San Joaquin Valley – population centers saturated with human-made sounds. Low-level military overflights interfere with the ability of visitors to hear natural sounds in a natural environment.

Reduced Opportunity to Experience Solitude

Wilderness is a place to enjoy primitive recreation in an undisturbed setting. It is a contemplative place, a place that affords "outstanding opportunities for solitude." Low-level military overflights diminish these opportunities by startling visitors and creating a lingering reminder of disruptive human presence.

Desired Future Conditions

Condition	Source
The administration of wilderness meets the standards within the Wilderness Act: • Protection of these areas in an unimpaired state for future use and enjoyment as wilderness; and • Preservation of the wilderness character of these areas.	Wilderness Act of 1964; California Wilderness Act of 1984; Director's Order #41

Condition	Source
Wilderness is protected and managed so as to preserve its natural conditions and which: • Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable. • Has outstanding opportunities for solitude or a primitive and unconfined type of recreation.	Wilderness Act of 1964; California Wilderness Act of 1984; Director's Order #41
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
90% of wilderness/backcountry visitors, as of 1996, have access to wilderness/backcountry information	Long-Term Goal Ib3 from Strategic Plan
Natural resources within wilderness areas are restored to natural conditions.	Resource Goal from Resource Management Plan (1999)
Natural resources within wilderness areas are managed to preserve wilderness character.	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

To achieve these Desired Future Conditions, close coordination with the Department of Defense is imperative. The National Park Service understands and supports the Department of Defense mission in the R-2508 relative to national defense. Optimum resolution of this issue will allow the Department of Defense to maintain combat readiness while allowing the NPS to manage the federally designated wilderness of Sequoia and Kings Canyon in a way that will provide a quality experience to visitors.

Strategies for Achieving Desired Future Conditions

To reach the Desired Future Conditions within the constraints listed above, the parks will need to perform the following actions:

- Maintain contact with top-level staff at Edwards Air Force Base, China Lake Naval Air Weapons Station, and Lemoore Naval Air Station.
- Provide briefings for Wing Commanders each year. Provide training by military personnel for seasonal backcountry rangers on military efforts to reduce low-level flights and on reporting procedures for low-level flights.
- Maintain close coordination with the Central Coordinating Facility at Edwards AFB to ensure that the low-level aircraft reporting procedure works well and that feedback is provided.
- Join with the Department of Defense to establish a sound-monitoring program within these parks. Better information on ambient sound levels is needed.

Geological, Soils, and Paleontological Resources

Geological Processes.

Summary

Geologic Processes have defined and created Sequoia and Kings Canyon. These on-going surface processes include landslides, rockfall, stream and river erosion, geologic uplift and associated earthquakes, hillside erosion, plutonic and metamorphic rock exfoliation, and karst erosion.

In a national park that is largely wilderness and high elevation backcountry there are few stressors on geologic processes. NPS maintenance and construction activities may effect small areas through increased runoff from paved areas, diversion of streams, and the use of retaining walls and structures to prevent slumps and active erosion. These actions do no threaten overall natural geologic processes. The National Park Service will take the following kinds of actions to meet legal and policy requirements relating to geologic processes:

- Enforce NPS policies and wilderness regulations in the parks' wilderness areas.
- Insure NEPA compliance and review of all construction projects.

Baseline and Present Condition and Understanding

In general the geologic processes that created Sequoia and Kings Canyon National Parks are proceeding unimpeded. Recent research in the park has indicated that the park sits upon a young, dynamic mountain range (Ruppert; Stock) that is continuing to uplift at a rapid rate. Over long-term time scales this will lead to repeated earthquakes along faults at the eastern base of the Sierras outside the park boundary in Inyo National Forest. Additional earthquakes can be expected beneath the San Joaquin Valley as a consequence of the uplift. These earthquakes can be expected to cause landslides, slumps and rock fall throughout the parks. Stream erosion remains a significant geologic process in the two parks. All river systems carry heavy sediment loads of sands, silts and plutonic rocks. Periodic channel-altering floods occur on average every three decades. These floods probably account for most of the material currently being transported down the parks' river and stream systems. Karst hydrology and carbonate chemical erosion play a significant role as an active geologic process in several key areas of the parks. The primary geologic process for the parks high country over the long-term is glaciation. Current climatic conditions have resulted in little or no on-going glacial erosion. However, the cyclic climatic pattern that creates periods of glacial advance can be expected to return. Flooding events in early 1997, rock fall on the Generals Highway in 1998, a sudden sinkhole collapse in Redwood Canyon in 1993, and the presence of a few remnant glaciers in the parks' high country are all indications of on-going geologic processes.

Stressors and Resource Preservation Issues

Maintenance and construction activities on average effect only a few dozen acres per year within the parks. These activities pose no threat to overall geologic processes, such as stream erosion or mountain uplift. The large projects that could disrupt geologic processes within the parks, such as dam building and large scale mining, will not occur under NPS management due to wilderness policies and regulations, provisions of the National Environmental Policy Act and NPS management policies.

Erosional processes are driven by climate. Current research in this park and across the globe indicates that human-induced climate change may have started to occur. This has unknown, though potentially far-reaching implications for geologic processes in the two parks.

Desired Future Conditions

Sequoia and Kings Canyon National Parks contain dynamic geologic systems prevalent in an uplifting and eroding mountain range. Current laws and policies require that the following conditions be achieved in the parks:

Condition	Source
Natural geologic processes proceed unimpeded.	NPS Management Policies 2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
Geological processes and soils are not impacted by human change	Resource Goal from Resource Management Plan (1999)

Strategies for Achieving Desired Future Conditions

Know and Understand the Resource

- Continue to study and support research on the history, development and long-term character of geologic changes and processes within the two parks.
- Support continued research into Global Climate Change and its effects on geo-physical processes.

Maintain the Pieces

- Current park programs of wilderness management and NEPA compliance.

Inform and Educate the Public and Others about the Resource

- Support informed quality programs on geologic processes at Crystal Cave and as a component of park interpretive presentations.

Vital Signs

Sedimentation in stream channels and soil loss on hillsides has been identified as a Vital Sign for geologic processes within Sequoia and Kings Canyon. Hillslope erosion may impact plant communities, adjacent streams and rivers and can be the result of dramatic processes including fires and floods. Stream-channel sediments have strong impacts on riparian communities and change both on a year to year basis and in large-scale events, such as periodic floods.

This vital sign will give park staff information on:

- the background soil transport levels for areas in Sequoia and Kings Canyon National Parks
- the effect of fires or other dynamic events on soil transport
- any long-term trends or changes in the rate or volume of soil movement in the two parks

Caves and Karst (including cave fauna)

Summary

Cave and Karst systems in Sequoia and Kings Canyon National Parks are generally in good condition. Many of the 200 caves are in isolated areas and are not well known to the general public. They contain many endemic invertebrates, several bat species, very unusual mineral deposits and outstanding speleothems. However the caves and karst systems do face a number of existing and potential threats. Recreational use of park caves continues to slowly grow. Human activities in caves may lead to the destruction of mineralogical resources, the trampling or disturbance of sensitive animals and their habitat, and the alteration of natural airflow regimes. Commercialized Crystal Cave continues to suffer the effects of artificial lighting, anthropogenic lint and dust accumulation, direct (intentional or unintentional) vandalism of mineralogical features, litter, and the lingering effects of 1930s era development. Other caves have been badly damaged by human activities including speleothem mining, commercialization, inadvertent vandalism and graffiti. Karst hydrologies face water quality threats from sewage and sewage treatment problems, hazardous materials spills on roadways, and run off concerns from park roads and parking lots. The endemic cave invertebrates are so poorly studied that their basic ecological needs and population dynamics are completely unknown. The National Park Service will take the following kinds of actions to meet legal and policy requirements for cave and karst systems.

- Continue restoration efforts in damaged park caves such as Crystal, Soldiers, and Clough
- Maintain gates on caves that have been subjected to unregulated damaging use
- Create baseline data on endemic cave invertebrate taxonomy, distribution, and populations
- Work with cavers and caving clubs to ensure sound resource-sensitive caving practices
- Continue to require permits and trip leaders for many caves
- Continue to survey caves to create basic geographic data
- Support cave survey and inventory efforts by the Cave Research Foundation
- Monitor water quality in karst systems when there are indications of problems or pollution

Stressors and Resource Preservation Issues

More than 200 caves and at least 75 active karst systems are known within Sequoia and Kings Canyon National Parks. They have developed in accreted Mesozoic marble and occur in roof pendants of mostly metamorphosed marine volcanic rock. The 200 includes the longest cave west of the Continental Divide in North America, Lilburn Cave with 17 miles of passage, commercialized Crystal Cave and nearly pristine Hurricane Crawl found in 1988. A total of more than 30 miles of cave passage has been documented in park caves. These caves are also particularly rich in rare and unusual minerals. These are associated with ore bodies and hydrothermal deposits that are sometimes occur in metamorphic rocks. Unusual minerals include melanterite, azurite, fluorite, garnets and iron and calcium sulfates. Caves in the park, as is sometimes associated with mountainous terrain, contain rare calcite speleothems. These include shields in five caves, folia in several caves, large vermiform helictites in four caves, and expansive displays of filamental helictites in Hurricane Crawl. Other significant calcite deposits include massive scalenohedron crystals in Soldiers Cave, 20-foot-long

curtains and stalactites in Hurricane Crawl, extensive rimstone and calcite ice in Crystal and Hurricane Crawl Caves and multi-colored formations in Lilburn Cave. The caves are also significant sediment repositories with large deposits of clays, sands, and cobbles that may provide date information for cave development. The caves are home to a number of vertebrate species including seven species of bats (including *Corynorhinus townsendii*), three species of salamanders, and are also visited by ringtail cats and bears. The invertebrate residents of the caves are large in number, largely cave adapted and mostly endemic to a single valley, cave or even room. Tulare County is recognized as a national hot spot for rare cave-adapted animals. These invertebrates include several species of isopods from Hurricane Crawl, Crystal and Clough Caves, spiders and harvestman from more than a dozen caves, homopterans from Overhang, Clough and Crystal Cave, millipedes from Crystal, Bear Den, and Clough caves as well as scorpions, mites, centipedes, and a new genus of beetle from Soldiers Cave.

Karst systems are a major contributor and potential phreatic storehouse for water in all five forks of the Kaweah River. Karst springs feed all streams in the North Fork watershed, and a significant source for the headwaters of the East Fork. The entire Marble Fork plays a role in at least two karst hydrologies and the South Fork and Middle Fork also have significant karst springs. Recharge in the parks in almost completely allogenic, due to the prevalence of non-carbonate rock. Sinkhole development is only seen in Mineral King and Redwood Canyon, while sinking streams are common in most marble areas.

Stressors include the recreational use of park caves. Currently several hundred people per year recreate in park caves. Past damage from their activities include broken speleothems, trampled invertebrates, compacted soils, sediment transport on clothes, litter, deposits of toxic spent carbide, and the alteration of airflow and therefor microclimates due to digging. Commercialized Crystal Cave and formerly commercialized Clough Cave contain extensive areas of disturbance from trail construction and blasting. Rubble deposits from blasting create unnatural habitats, alter microclimates and have broken fragile cave features. Other problems in Crystal Cave include the effects of artificial lighting. Moss, algae, and even grasses are growing near lights along the cave tour route. The presence of this unnatural flora significantly alters habitats for cave-adapted animals. Anthropogenic lint and dust accumulations are probably a serious impact in several park caves including Crystal, Soldiers and Clough. Locally lints create acidic solutions that alter habitat and destroy cave surfaces. Lint is often deposited adjacent to commercial trails, but may also be left behind by recreational cavers. Dust may be deposited dozens of feet away from an area of disturbance, altering the appearance of cave surfaces and surficial habitats.

Karst hydrologies within the two parks have largely formed along the five forks of the Kaweah River, which is also the park's most intensively developed watershed. These subterranean stream systems are known to support at least two endemic stygian isopods. They also face water quality threats from sewage and sewage treatment problems, hazardous materials spills on roadways, and run off concerns from park roads and parking lots. The endemic cave invertebrates are so poorly studied that their basic ecological needs and population dynamics are completely unknown.

Desired Future Conditions

Sequoia and Kings Canyon National Parks contain some of the most extensive caves, and karst hydrologies and landscapes in the Western United States. Current laws and NPS policies require that the following conditions be achieved in the parks:

Condition	Source

Condition	Source
Karst terrains will be managed to ensure that water quality, spring flow, drainage patterns and caves are not significantly altered.	NPS Management Policies-2000; Chapter 4 (Draft)
Significant caves will be secured, protected and preserved for the perpetual use, enjoyment and benefit of all people.	1988 Federal Cave Resources Protection Act
Caves will be managed to perpetuate karst processes, airflow, mineral deposition, plant and animal communities and wilderness and cultural values.	NPS Management Policies-2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
At least 90% of known park caves, as of 1997, are protected and preserved for long-term ecosystem integrity and structure, with emphasis on the extremely fragile and irreplaceable nature of the physical and biotic resources.	Long-Term Goal Ia7 from Strategic Plan
Cave natural and cultural resources, and karistic processes are preserved, restored protected, and maintained.	Resource Goal from Resource Management Plan (1999)
Opportunities for the scientific study of cave resources and systems are provided and promoted to better understand and document park cave resources and caves in general	Resource Goal from Resource Management Plan (1999)
Educational and recreational opportunities to explore park caves are provided for the parks' visitors	Resource Goal from Resource Management Plan (1999)

The desired future conditions for cave resources are identified parks' Mission Goal of "Natural and Cultural Resources and Associated Values are Protected, Restored, Maintained in good condition and managed within their broader ecosystem and cultural context." And a 5-year Long- Term Goal of "At least 90% of known park caves, as of 1997, are protected and preserved for long-term ecosystem integrity and structure, with emphasis of the extremely fragile and irreplaceable nature of the physical and biotic resources."

Strategies for Achieving Desired Future Conditions

Know and Understand the Resource

- Seek out experts to complete taxonomic analysis of the parks endemic cave invertebrates
- Use aerial photography and dye tracing to denote karst basins and recharge areas
- Complete maps of caves to understand their geographic extent
- Work with geologists to determine the age and history of park caves

Maintain the Pieces

- Maintain cave environments through careful management of cave entrances and digging projects
- Maintain habitats and features through trail delineation and limited access

Protect the Resource and Mitigate Stressors

- Issue permits for sensitive caves
- Require trip leaders (trustees) for some caves
- Leave some caves or areas of caves "closed" to entry except under extreme circumstances

Inform and Educate the Public and Others about the Resource

- Work with the Sequoia Natural History Association (SNHA) staff in the production of quality interpretive programs for Crystal Cave

Vital Signs

Karst water quality, invertebrate populations and distribution, damage to cave speleothems, and bat populations have been identified as Vital Signs for cave ecosystem health. Cave and karst systems represent unique park features that include endemic species and rare bats, rare minerals and mineral morphologies, and hydrologic processes. The health of these systems insures the health of numerous cave-adapted animal and karst springs that feed key riparian areas and aquatic segments of the park.

This vital sign will give park staff information on:

- The quality of water moving through and exiting from karst systems
- The long-term status of cave formations and damage to these features
- Species distribution and population trends found in cave invertebrates
- Bat populations, species and distribution

Paleontological Resources.

Summary

Paleontological resources are limited in Sequoia and Kings Canyon National parks. However, the resources that exist are significant and require protection. Current laws and NPS policies require that the following conditions be achieved in the parks:

Condition	Source
Paleontological resources, including both organic and mineralized remains in body or trace form, will be protected, preserved, and managed for public education , interpretation, and scientific research	NPS Management Policies-2000; Chapter 4 (Draft)

Condition	Source
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
Known paleontological resources are in good condition	Resource Goal from Resource Management Plan (1999)

Paleontological resources are rare but significant in Sequoia and Kings Canyon National Parks. A landscape of plutonic and metamorphosed rocks means that mineral fossils are rare in the park and are actually known from only a few areas, including Mineral King. However, known, organic paleo-remains include bones from caves, plant material from caves and overhangs and pollens and plant materials preserved in bogs and meadows. To the best of the knowledge of park staff, paleontological resources are not under any particular threat within Sequoia and Kings Canyon. These resources are found in only a few isolated areas that are difficult to access. Materials found within the parks are likely to be of little or no economic value. Paleontological resources within the two parks are little known and have not been thoroughly studied. Limited work involving pollen and plant materials in bogs, caves and overhangs took place as part of an effort to determine a more long-term history for giant sequoia trees in the Sierra. [A reference may be provided in a later revision.] Bone material, mostly found in caves and comprehensive work in pollens and plants has not been undertaken. Materials in caves have been informally documented through photographs and are managed through cave and passage closures. Materials in meadows and bogs occur only in those discrete environments and are not known to be threatened by any park or visitor activity. Overhangs and smaller rock shelters, particularly as used by rats for middens, probably represent the most unknown sites that might preserve bone and plant materials.

- Continue cave management policies that close caves or passages with paleo-resources
- Continue to document bone and paleo-materials in caves using photography
- Follow NPS policies on wetland management that indirectly protect paleo-resources

Present Condition and Understanding and Stressors to the Ecosystem

The main paleontological resources that have been examined in the parks where the reported Harlan's ground sloth bones found in Lange's Cave. These were apparently examined and removed in the late 1940s. Unfortunately there are no written report of this work and the location of the bones is unknown. Volunteers enacted a significant search for the remains in 1993 and 1994 with no luck. The quantity and nature of the bones known to exist in other park caves is unknown. The extent, character and nature of paleontological resources found in rock shelters and overhangs are unknown. Wetland preservation of pollen and plant materials is limited to appropriate environments that can easily be defined across the park. The nature, extent and variety of these deposits are unknown. However, All of these resources are not known to be under any specific threat at this time.

The Mesozoic fossils found in Mineral King and possibly other areas and the possible Paleozoic fossils along the Sierran Crest remain unstudied. The few fossils present are likely to have been altered and misshapen by metamorphic forces that would have destroyed most fossils. These sparse fossil resources found in isolated areas are not known to be under any human-based threat at this time.

Desired Future Conditions

The desired future conditions for paleontological resources are identified parks' Mission Goal of "Natural and Cultural Resources and Associated Values are Protected, Restored, Maintained in good condition and managed within their broader ecosystem and cultural context."

Strategies for Achieving Desired Future Conditions

Know and Understand the Resource

- Attempt to have experts examine bone and paleontological material found in park caves
- Support pollen research in park meadows
- Initiate surveys of areas likely to contain sheltered rocks and overhangs in a quest for both paleontological and archaeological materials

Protect Resource and Mitigate Stressors

- Manage caves with sensitive paleontological resources largely through closures
- Manage wetlands in accordance with appropriate NPS policies

Soils.

Summary

Soils cover hundreds of thousands of acres in Sequoia and Kings Canyon National Parks. Much of the parks' high-country is glaciated bedrock or lakes, however moraines and rocky alpine soils can be found in these areas, Current laws and NPS policies require that the following conditions be achieved in the parks:

Condition	Source
Natural soil resources and processes function in as natural condition as possible, except where special management considerations are allowable under policy. (Areas of special management conditions will be determined through management zoning decisions in the GMP)	NPS Management Policies-2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
Geological processes and soils are not impacted by human change	Resource Goal from Resource Management Plan (1999)

Soil resources play a significant role in Sequoia and Kings Canyon National Parks. The parks elevational gradient and parent rock variety probably has lead to a diverse assemblage of soils. However, the overall nature and character of park soils is unknown. Several studies and projects have identified soil types is a few areas of the parks, in particular the Marble Fork and Middle Fork of the

Kaweah River drainages. [References and details may be provided in a later revision.] Most of the two parks are isolated areas where soils are generally not disturbed by human activities. Soils are disturbed in developed zones that total approximately 6000 acres. Disturbances include road corridors, building sites, utility corridors, fires and fire lines, along trails and in campgrounds and picnic areas. Soils may be available for rapid erosion following fires. The two parks maintain an active fire program in an attempt to restore natural fire regimes. The re-introduction of fire to the parks should encourage more natural erosion processes particularly in the mid-elevation zone where most fire occur. Overall these activities do not threaten the overall integrity of soil resources in the parks other 857,000 acres. The National Park Service will take the following kinds of actions to meet legal and policy requirements relating to soil resources.

- Adhere to wilderness boundaries in development and other soil disturbing activities
- Use construction and building techniques that mitigate for soil loss.

Present Condition and Understanding and Stressors to the Ecosystem

Soils have been partially mapped in the Middle Fork and Marble Fork of the Kaweah River drainages, as a component of other park research projects. Outside of these areas nothing is known about the park soil regimes. Stressors to the soils of the park out side of developed areas are limited or non-existent.

Desired Future Conditions

The desired future conditions for park soils identified parks' Mission Goal of "Natural and Cultural Resources and Associated Values are Protected, Restored, Maintained in good condition and managed within their broader ecosystem and cultural context."

Strategies for Achieving Desired Future Conditions

Know and Understand the Resource

- Attempt to have experts examine park soils and begin to create a soils map

Mining and Minerals

Summary

Mining activity in Sequoia and Kings Canyon National parks was limited compared to the rest of the Sierra Nevada. Most mining activity took place in the 18th century in Mineral King. However active mines also existed in both parks near the turn of the century and during World War II. There are a total of 15 known and inventoried mine sties in Sequoia and Kings Canyon. Commercially interesting mineral deposits are mostly associated with vein quartz (hydrothermal) and contact metamorphism concentrations and ores. Mined areas in the parks are known to contain silver, lead, copper, molybdenum, aluminum, iron and zinc. All mining operations in the parks were small. The largest occurred in Mineral King at the White Chief and Black Wolf Falls mines. Both sites include adits that are approximately 50 feet long. No significant smelting or processing of ore occurred in the two parks. An initial inventory of park mines using Geologic Resources Division funding and protocols was

completed in 1999. Abandoned mine sites do contain cultural resources reflective of the mining activities and the time of the mine's operation. Cultural materials at sites are known to include, anvils, pick axes, tobacco tins, barrel stays and other metal objects.

Mines may produce serious toxic waste problems through the release of heavy metals or acid wastewater. In addition open shafts or unstable adits can be very dangerous for visitors or park staff. However, a 1998 and 1999 inventory of abandoned mine lands revealed that mines within the two parks generally appear to lack these problems. Acid Mine Drainage may be a problem in the Franklin Creek Drainage in Mineral King and one shaft could be considered for closing in the White Chief area of Mineral King. The National Park Service will take the following kinds of actions to meet legal and policy requirements relating to mining and minerals.

- When possible sample water quality in watersheds affected by mining
- Continue to informally monitor mine site for changing conditions
- Continue to informally monitor mine sites to insure the continued protection of cultural resources
- Work to complete a complete inventory of "prospects" or small mine sites in the two parks

Baseline and Present Condition and Understanding

High-grade ore deposits have played a significant role in the history of the Sierra Nevada. In the Central Sierra some of the world's largest deposits of gold were found in the mid-1800s. However, further south in Sequoia and Kings Canyon, no significant mineral deposits were ever discovered. As a result mining activity was limited to two sites in central Kings Canyon in the watershed of the Middle Fork of the Kings River, two sites on the Great Western Divide near Triple Divide Peak, two sites in lower Redwood Canyon near Grant Grove and a half dozen sites in Mineral King. Despite its name and a "rush" in the 1870s, Mineral King never produced commercially viable quantities of ore. Today these abandoned mineral lands (AML), provide glimpses of a historic past, but might also prove dangerous for visitors and park resources. A 1998 and 1999 AML inventory of the parks revealed only a few potential problems. A shallow water-filled shaft along Franklin Creek in Mineral King may be leaching minerals into the stream. At the site, unusual colors and crystal growths associated with a seep are present. Also in Mineral King a shaft leading to water lies in the upper areas of the White Chief mine site. The shaft is within 200 feet of a frequently used trail and possibly should be considered for closure or remediation. All other AML sites in the parks do not appear to pose a health risk to visitors or an environmental hazard to park resources.

Stressors and Resource Preservation Issues

There are no active mining sites or claims within Sequoia and Kings Canyon National Parks. Current understanding of AML sites and the lack of existing claims mean that mining activities should not act as stressors for park resources. Cultural resources at mining sites generally are protected by their remoteness and small size. Wooden cultural artifacts have generally rotted away. Remaining artifacts are generally metal and badly rusted.

Desired Future Conditions

Mining activities and mineral lands were/are limited in scope in Sequoia and Kings Canyon. Current laws and policies require that the following conditions be achieved in the parks.

Condition	Source

Condition	Source
All units of the National Park System are closed to new mining claims	1976 Mining in the Parks Act
Each park should inventory abandoned mineral land sites to identify safety hazards and resource impacts.	NPS Management Policies-2000; Chapter 4 (Draft)
The NPS must, to the extent possible, mitigate or eliminate safety and environmental hazards associated with abandoned mineral lands.	NPS Management Policies-2000; Chapter 4 (Draft)
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ia from Strategic Plan
Abandoned mined lands are closed	Resource Goal from Resource Management Plan (1999)

Strategies for Achieving Desired Future Conditions

Know and Understand the Resource

- Continue to conduct water quality testing of streams suspected to be effected by AML wastes
- Follow-up on reports by park backcountry personnel and visitors concerning other potential AML sites
- Conduct an assessment of the potentially dangerous shaft in Mineral King

Maintain the Pieces

- Develop files and inventory information on known AML sites

Wilderness and Backcountry Resources

Summary

The Sequoia-Kings Canyon Wilderness, 736,980 acres, was designated in 1984 and comprises 85.3% of Sequoia and Kings Canyon National Parks. Additionally, approximately 35,500 acres in the Redwood Mountain and North Fork portions of the Kaweah drainage and 56,250 acres on the Hockett Plateau remain as proposed wilderness, and are managed as such.

This topographically diverse area contains the most rugged portion of the Sierra Nevada, with twelve peaks over 14,000 ft. Included within this area is Mt. Whitney (14,495 ft), the highest point in the contiguous 48 states. The Sequoia-Kings Canyon Wilderness also includes oak woodland and chaparral communities as low as 1700 ft. During the winter months when snow closes mountain passes to the north, the Sequoia-Kings Canyon Wilderness becomes part of the largest contiguous wilderness in the lower 48 states.

The general goal of managing the wilderness portion of these parks is to provide for enjoyment without significantly impairing park resources, the natural processes which shape them, or the quality of experience distinctive to them. This wilderness is made accessible by approximately 700 miles of maintained trail. In 1998, the park backcountry and wilderness areas were visited by 19,877 people who stayed a total of 57,485 user nights.

Staff specialists from several park Divisions perform specific tasks regarding wildlife management, stock use and meadow monitoring, wilderness interpretation, resource inventory, trail restoration, removal of trails from meadows, and fire management; however, the day-to-day resources monitoring and inventory and visitor use management is the responsibility of the wilderness rangers, including issuing permits. Monitoring includes documentation of aircraft overflight issues, rare and endangered plants, campsite conditions, stock impacts, inventory of archeological sites and historic resource conditions, creel census, trail/erosion, and general backcountry conditions. Because of logistical circumstances, the wilderness rangers will always bear the brunt of most resources monitoring activities in the wilderness of these parks.

Stressors and Resource Preservation Issues

Loss of Natural Fire Regime.

The park has long identified the loss of the historic fire regime as a primary stressor and threat to the integrity of the wilderness resource. The 1996 Sierra Nevada Ecosystem Project (SNEP) identified the loss of the natural fire regime as one of the dominant negative effects on the greater Sierran ecosystem.

Degraded Air Quality.

Degradation of regional air quality negatively impacts sensitive species of trees. Air pollution decreases the quality of the wilderness experience for visitors.

Visitor Use.

Visitor use results in both resource and sociological impacts. While baseline inventory conditions have been recorded for many aspects of visitor use, monitoring efforts must be ongoing to determine change over time. An excellent campsite-monitoring program developed by David Parsons and Tom Stohlgren has been established that has served as a model for monitoring nationwide. Monitoring has occurred periodically since 1978, but repeat sampling needs to be done. Meadows sustain impact from stock use and monitoring must continue to better understand the functioning and resiliency of different types of meadows at varying elevations.

Illegal Activities.

Poaching of wildlife, cattle trespass, vandalism, and theft of archeological artifacts can occur in remote areas that are infrequently patrolled. The extent of these problems is often unknown until someone reports an incident, often after some time has elapsed and considerable resource damage has occurred.

Need for Refined Wilderness Management Strategies.

These parks are currently operating under the 1986 Backcountry Management Plan, the 1986 Stock Use and Meadow Management Plan, and the 1971 Master Plan. Although the Sequoia-Kings Canyon Wilderness was formally designated in 1984, the 1986 plans did not formally recognize that designation, necessitating an evaluation of those plans to see if a higher level of protection is warranted. As issues have surfaced concerning campfires, sanitation, stock use, commercial use, party size, and trail maintenance, a refinement of existing plans has become necessary. The Wilderness Management Plan will provide a clear expression of our wilderness management philosophy, a clear statement of wilderness management goals (desired conditions) and objectives (strategies), and will establish criteria by which decisions will be made.

Lack of teamwork in managing resource-related problems.

Currently, each Division manages some aspect of wilderness, according to that Division's mission. Problems, such as cattle trespass, seen through that Division's lens then appear to be either a fencing issue, a landowner responsibility and cooperation trust issue, an interagency issue dealing with grazing conditions of a particular allotment, an enforcement issue, an educational issue, or a situation where trespass cattle should simply be shot. No one view of the problem would solve the problem without creating other problems. Failure to see more than one side of an issue has led to lack of a cooperative and integrated approach to wilderness issues. This, in turn, has led to misunderstanding within the park and among the public, creating the perception that complex issues have simple solutions. A formal in-park interdisciplinary forum is needed to cooperatively solve problems.

Administrative Use of Motorized Equipment within Wilderness.

A prime attribute of the wilderness resource is natural quiet. Each summer this quiet is compromised through the NPS use of chainsaws and helicopters, both justified in Section 4(c) as the "minimum requirement necessary to administer the area for the purposes of the (Wilderness) Act." Due to the time involved in clearing trails in early season, often meadows, trails and associated areas are protected more through the use of these tools, judiciously used, than would occur if stock and/or crosscut saws were chosen as the "minimum requirement."

Most of the administrative use of helicopters is for fire management and search and rescue activities. Frequent flights for fire monitoring, or to shuttle personnel for emergency activities, have become an expected occurrence, with the cumulative effect being a disruption in the natural quiet for wilderness visitors. While these activities are necessary, the park is closely scrutinized both internally and externally for the extent of its use of the helicopter. Currently, a flight request form is submitted for non-emergency flights, and these flights are scrutinized to determine appropriateness. Determining the appropriate level of administrative helicopter use is not easy, but a more formal "minimum requirement" decision tree would clarify the thought process used.

Desired Future Conditions

Condition	Source

Condition	Source
The administration of wilderness meets the standards within the Wilderness Act: • Protection of these areas in an unimpaired state for future use and enjoyment as wilderness; and • Preservation of the wilderness character of these areas.	Wilderness Act of 1964; California Wilderness Act of 1984; Director's Order #41
Wilderness is protected and managed so as to preserve its natural conditions and which: • Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable. • Has outstanding opportunities for solitude or a primitive and unconfined type of recreation.	Wilderness Act of 1964; California Wilderness Act of 1984; Director's Order #41
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context	Mission Goal Ib from Strategic Plan
90% of wilderness/backcountry visitors, as of 1996, have access to wilderness/backcountry information	Long-Term Goal Ib3 from Strategic Plan
Natural resources within wilderness areas are restored to natural conditions.	Resource Goal from Resource Management Plan (1999)
Natural resources within wilderness areas are managed to preserve wilderness character	Resource Goal from Resource Management Plan (1999)

Constraints on Desired Future Conditions

To achieve these desired future conditions, compromises in visitor use patterns may need to occur in order to achieve targeted resource and sociological conditions.

Strategies for Achieving Desired Future Conditions

To reach the desired future conditions within the constraints listed above, the parks will need to perform the following actions:

- Restore the natural fire regime to these parks.
- Improve the air quality of the wilderness areas of these parks.
- Implement a formal monitoring system for measuring changes in resource and sociological impacts over time. As part of this program, develop and implement a resampling scheme for long-term campsite monitoring. Continue to monitor different types of meadows at varying elevations to better understand their functioning and resiliency from packstock impacts.
- Develop a Wilderness Management Plan. The Wilderness Management Plan will provide a clear expression of our wilderness management philosophy and a clear statement of wilderness management goals (desired conditions) and objectives (strategies). The plan will also identify criteria for making decisions and ecological/sociological thresholds above which management action will be taken.

- Regulate wilderness use levels to prevent irreversible damage to park resources.
- Establish a formal in-park interdisciplinary forum to cooperatively solve problems.
- Establish a more formal "minimum requirement" decision tree to clarify the thought process used.

CULTURAL RESOURCES

Cultural Resource Baseline Information

Incremental progress has been made in the past five years (1994-1999) in several areas relating to the gathering of baseline information for the parks' Cultural Resources and Museum program. Annual site surveys (Inventories) have led to an increase in the number of recorded sites. The provisions of both national and parks-specific programmatic memoranda of agreement (PMOAs) have streamlined the application of compliance determinations regarding project effect and site eligibility (e.g., DOEs). The application of these agreements has led to an increase in the number of identified National Register-eligible sites and structures.

While no new formal listings in the National Register of Historic Places have been completed, progress has been made in evaluating potential districts and initiating the nomination forms, including a proposed historic district at Grant Grove and a proposed landscape district at Mineral King. Additionally, electronic databases have been updated for both cultural resources (GIS, ArcView) and archival (ANCS+) needs.

The Cultural Resources and Museum Program functions as a branch of the Division of Interpretation. The program is staffed by one fulltime Cultural Resources Specialist (GS-193-11) and one subject-to-furlough Museum Technician (GS-1016-06). Assistance is provided by a Seasonal Archeologist (GS-193-07), largely funded by FIREPRO. Additionally, temporary funding ("soft money") is competed for annually to support specific priorities (e.g., backlog cataloging, archeological inventory, and historic resources studies). Regional Office support has been provided for the List of Classified Structures (LCS) and Cultural Landscape Inventory (CLI) initiatives. Substantial information and staffing needs remain however, for example, the parks do not presently have a staff Curator, Historian, or Historic Architect.

The status of the following service-wide and baseline inventories and reports reflect the current conditions of the parks' Cultural Resources and Museum Program (Reference NPS-28, "Cultural Resource Management Guideline" for background). Individual resource summaries are also subsequently presented, noting stressors, constraints, and strategies for achieving desired future conditions.

Cultural Landscapes Inventory (CLI): The Great Basin System Support Office will coordinate a Level 1 inventory for the parks, focusing on Civilian Conservation Corps (CCC) developments. Funding for this work is being sought for Fiscal Years 2000-2002. Existing documentation that support the goals of the CLI program can be found in the Historic American Engineering Record (HAER) survey for the Generals Highway (1993), the Historic Resources Study for the Grant Grove Developed Area (1998), and the Determination of Eligibility (1999) and Supplement (1999) for the proposed Mineral King Cultural Landscape District. Cultural Landscape Inventories are needed for the other major developed areas of the parks (e.g., Ash Mountain, Lodgepole, and Cedar Grove).

Cultural Sites Inventory (CSI): The Cultural Sites Inventory is to contain database information on archeological and ethnographic resources. It is currently under development at the Washington Office. Eventually, parks-specific data would have to be prepared and coordinated.

List of Classified Structures (LCS): The List of Classified Structures was updated for the parks in 1998 with assistance from the System Support Office. Presently, there are 93 entries on the LCS, representing National Register-eligible or listed buildings, structures, and features. National Register nominations need to be completed as appropriate.

National Catalog of Museum Objects: All museum catalog records were converted in 1998 to the Automated National Catalog System-Plus (ANCS+) program. Some backlog cataloging remains to be done.

National Register of Historic Places (NRHP): Presently, the parks have 24 listings in the National Register. The majority of these entries are for historic era buildings; two prehistoric sites are also included (the Groenfeldt Site and the Hospital Rock Site). Two historic district entries, the Giant Forest Lodge Historic District and the Giant Forest Village – Camp Kaweah Historic District, were documented for mitigation purposes before their demolition in 1998-1999. These latter district entries need to be formally removed from the register. Conversely, five historic buildings, the Generals Highway, and aspects of an expanded district at Grant Grove have been formally determined eligible for listing but have not, to date, been formally listed; their nominations need to be prepared and submitted to the Keeper of the National Register.

Archeological Overview and Assessment: A brief assessment was prepared by D. Fee in 1980. Park Management would benefit from a revised, up-to-date overview and assessment as a substantial amount of data from the past 20 years remain to be fully summarized and evaluated. In the interim, a recent Overview prepared for Yosemite National Park (Moratto 1999) could serve to inform planning in Sequoia-Kings Canyon given the three parks' geographic and culture area similarities.

Archeological Identification/Evaluation Studies: Systematic archeological survey and testing efforts need to be expanded to better inform management decisions and meet public archeology/interpretive opportunities. Approximately five percent of the parks' aggregate of 863,741 acres has been surveyed in the past 45 years. The earlier surveys largely focused on developed areas and prominent sites; more recent surveys (post-1980) have been largely in advance of prescribed fire, road improvement, and campground development proposals, though some planning-driven inventories and testing (evaluation) efforts have also been conducted. A substantial number of early site forms provide little information; these sites remain to be systematically re-visited and their site forms updated to contemporary recordation standards. Representative surveys and evaluations are needed across the parks, especially in the little-investigated backcountry areas. Small-scale, high elevation surveys were conducted during the 1997-1999 field seasons for the Taboose Pass and Bench Lake areas of Kings Canyon National Park.

Ethnographic Overview and Assessment: An ethnographic overview and assessment for the parks has never been prepared. A review of ethnohistoric data, supplemented by Native American consultations, was completed in J. Herron (1980) for purposes of implementing the American Indian Religious Freedom Act within Sequoia and Kings Canyon National Parks. Similarly, Native American consultations were conducted in the summer of 1999 in support of the update to the parks' General Management Plan. A formal overview and assessment is needed, one which incorporates information on contemporary Native American issues and concerns.

Cultural Affiliation Study: A contemporary study of the cultural affiliation of past and present groups that use or relate to the parks' areas and resources has not been undertaken. Noted anthropologist Julian H. Steward did prepare a study in 1935 of the ethnohistoric tribal groups of Sequoia National Park for the National Park Service. This study still stands as a key baseline reference.

Historic Resource Study (HRS): A number of historic resource studies are needed for both parks to better inform resource management decisions, interpretation efforts, and National Register nominations. Area histories are needed for Cedar Grove, Lodgepole, Redwood Mountain, and Ash Mountain, the latter including a potential historic district associated with a Civilian Conservation Corps (CCC) camp in the Sycamore area. Important data for many of these areas can be found in the recently updated List of Classified Structures (LCS). Additionally, pending its acceptance, the proposed Mineral King Cultural Landscape District could be expanded upon using HRS-level data focusing on historic era mining and hydroelectric developments. A single HRS was prepared for the Grant Grove Developed Area (Kopczynski and McCoy 1998) in which an expansion was proposed to the National Register-listed General Grant National Park Historic District (Tweed 1977).

Cultural Resources Base Map: A computerized base map of recorded historic and prehistoric sites, structures, and features is maintained in the parks' Geographic Information System (GIS) database, using ArcView software. It was last updated in 1999.

Park Administrative History: Various historical aspects of the parks have been well covered in a wide range of publications. Early aspects of Sequoia National Park's history can be found in Junep (1937) and Strong (1964). The most recent comprehensive general history, being a resource history of both Sequoia and Kings Canyon, is to be found in Dilsaver and Tweed (1990).

Rapid Ethnographic Assessment Project (REAP): The parks have not conducted a Rapid Ethnographic Assessment Project.

Scope of Collection Statement (SOCS): An update of the parks' Scope of Collection Statement was drafted in 1999 and is under review (Eldredge 1999). The following additional documents have been prepared to help assess and manage the museum and archival collections: Collections Management Plan (Bayless 1994), Collections Condition Survey (Katterman and Voeks 1997), and Collections Storage Plan (Bush et al. 1997).

Prehistoric and Historic Archeological Sites

Summary

As noted above, approximately five percent of the parks have been surveyed for cultural resources (circa 40,000 acres). Viewed collectively, these survey efforts have been unevenly conducted, reflecting changes in recordation emphases and survey strategies over the course of 45 years or so. Nonetheless, they have resulted in the recordation of 312 prehistoric sites and 110 historic sites (including structures). The condition of the majority of these sites is presently unknown in any detailed sense given that perhaps less than a quarter of all sites recorded before the 1980s have been revisited since their original recordation. The general understanding is that most prehistoric and historic sites are in reasonably good condition, in an archeological sense. They remain largely unaffected by management and visitor activities. The sites' presence in national parks has afforded them a level of protection, aided by their general anonymity to most visitors. Standing historic structures, as identified in the List of Classified Structures, are of course more visible; their condition is summarized below.

Other highly visible and actively interpreted sites, like Hospital Rock, receive heavy visitation year-round and are correspondingly more vulnerable to impact, inadvertent or otherwise.

Stressors and Resource Preservation Issues

Impacts from natural processes.

The majority of the total 422 recorded sites are largely subsurface sites or thin surface scatters of cultural features and debris. Very little is known about the presence or absence of human remains, site integrity, site depth, or general research potential. Ongoing natural processes such as wind or water erosion, rodent burrowing, wildfire, and root growth can adversely impact such sites.

Impacts from management activities.

Construction or maintenance work that disturb the ground surface has the potential to adversely impact prehistoric and historic archeological sites within the parks' developed areas. Similarly, trail construction or uninformed building maintenance stand to adversely impact sites and historic structures, often in remote backcountry areas of the parks. Ground disturbance associated with line construction and the preparation of staging areas related to wildfire or prescribed fire activities also pose a potential threat to sites and structures. Fire itself can of course threaten standing historic structures or features, and can also adversely impact prehistoric sites exhibiting obsidian tools and debris on their surfaces. Routine review of proposed projects that have the potential to adversely effect sites and structures is to be made by the standing Environmental Review Committee (EMC), with pertinent compliance measures being identified by the committee.

Impacts from visitor use.

A significant number of park campgrounds and other developments have been located on or adjacent to the locations of prehistoric villages, campsites, or processing areas (e.g., bedrock mortars). This co-occurrence is a reflection of these localities' continued desirability for settlement or use given their general levelness, good soil drainage, access to trails and water, view, protection from the wind, and the like. Impacts to sites or structures can occur through uninformed recreational activities, including ground-leveling and trenching for tents, latrine excavation, rock removal, livestock corralling, climbing in caves or rockshelters, and the effects of escaped campfires. Additionally, uninformed or intentional artifact collecting, looting (excavation), and vandalism (spray painting, wood removal, carving, etc.) can have obvious and dramatic impacts to prehistoric and historic sites and structures.

Desired Future Conditions

Condition	Source
Manage parks "to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."	National Park Service Act of 1916.

Condition	Source
Section 106 compliance requires the agency to consider the effects of its undertakings on National Register listed or eligible properties. The agency is also directed to identify and nominate properties to the National Register of Historic Places.	National Historic Preservation Act of 1966, as amended.
Cultural resources are protected, preserved, and maintained in good condition.	Mission Goal Ia from Strategic Plan.
Cultural resources are managed within a broad context based on adequate scholarly and scientific information.	Mission Goal Ib from Strategic Plan.
NPS contributes to knowledge about cultural resources and human populations.	Mission Goal Ic from Strategic Plan.
75% of the archeological sites listed on the National Register or eligible are in good condition.	Long-Term Goal Ia10 from Strategic Plan.
Protect and preserve access for American Indians to sites to allow for the exercise of traditional religions.	American Indian Religious Freedom Act of 1978.
Defines “archaeological resources” in part as being at least 100 years old. Requires permit for excavation and removal of resources and sets penalties for violations.	Archaeological Resources Protection Act of 1979.
Assigns ownership and control of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony recovered from federal lands to lineal descendants or affiliated Indian tribes. Establishes criminal penalties for trafficking in human remains or cultural objects.	Native American Graves Protection and Repatriation Act of 1990.
Outlines NPS management policies regarding research, planning, stewardship, compliance, and management of cultural resources.	NPS-28, Cultural Resource Management Guidelines.

Constraints on Desired Future Conditions

The conservation (preservation) of a park’s “historic objects” (including sites, structures, and features) for the enjoyment of present and future visitors has effectively evolved into the identification and active interpretation of selective prehistoric and historic sites, and the protection, largely through maintaining their anonymity, of other sites. Section 106 compliance activities (inventories, evaluations, and planning) demand the vast majority of staff time, at the expense of other duties, including National Register nominations and listings. Limited resources further constrain opportunities, including the inventory of all parks lands, systematic site monitoring, building maintenance, and increased interpretation. Resource violations are investigated whenever they are encountered; though no ARPA cases have been advanced from the parks to date. Native American access for the practicing of traditional religious activities has not been formally requested; though discrete, small-party, private visitations have been related in conversations with program staff. The disturbance of Native American human remains has occurred through park-related activities at two locations since 1996. Native American involvement was immediately sought in both of these instances

of inadvertent discovery; remains and associated artifacts have been recovered and reburials are pending.

Strategies for Achieving Desired Future Conditions

The following actions will need to be pursued in order to attempt to reach the desired future conditions within existing constraints.

Understanding Cultural Resources

- Continue to conduct inventories and evaluations for planned projects.
- Seek supplemental funds annually to conduct additional inventories and evaluations, focusing on backcountry areas.
- Seek supplemental funds to conduct studies on administrative history, overview and assessment, historic resource studies, and National Register nominations and listings.
- Seek continued System Support Office involvement for cultural landscape inventories and evaluations.

Preservation and Maintenance

- Continue ad hoc monitoring of major, heavily visited sites.
- Seek supplemental funds to design and implement a parks-wide monitoring plan.
- Seek partnerships with universities, tribal groups, and research institutions to identify and support preservation needs.
- Involved law enforcement (Visitor Protection) rangers in increased patrolling of sites in developed areas.
- Involve maintenance personnel in protecting sites from erosion and other natural impacts.

Historic Structures

Summary

The List of Classified Structures (LCS) serves as the most up-to-date statement on the condition of the parks' historic structures. The list's 93 entries include buildings, structures, and features scattered across both parks, but primarily concentrated in the developed areas of the frontcountry.

Stressors and Resource Preservation Issues

Impacts from natural processes

The greatest threats to buildings and structures are the natural processes of decay and weathering. Heavy winter snows; moist, forested environments; and the falling of mature trees or their branches continue to create the greatest seasonal damage.

Impacts from management activities

Impacts resulting from general use (wear and tear) and decay continue to effect buildings and structures used for management purposes. Program funds are presently insufficient to maintain all of the buildings and structures to the level of the Secretary of the Interior's Standards for the Treatment of Historic Properties. The parks do however have a small team of skilled seasonal workers, led by an experienced Maintenance Work Leader (WL-4749-09), who undertake prioritized historic preservation treatments; funds to support these efforts have to be competed for annually.

Impacts from visitor use

Impacts to LCS-listed buildings or structures can occur through uninformed visitor use, including wood removal, carving, and collecting. Intentional vandalism, while uncommon, has occurred. Intentional destruction, while a potential impact, has not occurred.

Desired Future Conditions

Condition	Source
Manage parks "to conserve the scenery and the natural and historic objects…"	National Park Service Act of 1916.
Section 106 compliance.	National Historic Preservation Act of 1966, as amended.
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan.
Legally designated and proposed wilderness is managed to meet the standards and ideals of the Wilderness Act and as a component of a larger regional wilderness area.	Mission Goal Ib from Strategic Plan.
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan.
50% of the historic structures on the 1998 List of Classified Structures that appear to be eligible for National Register listing are in good condition.	Long-Term Goal 1a11 from Strategic Plan.
Apply provisions to historic structures where the structures are at least 100 years old.	Archaeological Resources Protection Act of 1979.
Follow management policies, including those that address the management of historic structures and the application of the Secretary of the Interior's Standards and Guidelines.	NPS-28, Cultural Resource Management Guidelines.

Constraints on Desired Future Conditions

Selective historic structures and features have been identified, interpreted (e.g., Gamlin Cabin and the Generals Highway) for the enjoyment of visitors, and, in some cases, made available for visitor use (e.g., Pear Lake Ski Hut and various Comfort Stations). The majority of the LCS-listed structures however are actively used for offices, storage, or employee housing; few of these structures are readily accessible to visitors, per se. Section 106 compliance activities are routinely undertaken relative to projects which stand to adversely effect LCS-listed structures (e.g., maintenance projects), but staff and funding are not currently available to prepare and submit nomination forms for increasing the number of National Register-listed structures. Non-base level maintenance monies (e.g., Cultural Cyclic and Repair/Rehab funds) are competed for annually; the parks have proven reasonably successful in competing for such funds. Resource violations are investigated whenever violations are encountered. Limited program resources constrain monitoring and interpretation activities, actions which, if expanded, could help to detect building decay and educate against vandalism.

Strategies for Achieving Desired Future Conditions

The following actions will need to be pursued in order to attempt to reach the desired future conditions within existing constraints.

Understanding Historic Structures

- Seek supplemental funds to undertake additional Historic Resource Studies and the subsequent preparation of individual Historic Structure Reports.
- Continue to work with the System Support Office to update periodically the List of Classified Structures.
- Seek additional base funding for the Maintenance Work Leader position to increase his work-year and oversee the planning and prioritization of historic preservation treatments.

Preservation and Maintenance

- Seek supplemental funding to prepare Historic Structural Preservation Guides (HSPGs); integrate results into the Inventory Condition and Assessment Program (ICAP).
- Develop a maintenance schedule for all historic structures.

Stabilization

- Identify priorities and seek supplemental funds as needed, including Emergency Stabilization funds

Preservation/Rehabilitation/Restoration/Reconstruction

- Seek supplemental Repair/Rehab, Cyclic Maintenance, and Cultural Cyclic funds annually.
- Apply the provisions of the Servicewide Programmatic Agreement, adhering to the Secretary of the Interior's Standard for the Treatment of Historic Properties.

Objects and Archival Manuscripts Collections

Summary

The Sequoia-Kings Canyon Museum (collections) serves to preserve and protect an aspect of the parks' cultural resources and to offer support to all branches of park management. At present, the museum collections contain approximately 320,000 items of which approximately one-quarter remains uncataloged. Significant collections include some 11,000 historic photographs and negatives, a small but important collection of local Native American basketry, the parks' archives, and a heavily used herbarium. The vast majority of collections are stored in the Museum Collections Area in the basement of the Ash Mountain Headquarters Building. This facility is relatively secure and well alarmed, a fire suppression system is in place, and the environment is closely monitored. Additional material is being stored in associated historic structures (e.g., Alles Cabin), oversized material is presently kept in a locked room in the Ash Mountain Warehouse, and additional items are on display in the parks' Visitor Centers. The security and degree of environmental monitoring varies widely amongst these secondary storage facilities.

Stressors and Resource Preservation Issues

Lack of Space in the Primary Collections Storage Facility

As identified in the Collections Storage Plan (Bush et al. 1997), the continued growth of the collections will only exacerbate the space constraints of the current facility. While the installation of compressed shelving has afforded a margin of room for growth, additional space, particularly for the herbarium, will soon be needed. The lack of adequate workspace for researchers and staff puts the collections unnecessarily at risk.

Integrity of the Primary Collections Storage Facility

Recent inspection has determined that the Ash Mountain facility is less secure against rodents and insects than desirable. The exhaust duct for the building's heating system opens onto the collections storage area, affording direct access for pests. This condition was concealed by a false ceiling. A proposal is being developed to address this material weakness.

Increase of Backlog Cataloging

As the collections continue to grow, present staffing will be unable to fully process the collections to full NPS standards. Additional funding will be required to eliminate existing and future backlog cataloging.

Inadequate Staffing

At present, the management of the collections is one of several ancillary duties of the Cultural Resources Specialist, assisted by a subject-to-furlough Museum Technician. The hiring of a full-time Museum Curator would ensure year-round, professional care and maintenance of the parks' collections.

Housekeeping Protocols and Equipment

The need for a formal Housekeeping Plan has been identified in a number of documents. Also recommended is the purchase of a Nilfisk vacuum (Bailey 1998, Katterman and Voeks 1997).

Desired Future Conditions

Condition	Source
To provide for "the preservation from injury of all timber, mineral deposits, natural curiosities or wonders… and their retention in their natural condition"	Act of September 25, 1890 – Establishing Sequoia National Park.
Manage parks to provide for the protection of historic, prehistoric and scientific features.	The Antiquities Act of 1906.
Manage parks "to conserve the scenery and the natural and historic objects… and to provide for the enjoyment of the same in such a manner and by such means as will leave them unimpaired for the enjoyment of future generations."	The National Park Service Act of August 25, 1916
Manage parks to "maintain historic or prehistoric sites, buildings, objects, and properties of national historical or archaeological significance and… establish and maintain museums in connection therewith."	The Historic Sites Act of 1935.
To accept donations or bequests of museum properties, purchase them from donated funds, exchange them, and receive and grant museum loans.	The Management of Museum Properties Act of 1955.
90% of preservation and protection conditions in park museum collections meet professional standards	Long-Term Goal 1a12 from Strategic Plan.
To maintain collections in keeping with NPS standards and objectives.	Museum Handbook (1998).
To preserve resources in keeping with NPS standards and objectives.	NPS-28, Cultural Resource Management Guideline.

Constraints on Desired Future Conditions

The primary limits upon the collection and maintenance of museum properties are identified with some precision in the aforementioned legislation. In general, a museum is not to acquire material it cannot maintain to NPS standards and, if a resource is not threatened, the express preference is to leave it *in situ* (in place and uncollected). The growth of collections is to be guided by a Scope of Collections Statement (SOCS) which should be reviewed periodically. As developed for Sequoia-Kings Canyon, the SOCS is specifically regional and limited to the natural and human history of the Southern Sierra Nevada.

Strategies for Achieving Desired Future Conditions

The following actions will need to be pursued in order to attempt to reach the desired future conditions within existing constraints.

Understanding of Collections

- Inventory holdings on a regular basis.
- Encourage research inside and outside of the parks.
- Develop and maintain relationships with other institutions with related holdings.
- Research and record topics of local interest and relevance.
- Identify and redress shortfalls in the collections.

Preservation and Maintenance

- Continue to record and analyze environmental conditions in the collections area.
- Continue to follow NPS collections management guidelines.
- Document collections in ANCS+ (catalog database).
- Continue to monitor and address potential infestation.
- Pursue soft monies to complete backlog cataloging, prepare a Housekeeping Plan, and to investigate storage area expansion.

Outreach and Education

- Continue to research questions from visitors and staff.
- Pursue emerging avenues for outreach (e.g., the parks' web page).
- Utilize available media for sharing of museum resources and research.
- Conduct informal tours of the collections as needed.

Cultural Landscapes

Summary

NPS management policies recognize four categories of cultural landscapes: Historic Designed Landscapes, Historic Vernacular Landscapes, Historic Sites, and Ethnographic Landscapes. The identification and documentation of cultural landscapes in the Pacific Great Basin Area is coordinated by the System Support Office (SSO) in San Francisco. The SSO is charged with designing an incremental, multi-year program that will eventually lead to the preparation of a Cultural Landscapes Inventory (CLI) for each eligible park in the Pacific Great Basin Area. Individual Cultural Landscape Reports (CLRs) are then to be prepared for all identified cultural landscapes. Ultimately, all National Register-eligible landscapes will be nominated for formal listing. To date, a single cultural landscape has been identified in Sequoia-Kings Canyon; this landscape, defined as the proposed Mineral King Cultural Landscape District (Carr and McNiel 1999), is of the historic vernacular landscape type.

Stressors and Resource Preservation Issues

In the absence of a preliminary inventory of cultural landscapes in the parks it is problematic to identify stressors and issues. In general terms however, it would not be unjustified to identify the major developed areas of the parks as likely containing potential historic designed or vernacular cultural landscapes (i.e., Ash Mountain, Lodgepole, Grant Grove, and Cedar Grove). A proposed landscape district in Mineral King has, as noted above, been identified.

Impacts from natural processes.

Natural processes such as erosion, wildfire, and plant succession have the potential to adversely effect cultural landscapes.

Impacts from management activities.

Construction or maintenance work which modifies either natural or cultural resources within a geographic area, and, which resources are associated with a historic event, activity, or person, stand to impact cultural landscapes. Similarly, aspects of trail construction or even prescribed fire management could adversely effect such landscapes.

Impacts from visitor use.

Uninformed recreational activities such as ground-leveling and trenching, waste disposal involving excavation, rock or wood removal, and livestock corralling could adversely impact the contributing elements of cultural landscapes, especially on a large-scale or aggregated over time (e.g., concentrated backcountry camping). Intentional theft, excavation, or vandalism can have obvious impacts on cultural landscapes.

Desired Future Conditions

Condition	Source
Manage parks "to conserve the scenery and the natural and historic objects…"	National Park Service Act of 1916.
Section 106 compliance.	National Historic Preservation Act of 1966, as amended.
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan.
Legally designated and proposed wilderness is managed to meet the standards and ideals of the Wilderness Act and as a component of a larger regional wilderness area.	Mission Goal Ib from Strategic Plan.
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan.

Condition	Source
Follow management policies, including those that address the management of cultural landscapes and the application of the Secretary of the Interior's Standards and Guidelines.	NPS-28, Cultural Resource Management Guideline.

Constraints on Desired Future Conditions

Pending the future preparation of a parks-specific inventory, conservation (preservation) of the parks' potential cultural landscapes will be conducted on a largely piecemeal, project-by-project basis. Section 106 compliance activities, within developed areas in particular, will have to take into account the emerging concept of cultural landscapes. Elsewhere, for example in backcountry areas, the general absence of landscape disturbing proposals will have to serve to protect potential cultural landscapes (i.e., arguably related to historic mining or livestock grazing, or ethnographic uses); this avoidance of impact will likely serve as ad hoc protection for the foreseeable future.

The identification and documentation of cultural landscapes is not specifically funded at the parks level. Funding to coordinate this work is assigned to the System Support Office (SSO). The resources are limited however in any given fiscal year, serving to constrain the timeliness of the completion of a Cultural Landscape Inventory (CLI) for Sequoia-Kings Canyon. Similarly, it is assumed that the production of any corresponding Cultural Landscape Reports (CLRs) or National Register nominations are, at best, several years in the future.

Strategies for Achieving Desired Future Conditions

The following actions will need to be pursued in order to attempt to reach the desired future conditions within existing constraints.

Understanding Cultural Landscapes

- Actively support the System Support Office (SSO) in its efforts to secure funds for inventory and documentation, leading to the preparation of a parks-specific Cultural Landscape Inventory.
- Seek continued SSO involvement for cultural landscape investigations, resulting in the preparation of Historic Resource Studies and Cultural Landscape Reports.
- Pending acceptance of the proposed Mineral King Cultural Landscape District, prepare and submit National Register nomination forms.

Preservation and Maintenance

- Complete Section 106 compliance for all projects that stand to adversely effect designed or vernacular landscapes, historic sites, or potential ethnographic landscapes.
- Inform Maintenance personnel and Law Enforcement (Visitor Protection) rangers of the contributing elements of potential cultural landscapes. Seek supplemental funds to enhance preservation training for key maintenance personnel.
- Continue monitoring by an archeologist of all ground disturbance in areas with potential cultural landscapes.

Preservation/Rehabilitation/Restoration/Reconstruction

- Involve a Historical Landscape Architect in the preparation or review of all treatment plans affecting potential cultural landscapes.
- Seek supplemental Cultural Cyclic and Cultural Resource Preservation Program funds annually.
- Follow the guidelines for research, planning, and stewardship in NPS-28, along with pertinent references in the Secretary of the Interior's Standards and Guidelines.

Ethnographic Resources

Summary

Ethnographic Resources include sites, structures, objects, landscapes, and natural resource features to which a group attaches traditional significance. Most often, ethnographic resources are identified as being associated with the cultural systems or lifeways of Native American groups. Potentially, ethnographic resources can be used to inform the management of many park programs, including archeology, history, natural resources, museum collections, cultural landscape inventories, interpretation, and planning.

Ethnographic information can be gathered and reported in a variety of ways, including the preparation of Ethnographic Overviews and Assessments, Traditional Use Studies, Rapid Ethnographic Assessment Projects (REAPs), Ethnographic Landscape Studies, Cultural Affiliation and Lineal Descent Studies, Ethnohistories, and Ethnographic Oral and Life Histories. The data gathered through the preparation of such studies should be summarized in an Ethnographic Resources Inventory (ERI); such an inventory serves as a management listing of the known cultural and natural features accorded significance by traditionally associated groups.

Very few of the types of research documents noted above are available for Sequoia-Kings Canyon. A parks-specific overview and assessment has not been prepared, neither have formal traditional use studies. Nevertheless, a small but important body of data pertinent to the Native American history of the area is available through past studies and syntheses. Key among these references are Gayton (1948), Herron (1980), Heizer (1978), Steward (1933, 1935), and Voegelin (1938).

The parks consulted with tribal groups throughout 1990 and 1991 to facilitate the reburial of human remains collected in the 1960s from the Hospital Rock site (CA-TUL-24). These remains were re-interred in November 1991. Museum collections were inventoried in the mid-1990s in response to the provisions of the Native American Graves Protection and Repatriation Act (NAGPRA). Presently, the disposition of human remains and artifacts associated with two subsequent incidents of "inadvertent discovery" (1996 and 1999) await final NAGPRA-related consultation, with reburial expected no later than the spring of 2000. Additionally, consultation meetings with Native American groups, on both sides of the Sierra Nevada, were conducted in the summer of 1999 as part of the ongoing update of the parks' General Management Plan (GMP).

Stressors and Resource Preservation Issues

In the absence of parks-specific traditional use studies or an overview and assessment, the identification of important ethnographic resources relies on past studies and existing consultation results. Minimally, sites such as Hospital Rock and Potwisha (CA-TUL-28), both of which contain prominent rock art panels, should be viewed as important sites; anecdotally, these and similar

"archeological" sites are visited informally by Native Americans for personal spiritual purposes (i.e., unannounced). Similarly, natural resource features such as oak groves (acorns), pinyon groves (pine nuts), elderberry stands (fruits), and bracken fern stands (roots) remain important sources of traditional food and raw material to many tribal groups. The degree to which any of these resources are actively sought on park-managed land is not known; the availability of these resources on nearby or adjacent Forest Service-managed lands have generally led to gathering activities in these non-park areas.

The identification and importance of ethnographic landscapes as such (e.g., Sequoia groves?) have not been ascertained. The protection and preservation of gravesites and their burials is of paramount importance to many Native American groups throughout the area. The traditional reluctance on the part of individuals and families to reveal the locations of cemeteries and burials serves to compound the difficulty, to some degree, of protecting those sites now located on public lands. However, early and continued consultation with Native American groups can serve equally well in helping to prevent unintentional impacts.

Impacts from natural processes.

Natural processes such as erosion, wildfire, and plant succession have the potential to adversely effect ethnographic resources.

Impacts from management activities

Construction or maintenance work that modify either natural or cultural resources within an area stands to impact ethnographic resources. Similarly, resource management activities such as pesticide or herbicide applications or prescribed fire could adversely effect ethnographic resources, especially culturally important plants and their distributions.

Impacts from visitor use

Uninformed recreational activities such as ground-leveling and trenching, waste disposal involving excavation, artifact removal, resource gathering, and livestock corralling could adversely impact ethnographic resources, especially individual sites or the contributing elements of potential landscapes. Intentional theft, excavation, or vandalism at valued sites or structures (e.g., hunting blinds) would have obvious adverse impacts.

Desired Future Conditions

Condition	Source
To provide for "the preservation from injury of all timber, mineral deposits, natural curiosities or wonders…and their retention in their natural condition".	Act of September 25, 1890 – Establishing Sequoia National Park.
Manage parks to provide for the protection of historic, prehistoric and scientific features.	Antiquities Act of 1906.
Manage parks "to conserve the scenery and the natural and historic objects…"	National Park Service Act of 1916.
Section 106 compliance.	National Historic Preservation Act of 1966, as amended.

Condition	Source
Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.	Mission Goal Ia from Strategic Plan.
Legally designated and proposed wilderness is managed to meet the standards and ideals of the Wilderness Act and as a component of a larger regional wilderness area.	Mission Goal Ib from Strategic Plan.
The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.	Mission Goal Ic from Strategic Plan.
The 1997 baseline inventory and evaluation of each category of cultural resources is increased by 5%.	Long-Term Goal Ic2 from Strategic Plan.
Protect and preserve access for American Indians to sites to allow for the exercise of traditional religions.	American Indian Religious Freedom Act of 1978.
Apply the provisions to sites, structures, and objects that are at least 100 years old.	Archaeological Resources Protection Act of 1979.
Apply the provisions to Native American human remains and objects as defined.	Native American Graves Protection and Repatriation Act of 1990.
Follow management policies, including those that address the management of ethnographic resources and the application of the Secretary of the Interior's Standards and Guidelines.	NPS-28, Cultural Resource Management Guideline.

Constraints on Desired Future Conditions

Pending the future preparation of a parks-specific overview and assessment, conservation (preservation) of the parks' ethnographic resources will be conducted on a largely piecemeal, project-by-project basis. Section 106 compliance activities, within developed areas in particular, will have to take into account known or potential ethnographic resources. Elsewhere, for example in backcountry areas, the general absence of larger-scale, ground-disturbing activities will have to serve to protect ethnographic resources; this avoidance of impact will likely serve as ad hoc protection for such resources for the foreseeable future.

The identification and evaluation of ethnographic resources (including National Register-eligible Traditional Cultural Properties) are not specifically funded at the parks level. Funding must be sought and competed for annually. Pertinent sources are often moderately funded, including the Cultural Resources Preservation Program and the Ethnography Program.

Strategies for Achieving Desired Future Conditions

The following actions will need to be pursued in order to attempt to reach the desired future conditions within existing constraints.

Understanding Ethnographic Resources

- Seek supplemental funds to prepare an Ethnographic Overview and Assessment.
- Seek supplemental funds to prepare Traditional Use Studies for areas of highest impact or potential access (i.e., Developed Areas).
- Evaluate the need for future Landscape Studies, Cultural Affiliation and Lineal Descent Studies, Ethnohistories, and Ethnographic Oral and Life Histories.
- Prepare and update an annotated bibliography of park-related ethnographic works.

Preservation and Maintenance

- Complete Section 106 compliance for all projects that stand to adversely effect known or potential ethnographic resources.
- Prepare and keep current an Ethnographic Resources Inventory.
- Train Maintenance personnel and Law Enforcement (Visitor Protection) rangers in the importance of Ethnographic Resources and their protection.
- Continue monitoring by an archeologist, in consultation with appropriate Native American groups, of all ground disturbance in areas with known or potential ethnographic resources.
- Follow the guidelines for research, planning, and stewardship in NPS-28.

NATURAL AND CULTURAL RESOURCES MANAGEMENT PROGRAM

OVERVIEW OF CURRENT PROGRAM AND NEEDS

This section contains the current and proposed resource stewardship programs of the parks. These include the Science and Natural Resources Management, Resource Protection, Research, and Resource Interpretation/Education Programs. It builds on the Resource Description in the Introduction and the Resource Conditions sections. It also expands on the overall strategies identified in the Resources Condition section and the strategies behind the project statements.

The section describes the parks' day to day Science and Natural Resources Management Program, including interdivisional responsibilities in natural resources management, resource protection, resource interpretation/education, and environmental compliance. The scope of the parks' current science and resources management, resource protection, research, and resource interpretation/ education programs are discussed with reference to personnel and funding for the current fiscal year and future needs. A statement and responsibilities of each of the parks' divisions with respect to the resources is included.

Unfunded operational needs are presented through a NR-MAP and CR-MAP analysis of the parks. A Natural and Cultural Resources Management Budget Summary linked to the Strategic Plan long-term Goals and funding sources is also presented. Staffing and skills needed to implement the Science and Natural Resources Management, Resource Protection, Research, Resource Interpretation/Education, and Compliance Programs are prioritized for future operational funding submissions. These submissions are linked to OFS and PMIS. Organization charts show the existing natural and cultural resource positions and how the natural and cultural resources management programs would be organized if they were at the one hundred percent level according to NR-MAP and CR-MAP.

NATURAL RESOURCES

Introduction

The natural resources of Sequoia and Kings Canyon National Parks are outstanding examples of the central and southern Sierran ecosystems. Natural resources, which undoubtedly brought about national park status, were wilderness and forest vegetation, especially sequoia forests. These natural resources were cited in the Acts establishing the area as parks. All of these parks' natural resources are like building blocks with the logical capstone being wilderness. Here there are many ecological factors working within a natural system relatively unaltered by man. The sequoia forests are a wonder of the world and the magnificent groves in these parks are some of the finest still in existence.

The natural resources of these parks are increasingly being threatened by air pollution. Wildfire, the exclusion of some natural fires, and man's use of these parks also cause impacts. Global climate change, possibly including the loss of some species; acid deposition; exotic species invasions, habitat fragmentation, and ozone will affect these parks' resources well into the future. These threats alter the natural processes and ecological relationships. Unless the trends are mitigated or reversed, we will not be able to *perpetuate the natural ecosystems of these parks so they may operate essentially unimpaired by human interference* and preserve these parks for future generations.

The Science and Natural Resources Management Program and the Western Ecological Research Center (WERC) of the Biological Resources Division (BRD) of the USGS Research Program are designed to address the issues identified above. Elements of the program include:

(1) Know and Understand the Condition of the Natural Resources

This element includes developing a Long-Term Ecological Inventory and Monitoring Program to inventory the natural resources and to understand changes in the natural resources and ecosystems over time, through the identification and monitoring of vital signs. Long-term ecological monitoring programs that are currently underway, or being developed, include: air resources; aquatic/water resources; caves/karst; exotic species; experiential values (soundscapes/nightsky/aircraft overflights); fire; geological resources; human resources; meadows; paleontological resources; threatened/endangered/sensitive species; terrestrial and aquatic vegetation; and terrestrial and aquatic fauna.

WERC's Research Program is designed to provide knowledge in a wide variety of areas. These include global climate change, fire research, and baseline studies on understanding environmental controls on species distribution, soils and vegetation, effects of air pollution on ecosystems, exotic and T&E and sensitive plant species, caves, hydrology, and sociology.

(2) Restoring Altered Natural Systems

This element includes restoring fire to park ecosystems and restoring areas disturbed by humans to "natural conditions" through an active restoration program. The Prescribed Fire Program is designed to restore the natural role of fire and to reduce unnatural fuels, especially in sequoia groves. Once the natural structure has been restored and the unnatural fuels reduced natural fire will once again be allowed to burn. The revegetation program will focus on restoring/revegetating areas disturbed by construction and by humans in the Development Zone and heavily impacted wilderness campsites and high mountain meadows.

Many of the parks' aquatic communities require restoration to eliminate changes caused by exotic species and anthropogenic addition of nutrients and other chemical constituents. Some lakes and streams are physically impacted by streambank degradation and substrate disturbance caused by swimmers, waders, and anglers. Exotic trout in lakes will be eliminated to preserve the native aquatic biota, particularly the mountain yellow-legged frog.

Some wildlife populations require restoration. Reasons include habitat alteration; changes in population structure, behavior, and distribution caused by access to anthropogenic foods; genetic introgression; and competition by exotic species. Areas disturbed by exotic plant species also need to be restored.

(3) Maintaining Natural Resources and System Function

This element includes managing vegetation and wildlife in the front country and backcountry, evaluating the impacts of grazing on meadows in the backcountry, excluding trespass cattle, controlling exotic plants and animals, maintaining the natural fire regimes, managing bears, managing other wildlife species, and developing and implementing the cave management program.

(4) Protecting Natural Resources

This element includes a wide range of programs carried out by the Division of Fire and Visitor Management. Programs include wilderness/backcountry management of visitors to mitigate impacts to natural resources; monitoring of aircraft overflights; and fishing, poaching and trespass-grazing patrols.

(5) Interpretation and Education of Natural Resources

Interpretation and education about the natural resources and processes and their significance to the park visitor and the public encourages involvement and protecting the natural resources.

STATUS OF SCIENCE AND NATURAL RESOURCES MANAGEMENT, RESOURCE PROTECTION, NATURAL RESOURCES INTERPRETATION/EDUCATION, AND RESEARCH PROGRAMS

The Natural Resources Program outlines a comprehensive, step-by-step strategy for addressing each of the major natural resource issues facing the parks. This is accomplished through the Natural Resources Management Assessment Program (NR-MAP). Each major natural resource issue is addressed in the appropriate NR-MAP program. Projects that are related to each program are identified.

The Natural Resources Program of Sequoia and Kings Canyon National Parks is a diverse program that involves all divisions. The Division of Science and Natural Resources Management carries out the bulk of the program. The Division of Research is now a field station of the Western Ecological Research Center of the Biological Resources Division (BRD) of the USGS stationed at the parks and continues to do ecosystem research in the parks. The Divisions of Interpretation and Cultural Resources, Fire and Visitor Management, and Maintenance are also actively involved in natural resource programs and projects. The following presents a brief discussion of the current Natural Resources Program in each division and the Research Program conducted by BRD. The sections following provide a more in depth description of the programs for the divisions, the current program, and the fully funded (adequate) program, as identified by the Natural Resources Management Assessment Program (NR-MAP).

Division of Science and Natural Resources Management

The current FY 2000 science and natural resources management programs only partially address the issues identified in the introduction to this section (page 135). Programs that are currently underway include: long-term ecological inventory and monitoring; vegetation management (exotic species management and threatened/endangered and sensitive plant species management); wildlife management (bear management, exotic animal management, and threatened/endangered, and sensitive animal species management); prescribed fire monitoring and management; air resources management, cave management; stock use and meadow monitoring; tree hazard management; disturbed lands restoration; revegetation; GIS/data management; science, natural resources management/supervision and administration; resource and bioregional planning; and compliance.

These parks have been leaders of programs such as prescribed fire management, fire research, and fire effects monitoring for more than 30 years and are recognized as leaders in the fields of air quality monitoring, wildlife management, wilderness management, and tree hazard management. Despite its wide recognition and successful track record, the science and natural resources management program survives precariously. The lack of ONPS base funding and adequate professional staff to stay on top of the myriad of issues with which the park maintains a leadership role has created a serious situation. It is ineffective for the National Park Service and

stressful for the principals. Similarly facilities that include office and storage space and housing are totally inadequate. Many offices are now located in condemned houses. This restricts the potential for leveraging funds to attract outside research cooperators and programs. If Sequoia and Kings Canyon National Parks are to continue to provide a leadership role, a consensus for commitment must be developed among the park, Region, and Washington staff to support the level of science and natural resources management necessary to *preserve the parks' natural resources for future generations*. This commitment must involve management endorsement as well as cooperation in improving and enlarging facilities and securing adequate ONPS base funding and staff.

Divisions of Interpretation and Cultural Resources, Maintenance, Fire and Visitor Management, and the Environmental Management Committee

The objectives of the Division of Interpretation and Cultural Resources are to (1) communicate and interpret natural-resources issues to the visitor, (2) educate the visitors and the public in ways that they can preserve the natural resources, and (3) discuss the ongoing science and natural resources management and research programs. Activities include providing interpretive walks and talks to discuss fire management and the role of natural fire; air quality issues such as ozone impacts and visibility impairment; and bear-human interactions in the front country and backcountry. Much of the knowledge that is gained from the science and natural resources management program is interpreted to the visitor. By improving the public's understanding of our natural resources and natural resource problems, we improve our chance of preserving our natural resources.

The Division of Maintenance is involved in rerouting trails (especially removing trails from backcountry meadows) and restoring abandoned trail segments. The bulk of the backcountry maintenance program is in trail maintenance. Proper maintenance and restoration of trails prevents natural resource damage caused by erosion. The Division of Maintenance also provides support to the bear management program through installation and maintenance of bear-proof facilities.

The Division of Fire and Visitor Management is involved in natural resource protection and enforcement of regulations. Programs consist of fire management (e.g., presuppression, suppression, and prescribed fire operations), visitor and stock use management in the wilderness, rock climbing management, poaching patrols, trespass grazing, and enforcement of natural resource regulations. In bear management the Division of Fire and Visitor Management provides the majority of the public contact (educating and assisting visitors and enforcing bear-management regulations).

The Environmental Management Committee is involved in reviewing park plans, such as the General Management Plan and DSC Plans and park projects, and providing the necessary environmental compliance.

Research Program

The parks seek to incorporate the best possible scientific information and scientific methods in resources management activities. This is accomplished by utilizing published and sometimes unpublished research findings, the expertise of scientists and other professional experts; by collecting and analyzing data about resources conditions in the parks; and by sponsoring or collaborating with others to conduct scientific research in support of park natural resources management.

Current Research

A major research focus is the Sierra Nevada Global Change Research Program, which began in 1991 and is currently funded largely by USGS cyclical money through fiscal year 2003. The aim of this project is to understand forest structure and function and to predict the effects of global changes on these forests. The program is organized around three themes: contemporary ecology, paleoecology, and modeling. The contemporary ecology theme, led by Dr. Nate Stephenson and Dr. Jon Keeley (Sequoia and Kings Canyon Field Station) and Dr. Jan van Wagtendonk (Yosemite Field Station), takes advantage of the Sierra Nevada's substantive climatic gradients as "natural experiments," allowing researchers to evaluate climatic mechanisms controlling forest composition, structure, dynamics and fire regimes. The paleoecological theme, led by researchers from the University of Arizona and Montana State University, is providing an increasingly clearer picture of past changes in climate, disturbance, and forest response. Computer models, developed by researchers from Duke University, act as an integrative framework for research findings in the contemporary and paleoecological themes, and provide managers with a tool for "gaming" the outcome of different management approaches.

Work to date in the Sierra Nevada Global Change Research Program has demonstrated that the last 50 years in California have been among the wettest of the last millennium, and that multi-decadal droughts of much greater length and severity than any experienced in California during the last century have occurred regularly in the past. These findings have served as an abrupt wake-up call for California land managers and water resource planners. The program's fire history reconstructions are now used by land managers up and down the Sierra Nevada as a target for restoring pre-Euroamerican fire regimes to forests suffering the effects of a century of fire exclusion. Investigations into the effects of fire regimes on forest pattern and dynamics have led to modifications in both prescribed fire and timber harvesting approaches in the Sierra. The FARSITE fire behavior and spread model, initiated as part of the program, has become the most widely-used fire model by North American land managers, giving managers a valuable tool for planning prescribed fires and for predicting the spread of wildfires. The program has also supplied resource managers with a means of using simple tree measurements to predict forest fuel accumulation in the fire-prone forests of the Sierra Nevada. Past and expected results of the global change program will also contribute heavily to the development of vital signs monitoring.

This and other field station programs, funded by both base and cyclical money, and in cooperation with NPS and academic scientists, are providing needed input to NPS fire management plans. Currently, these plans call for restoring fire to the brush and forested communities and appropriate target conditions require reliable information on the historical range of variation in fire regimes and vegetation communities across a topographically diverse landscape. Several projects are actively researching this topic through studies of the following sources of information: historical documents, temporal comparisons with historical photographs, historical records from tree rings and shrub stand ages, correlative studies with climatic variables, and comparative studies with other regions in the state. In addition, station scientists, in cooperation with fire and resource management in the park, have worked over the past year with a network of outside scientists to include Sequoia in a national study on the ecological impacts of fire hazard reduction. This proposal has been submitted to the USDI/USDA Joint Fire Science Program with funding expected in FY2000.

Fire related studies and research is coordinated by an ecologist in the Fire and Vegetation Monitoring branch.

A research program designed to address invasive plant problems in the southern Sierra Nevada was begun in 1991 through a merger of the Natural Resources Inventory and the Weeds of the West

initiative and is continuing through FY 2000 on base funding. One product nearing completion is an inventory of exotic species and relative abundance along road and river corridors and other suspected points of invasion such as campgrounds within Sequoia, Kings Canyon and Yosemite national parks. Products to be completed by the fall of 2000 are GIS maps of exotic species in these selected sites and a report that utilizes published information to make predictions of the potential for further invasion by these exotic species and possibilities for eradication. This program is currently focusing on the role of disturbance and native plant diversity on invasive plant success in selected grass, shrub and tree dominated communities in Sequoia and Kings Canyon national parks.

Since 1982, air and water quality have been a primary focus of the watershed program at Sequoia and Kings Canyon field station. One early conclusion of this project was that stream chemistry was perturbed far more by fires than by air pollution and thus the current focus is centered on collecting pre-fire data from watersheds scheduled for prescription burning. A synthesis of this program is currently planned but a completion date has not been set. Continued funding is guaranteed through FY 2000 from a combination of USGS cyclical and base funds and NPS funds. Other air quality studies are being conducted by research scientists from USDA Forest Service and the Boyce Thompson Institute. These studies are focused on the biological impacts of ozone and atmospheric pollutants and development of markers for these stressors.

Future Research Needs

Invasive plants and animals will continue for some time to pose significant threats to the resources of these parks. One area in need of more immediate research focus is the role of management activities like prescription burning on potential invasive problems such as the cheatgrass invasion, most prominent in the Cedar Grove area of Kings Canyon National Park.

Rare and endangered species have received minimal research attention in the past and those requiring the most immediate attention are the mountain bighorn sheep and mountain yellow-legged frog.

Restoring fire to brushland and forested ecosystems in the parks will require further research into the appropriate targets for long-range ecosystem maintenance. In particular, as the park moves more and more from localized prescribed burning to landscape scale fire management, there is the need for a much better understanding of the appropriate spatial and temporal variation in fire frequency. We also need a better understanding of the extent to which landscape fragmentation and continuing fire suppression activities prevent natural fires alone from restoring the historical fire regimes. This information will be crucial to determining the extent to which natural fires must be subsidized by prescribed burns. Also a more quantitative understanding of the Native American contribution to the historical fire record is needed in order to develop fire management plans that subsidize natural fires with the appropriate amount of prescribed burning. Future modeling studies that relate forest changes to fire regimes will add greatly to the manager’s ability to develop fire management plans appropriate for long term ecosystem maintenance.

Additionally, returning fire to these ecosystems following a century of fuel accumulation, has potential impacts on watershed hydrology, nutrient cycling and sediment loss. These issues have ramifications for both park resources and for downstream resources.

Considering the projected demographic patterns for the San Joaquin Valley it is certain that air quality issues will be of increasing concern. Future research will be needed on the impacts of atmospheric pollutants (ozone, nitrogen oxides, and pesticides) on both human health as well as well as on other animals and plants.

Western Ecological Research Center Field Station

The USGS Western Ecological Research Center field station at Sequoia and Kings Canyon national parks has broad responsibility for planning, coordinating, and executing research programs and studies necessary to provide the scientific information upon which management decisions are made. The field station staff conduct scientific research that focuses primarily upon ecosystems of the southern Sierra Nevada with a major emphasis on research conducted within Sequoia and Kings Canyon national parks. Research programs are funded through base and cyclical funds from USGS as well as grants and contracts from other state and federal agencies and private organizations. Scientists at the station work with park personnel in the development of research priorities and all projects are peer reviewed by outside scientists. Research results and their implications are provided to the Park Service and to other Department of Interior agencies.

Research scientists at the station routinely contribute their technical expertise to management through participation in meetings, workshops, training activities, project reviews and other professional consultation in the park. Additionally, technical assistance is provided to other national parks as well as to other Department of Interior agencies in the region. An important function of the field station is to develop close ties with research scientists from universities and other state and federal agencies and encourage cooperative research in Sequoia and Kings Canyon national parks. In this regard the station acts as a liaison between the Park Service and the outside research community. The field station is responsible for administrative oversight and technical, lab, and field support for both in-house and cooperative research and is the chief repository for scientific products pertaining to Sequoia and Kings Canyon national parks. Currently there are three permanent positions assigned to the field station.

Science Advisor

The Parks' Science Advisor is attached to the Superintendent's Office. He assures that scientific information of credibility and known reliability is applied to the resources stewardship and public interpretation missions of the parks. He further assures that objective, disinterested analysis (i.e., scientific thinking) is appropriately incorporated into planning, policy, and decision-making. The science advisor has principal responsibility for the following functions:

- Tactical research
- Administration and management of sponsored research
- Coordination of contributed, cooperative and collaborative research
- Solicitation of research and funding for it
- Research oversight and review
- Liaison with USGS and scientific community at large
- Access to the body of scientific literature
- In-house objective analysis
- Technical transfer of scientific information for management and interpretation
- Strategic planning to meet anticipated scientific needs

The Science Advisor works closely with resources management specialists to anticipate forthcoming needs for scientific information, and to coordinate necessary research with the resources management function. In particular, he serves as principal liaison with the Sequoia and Kings Canyon Field Station of USGS.

Table 5 identifies each division and WERC and their areas of involvement.

Table 5: Natural Resource Programs Conducted by Park Divisions, the Environmental Management Committee, and WERC

Natural Resource Program Area	Div of Science and NRM	Division of Interp. and Cultural Resources	Division of Fire and Visitor Management	Division of Maintenance	WERC	Environmenta Management Committee
Science and Natural Resources Management	X		X	X		
Natural Resources Protection			X	X		
Natural Resource Interpretation Education		X				
Research	X				X	
Compliance	X	X	X	X	X	X

Natural Resources Management Assessment Program (NR-MAP) Analysis for the Science and Natural Resources Management, Resource Protection, Natural Resource Interpretation/Education and Research Programs

NR-MAP is a process that provides an objective assessment of the ONPS base staffing and funding needed to implement a thorough natural resources program in a park. NR-MAP allocates FTEs and support funding for four major natural resource categories – natural resources management, natural resource protection, natural resource interpretation/education, and research (following three tables). Within each of these categories there are several programs, such as vegetation management and wilderness patrol. The long-term goal is to bring the natural resources management, resource protection, natural resource interpretation/education, and research programs to full funding, as identified by NR-MAP. The current science and natural resources management program (including all divisions and programs described above) consists of. 106.09 FTEs. The fully funded (adequate) NR-MAP natural resources program, resource protection, and research program is 164.22 FTEs (also includes management and supervision, clerical, administration, and maintenance support).

There will be three phases, or benchmarks needed to close the gap between the current natural resources program of FTEs to reach the fully funded (adequate) level of FTEs. Each phase or benchmark will fund approximately one third of the gap. The one third may vary depending on the particular needs of each program. Table 6 shows the NR-MAP Analysis for the parks.

Table 6: Natural Resources Management Assessment Program Analysis for the Science and Natural Resources Management Program (ONPS Base Only)

Natural Resource Program Area	Current Park Staffing (FTEs)	Workload (FTE)	Difference	
			FTE	% Staffed
Vegetation Management	1.10	4.94	3.84	22
Wildlife Management	2.00	16.59	14.59	12
Prescribed Fire Management	2.00	10.04	8.04	20
Water Resources Management	0.00	4.39	4.39	0
Air Resources Management	1.00	3.89	2.89	26
Geologic Resources Management	1.00	4.86	3.86	26
Paleontological Res. Management	0.00	0.22	0.22	0
Grazing management	1.00	2.70	1.70	37
Fence maintenance	0.00	0.32	0.32	0
Disturbed area rehabilitation	0.70	6.80	6.10	10
Pest and hazard management	2.70	9.07	6.37	30
Environmental planning and compliance	1.00	3.20	2.20	31
GIS/data management	1.00	4.50	3.50	22
Science oversight	1.00	1.10	.10	91
Clerical/Admin. Support	1.0	11.60	10.60	8
Management/Supervision	1.0	7.00	6.0	14
Total	**16.50**	**91.22**	**74.72**	**18.1**

Table 7: Natural Resource Management Assessment Program Analysis for Natural Resources Protection, Natural Resource Interpretation/Education, Administration and Maintenance Programs

Resource Program Area	Current Park Staffing (FTEs)	Workload (FTE)	Difference	
			FTE	% Staffed
Control of Poaching/Theft of Natural Resources	0.75	3.24	2.49	23
Backcountry Patrol	8.0	10.26	2.26	78
Frontcountry Trail Patrol	1.4	1.51	0.11	93
Backcountry/Wilderness Permitting	3.0	3.24	0.24	93
Rock Climbing Management	0.0	0.54	0.54	0
Alpine Climbing Management	0.0	0.76	0.76	0
Fishing Enforcement	0.1	1.08	0.98	9
Trespass Grazing Management	0.5	0.76	0.26	66
Natural Resources Interpretation/Education	0.0	2.24	2.24	0.0
Administration (Division of Administration)	0.00	15.67	0	0
Maintenance of Resource Protection Facilities (Division of Maintenance)	0.50	15.39	14.89	3
Clerical Support for Resource Protection	2.84	3.24	0.40	88
Management and Supervision for Resource Protection	3.00	3.00	0.00	100
Prescribed Fire Operations	6.8	7.34	0.54	93
Collections Management	0.1	1.7	1.6	6
Total	**27.**	**66.98**	**39.99**	**40.3**

Table 8: Natural Resource Management Assessment Program Analysis for Research

Research Program Area	Current Park Staffing (FTEs)	Workload (FTE)	Difference	
			FTE	% Staffed
Native Terrestrial Plant Research	1.10	1.12	0.02	98
Native Aquatic Plant Research		0.32	0.32	0
Threatened and Endangered Plant Research		0.22	0.22	0
Exotic Plant Research	0.20	0.43	0.23	46
Fire Research	0.50	0.97	0.47	51
Native Terrestrial Animal Research		0.86	0.86	0
Native Aquatic Animal Research		0.76	0.76	0
Threatened and Endangered Animal Research		0.86	0.86	0
Exotic Animal Research		0.22	0.22	0
Hydrology Research	0.10	0.76	0.66	13
Air Quality Research	0.10	0.76	0.66	13
Paleontological Research		0.11	0.11	0
Geoscience Research		0.32	0.32	0
Social Science Research		0.43	0.43	0
Clerical Support for Research		1.23	1.23	0
Management Supervision for Research	1.00	1.00	0.00	100
Total	**3.0**	**10.37**	**7.37**	**29**

Natural Resources Budget Summary by Funding Source and Long-Term Goal

Table 9 presents the FY 2000 budget (all funding sources) for the Natural Resources Management Program

Table 9: Natural Resource Management Budget Summary by Funding Source.

NATURAL RESOURCES	FY 98 Actual ($000)	FY 99 Actual ($000)	Current FY Actual ($000)	FY 01 Estimated ($000)	FY 02 Projected ($000)
ONPS Base	1,852	1,656	1,700	1,700	1,700
ONPS Other	26	37	37	37	37
Cluster/Region					
WASO/National (NRPP, etc.)			767	277	309
Other non-NPS agency	20	9	9	9	9
Fee Demonstration			490		
Donation and Other		166	166	166	166
FIREPRO	1,780	1,746	1,746	1,746	1,746
Total	3,678	3,614	4,913	3,395	3,967

Table 10: Natural Resources Management Budget Summary by Natural Resources Long-Term Goals from the Strategic Plan

LONG-TERM GOAL	FY 98 Actual ($000)	FY 99 Actual ($000)	Current FY Actual ($000)	FY 2001 Estimated ($000)	FY 2002 Projected ($000)
Ia1-Fire Regimes	2,310	2,194	2,518	2,518	2,518
Ia2 – Exotic Species	7	6	6	6	6
Ia3 – Disturbed Lands	72	72	72	72	72
Ia4 – Aquatic Ecosystems	3	3	5	5	5
Ia5 – Air Quality	111	111	118	118	118
Ia6 – T/E Species	18	16	16	16	16
Ia7 – Cave Resources	78	78	54	54	54
Ia8 – Giant Forest	53	220	220	220	220
Ia9 – Non-Conforming Uses	78	75	87	87	87
Ib3 – Wilder Ness Info	397	325	554	554	554
Ic1 – Natural Resources I&M	258	256	248	248	248
Ic4 – Data Sets	81	46	324	324	324
IIa4 –Visitor Safety (Bears/ Tree Hazards)	212	212	842	352	352
Total	3,678	3,614	5,064	4,574	4,574

SCIENCE AND NATURAL RESOURCES MANAGEMENT PROGRAM

Division of Science and Natural Resources Management

The purpose of this section is to describe the current and fully funded (adequate) science and natural resources program for the Division of Science and Natural Resources Management and to identify the program needed to meet the critical natural resource issues described in the introduction to the natural resources program (page 135). The Program will be implemented over three phases or benchmarks. Current and fully funded (adequate) organization charts are also included in the Staffing Plans Section.

The Science and Natural Resources Management Program at Sequoia and Kings Canyon National Parks is diverse and is designed to preserve the natural resources of the parks. Science and natural resources management activities are aggregated into programs managed by professional natural resource managers who

are responsible for implementing their programs, as well as integrating them with other division programs. The Divisions of Fire and Visitor Management, Interpretation and Cultural Resources, and Maintenance are also involved in science and natural resources management. Programs for these divisions are discussed later in this section. The programs within the Division of Science and Natural Resources Management correspond with the NR-MAP major program designations. The current FY 2000 ONPS base Science and Natural Resources Management Program consists of 16.50 FTEs in nine major programs e.g., vegetation management/monitoring, wildlife management, prescribed fire management/monitoring, air resources management, cave management, tree hazard management, disturbed lands restoration, stock use and meadow monitoring, GIS/data management, and science and natural resources management planning/management/supervision and administrative support.

The fully funded (adequate) NR-MAP Science and natural Resources Management Program is 91.22 FTEs (including clerical support, management and supervision). With the current Science and Natural Resources Management Program of 16.50 FTEs there is a gap of 74.72 FTEs. The Program is 18.1% funded. The above NR-MAP allocation in includes programs, such as prescribed fire operations, that will be managed by the Division of Fire and Visitor Management. These programs are identified in the totals for Science and Natural Resources Management.

NR-MAP also allocates funding for support by the Division of Administration (15.67 FTEs) and Division of Maintenance (15.39 FTEs), in the form of maintenance/upkeep of facilities. There is no current staffing from the Division of Administration to directly support the Science and Natural Resources Management Program and only 0.5 FTEs form the Division of Maintenance to support maintenance/upkeep of science and natural resources management facilities.

The natural resources programs in the Division of Science and Natural Resources Management are organized into two offices (offices support all branches with the division) and four branches as described in Table 11.

Table 11: NR-MAP Program Responsibilities for the Division of Science and Natural Resources Management

R-MAP Program	Office of Admin. Support and Resource/Bioregional Planning	Office of GIS Info. Mgt.	Branch of Forestry & Veg. Mgt.	Branch of Pres. Fire/ Veg. Mont.	Branch of Aquatic Wildlife, Water	Branch of Air Res. Mgt.
Veg. Mgt.			X	X		
Wildlife Mgt.					X	
Pres. Fire. Mont.				X		
Water Res. Mgt.					X	
Air Res. Mgt.						X
Geo. Res. Mgt.					X	
Grazing Mgt.				X		
Dist. Area Rehab.			X			
Pest & Haz. (Includes Tree Hazard Mgt. IPM)			X		X	
Bioregional Planning & NR Planning	X					
Coll. & GIS/Data Mgt.		X				
Sci. Consultation Oversight	X (Under the Superintendent)					
Sci. & NRM Admin.	X					
Clerical/Supv. for each Office & Branch and Management and Supervision	X	X	X	X	X	X

There will be three phases or benchmarks to bring the current science and natural resources management program to the fully funded (adequate) level of 91.22 FTEs. Inventory and monitoring programs, natural resources management programs that impact ecosystems on a large scale, and natural resources management programs that restore altered natural resources to natural conditions will given high priority for funding. The first phase will be to bring each program up to approximately third of the identified fully funded level. The final priority for Phase I will be to ensure that there are

professional level employees qualified to oversee each science and natural resources management program. For which FTE has been allocated, achieving a balance to ensure the quality of the program while protecting the current status of the permanent employees. Phases II and III will each bring the program up another one third.

Office of Science and Natural Resources Management/Management/ Planning/Supervision and Administrative Support

Program Overview

Science and Natural Resources Management/Supervision, and Administration

Science and Natural Resources Management/Supervision, and Administrative Support is responsible for Division leadership and management; personnel management; position management, budgeting; and overall supervisory activities for science and natural resources management programs. The Chief of Science and Natural Resources Management provides overall program direction, development, leadership/management, and position management. The Budget Assistant provides all administrative support; such as budget analysis and tracking, preparation of time and attendance/travel/training/personnel action documents, and clerical support for the Division that currently includes 22 permanents and up to 30 temporary employees (includes all funding sources).

Resource/Bioregional Planning/Long-Term Ecological Monitoring/DSC Input

The Resource Planner, GS-401-12, provides leadership in natural resource and bioregional planning; coordination for the Long-Term Ecological Inventory and Monitoring Program; natural resources input into all construction/development projects in the parks, serves as the Division's environmental compliance person; assists the Division Chief in the Man in the Biosphere Program; and administers the Resource Natural Areas; and coordinates SNRM PMIS/OFS, and the Unified Call funding requests**.**

Internal science and natural resources management planning involves coordinating with all natural and cultural resources managers and division chiefs in the preparation of the annual update and periodic revision of the Resource Management Plan and the coordinating the development and update/revision of science and natural resources management action plans, such as the Water Resources, Fire Management and Air Resources Management Plans. The Resource Planner also assists in GMP, WMP, and Strategic/Annual Performance Planning

Bioregional planning involves coordinating park program and activities with the Biological Resources Division Global Change Research Program, the Memorandum of Understanding, California's Coordinated Regional Strategy to Conserve Biological Diversity, SPAM, and the Kaweah Watershed Group. These programs provide potential frameworks for interagency and regional cooperation to address regional problems affecting the Sierra.

Sequoia and Kings Canyon National Parks became an International Biosphere Reserve in 1976, as part of the MAB Program. The **MAB Program** involves developing goals and objectives, preparing a Biosphere Action Plan for the parks, and coordinating Biosphere activities with surrounding federal, state, local agencies, and private citizens.

Research Natural Areas (RNAs) are areas designated to preserve natural features and processes within areas which have had little to no past human disturbance for research, and educational purposes. Six

RNAs were established in Sequoia and Kings Canyon National Parks in 1977. Nothing has been done with the RNAs since their establishment. The RNA Program will reevaluate the existing RNAs and make a determination if they should be used for the purpose they were established or that new RNAs be established.

A major part of the Resource Planner's job is to provide coordination of the **Long-Term Ecological Inventory and Monitoring Program (LTEM).** This consists of developing the LTEM Plan and coordinating program outcomes with the SNRM program managers. The Resource Planner also is the Division's representative on the DSC Team that is involved in all construction activities in the parks. He provides natural resources input into all construction projects in the parks.

Current FY 2000 Funded Science and Natural Resources Management /Management/Planning/Supervision and Administrative Support Program Base and Staffing

Science and Natural Resources Management Management/Supervision and Administrative Support

Current ONPS Funding: $134,900 and 2.0 FTEs (See Project Statement SEKI-N-190.010)

The current organization (see Staffing Plans Section) consists of the Chief of Science and Natural Resources Management and the Budget Assistant. Current staffing levels provide about 17% of the needed administrative and clerical support for the existing Division of Science and Natural Resources Management.

Resource/Bioregional Planning/Long-Term Ecological Monitoring/DSC Input

Current ONPS funding: $87,200 and 1.0 FTE

The current organization (see Staffing Plan Section) consists of the Resource Planner, GS-401-12

Unfunded Science and Natural Resources Management Planning/Management/Supervision and Administrative Support Program Base and Staffing

Unfunded NR-MAP ONPS Program Base: $252,600 and 4.0 FTEs (See Project Statement SEKI-N-190.010 and OFS Number 5166A)

Management/Supervision and Administrative Support Program (Two new positions —2 FTEs)

The NR-MAP Target Organization for the science and natural resources management /supervision and administrative support program is characterized in the Staffing Plans section. The administration and clerical staff and support will be increased over time to meet the fully funded (adequate) NR-MAP program.

The Budget Assistant, GS-561-07 will promoted to Budget Assistant, GS-561-09 and the Chief of Science and Natural Resources Management, GS-401-13 will be promoted to Chief of Science and Natural Resources Management, GS-401-14.

New permanent positions (by priority) are the Office Automation Clerk, GS-326-05 (1 FTE), and the Program Analyst, GS-345-09 (1 FTE). These changes will result in improved budget tracking and analysis; free up program managers to concentrate on natural resource planning, program implementation, coordination/direction, and monitoring/evaluation. It will also allow the Chief of Science and Natural Resources Management more time for leadership and coordination of the science and natural resources management program with other park operations and with outside entities.

Resource/Bioregional Planning/Long-Term Ecological Monitoring/DSC Input – *Two New Positions (2 .0 FTE)*

A GS-401-11 Natural Resources Specialist (1.0 FTE) is needed to assist the Resource Planner in coordinating, resource planning, bioregional planning, and environmental compliance. A Natural Resources Specialist, GS-401-9 (1.0 FTE) is also needed to assist in the Long-Term Ecological Monitoring Program.

Phasing

In Phase I the Budget Assistant, GS-561-07 will be promoted to Budget Assistant, GS-561-09 and an Office Automation Clerk, GS-326-05 (1 FTE) and a Natural Resources Specialist (LTEM), GS-401-11 (1 FTE) will be hired. The Chief of Science and Natural Resources Management will be promoted to Chief of Science and Natural Resources Management, GS-401-14.

In Phase II the Program Analyst, GS-345-09 (1 FTE) and Natural Resources Specialist (Bioregional Planning), GS-409-09 (1 FTE) positions will be hired. The fully funded (adequate) NR-MAP program for science and natural resources planning/management/supervision and administrative support program will be fully funded in Phase II. Once fully funded there will be adequate management/supervision and administrative/clerical, planning, and LTEM support for all major science and natural resources management programs.

Unfunded Science and Natural Resources Management/Planning/Management and Administrative Support Base Increase Needs

Mitigate Threats to Natural Resources (OFS Number 5166A, $40,000 for Office Automation Clerk, GS-326-05)

Unfunded Science and Natural Resources Management/Supervision and Administrative Support Projects

Develop Facilities for Science and Natural/Cultural Resources Management (SEKI-I-001.000).

Develop Integrated Inventory and Monitoring Program (SEKI-N-190.011).

Study Sociology of Park Visitors (SEKI-N-140.151).

Positions Needed

Positions are listed by priority for funding.

Phase	Position	Office Priority	Project Statement No.	FTE(s)
1	Budget Assistant, GS-561-07 promoted to GS-561-09 (Existing)	1	SEKI-N-190.010	0.0
	Office Automation Clerk, GS-326-05 Responsible for providing clerical and data entry for the division (New)	1	SEKI-N-190.010 and OFS # 5166A	1.0
	Natural Resources Mgmt Specialist, GS-401-11 Responsible for LTEM coordination, (New)	1	SEKI-N-190.010	1.0
	Chief of Science and Natural Resources Management, GS-401-14 promoted from Chief of Science and Natural Resources Management, GS-401-13 Responsible for overall leadership and management of the Division of Science and Natural Resources Management (Existing)	1	SEKI-N-190.010	0.0
2	Natural Resource Specialist, GS-401-09 Responsible for assisting in bioregional planning (New)	2	SEKI-N-190.010	1.0
	Program Analyst, GS-345-09 Responsible for all Science and Natural Resources Program administration at the fully funded NR-MAP level (New)	3	SEKI-N-190.010	1.0
Total				4.0

Office of GIS, Data, and Information Management

Program Overview

The Office of GIS and Data Management focuses on enhancing the long-term goals of preserving park resources, providing for public and visitor enjoyment, and ensuring organizational effectiveness. The GIS Program has aligned its role and function around the parks' strategic plan and the overall mission of these Parks. Although the GIS office is located in the Science and Natural Resource Management Division, support is provided to all divisions. The activities below are a general summary of the GIS and Data Management program.

- Manages daily and long-term computer system operations for a variety of hardware and software
- Coordinates data collection and metadata on an interdivisional basis
- Develops and manages databases integrates, archive, and distributes data (data management) through appropriate sources
- Perform GIS applications, analyses, and mapping
- Advise and assist park staff and partners with GIS applications and data development
- Facilitate and conduct training for park staff and partners
- Develops and nurtures information and GIS sharing frameworks with other agencies/partners
- Coordinates fiscal/program budget including new funding and grant requests
- Represents park on NPS regional task groups or similar organizations

- Assists other Parks with programmatic and other GIS/Information Needs
- Develops presentations for conferences and writes articles about uses and applications of GIS to park and resources management.

Evolution of GIS at the Parks

The Sequoia and Kings Canyon (SEKI) Geographic Information System (GIS) was begun in 1985 by David Graber, the parks' Research Scientist. The program started as a cost-sharing effort with the United States Geological Survey (USGS) and the development of digital data. This included digital elevation and digital line information including transportation and hydrography. In 1988, the parks acquired their first Unix workstation that allowed on-site analysis and data development capabilities. Gradually, the parks began developing new vital digital data such as geology and vegetation. The original primary purpose was to aid as a research and management tool for several of the parks research programs. In 1994, the first full-time GIS Coordinator, Pat Lineback, was hired and the program began to expand and grow further. In 1998, due to the growing demands for GIS support to the fire management program at the parks, a full-time term Cartographic Technician position was established. This latter position is being funded through FIREPRO.

From those early years until the present the program has evolved from a single Unix workstation located in a closet and running public domain GRASS software to a GIS program that is dynamically changing and suffering some growing pains. This evolution has lead to a GIS program that includes three networked Unix workstations and many desktop computers running a variety of GIS and related software support products including GRASS, Arc/Info, ArcView, Grid, Tin, AutoCad, Corel Draw, and more.

The original vision of GIS use at the parks continues to evolve for a variety of reasons. Computer hardware costs have decreased dramatically with a concurrent increase in processing speed. GIS software is now more affordable and powerful than ever. Now, some of the GIS software is designed for non-GIS professionals to operate in a desktop environment, resulting in dramatic increases in the number of GIS users. The parks now have 15 ArcView licenses with more than 20 staff that have had training in ArcView. Many of them are running GIS applications on their desktop computer. The development of the Internet is creating an entirely new and evolving niche GIS market that didn't exist just a few years ago. These reasons and the gradual acceptance of GIS as a standard tool within most large organizations, including Sequoia and Kings Canyon National Parks, has dramatically changed the outlook for GIS and its application within the organizational culture. From a single Unix workstation and one or two GIS trained individuals, the parks are evolving towards an enterprise-wide GIS with distributed and shared databases and many trained GIS users. In FY 2000, the parks are spearheading the development of an interagency GIS landscape framework that will be developing seamless data and analysis across watersheds with the development of business processes and relationships needed to manage data across jurisdictional boundaries.

This rapid growth and change in use and application of GIS at Sequoia and Kings Canyon National Parks has caused growing pains and numerous hurdles along the way. Static budgets make it difficult to plan hardware and software upgrades, as well as maintenance of existing systems. Users want increased support with their projects including data and application development, and mapping. Creating the data storage and archival infrastructure that allows distributed access to data has become more difficult as more individuals tap into the wealth of GIS data. Important digital data that is missing or inadequate is unlikely to be funded anytime soon, but the information needs remain. New federal policy requires federal agencies to make GIS data available for sharing with the public and other organizations, including the development of metadata (data about data). Neighboring

organizations, including other land management agencies, state and local governments, are developing their own spatial databases that is making coordination and sharing of information increasingly important. Coordination, data maintenance and integration for higher level applications is requiring a new level of commitment that involves more individuals and increased involvement by other divisions. This is difficult to accomplish given the parks' traditional hierarchical management structure that encourages self-sufficiency within each division.

Finally, the current trend of GIS is the merging of geospatial information management into the broader discipline of information management technologies. It is increasingly difficult to consider GIS a separate entity as information management and GIS merge into increasingly seamless interrelated data and applications.

Current FY 2000 Funded GIS and Data Management Program Base and Staffing

Current ONPS Funding: $63,700 1.0 FTE (See Project Statement SEKI-N-130.050)
Current FIREPRO Funding: $35,636 1.0 FTE
Total $99,336 2.0 FTE

The current program consists of the GIS Coordinator, GS-401-11 and a GS-1371-07, Cartographic Technician. This GIS Coordinator position was established in FY-94 and has overall responsibility for GIS and data management for these Parks. The Cartographic Technician position was established in FY-98 and under the supervision of the GIS Coordinator provides technical support to the fire management program at the parks. This FIREPRO term position expires in FY 2000.

Unfunded GIS and Data Management Program Base and Staffing

Unfunded NR-MAP ONPS Program Base: 3.5 FTEs ($219,000) for GIS and Data Management, (See Project Statement SEKI-N-130.050)

The NR-MAP target program/organization for the GIS and Data Management Program is characterized in the Staffing Plans section. The Office of GIS and Data Management staff will be increased over time to meet the fully funded (adequate) NR-MAP program (4.5 FTEs). This total includes the existing GIS Coordinator position, but not the FIREPRO Cartographic Technician position, which is still a temporary position. Four new permanent positions and one subject-to-furlough position will be hired as follows.

GIS/Data and Information Management Program (4.5 FTEs)

The GIS Coordinator, GS-150-11, will be promoted to the Chief of the Office of GIS and Data Management (GS-12). Three new permanent full time and one permanent subject-to-furlough positions will be hired in the GIS and Data Management program area. These include the following positions: (1) One Cartographer, GS-1370-09 (1.0 FTE), (2) One Database Specialist, GS-334-11 (1.0 FTE), (3) Information Specialist, GS-1001-09 (1.0 FTE), and (4) Information Specialist, GS-1001-05 (0.5 FTE). The Cartographer and Cartographic Technician will provide support to the GIS and Data Management program through precompilation tasks (such as the investigation of source materials, extension of basic geodetic control network, and the plotting map projection and ground control on base sheets), manual or photogrammetric compilation, assembling aerial photograph in mosaics, drafting, digitizing, and editing or reviewing, mapping, and geospatial analysis. The Data Base Administrator will help develop a park Database Management Plan, with input from other natural resource staff; coordinate all natural resource databases with natural program managers; and provide professional consultation in the application of

statistical theories, techniques and methods to the gathering and/or interpretation of quantified information. The Information Specialist will communicate natural resources information and ideas through verbal, visual, and pictorial means using the Internet and other contemporary sources. This includes providing writing and editing service to the natural resources specialists and developing audiovisual presentations for the parks science and natural resources program. These changes will (1) allow the GIS to become fully operational and usable by all park divisions, (2) provide comprehensive data management for all natural resource programs, (3) provide technical writing/editing services for natural resource managers, and (4) develop audiovisual presentations for distribution to the public on the natural resources program of the parks.

GIS/Data and Information Management

SEKI-N-130.050 GIS, Data, and Information Management Program
SEKI-N-130.055 Digitize Sequoia Tree Inventory (GSI)
SEKI-N-170.011 Expand Geographic Plot Inventory
SEKI-N-170.012 Develop Vegetation Map
SEKI-N-140.020 Manage Wilderness/Backcountry Resources
SEKI-N-190.012 Develop Digital GIS Infrastructure
SEKI-N-190.011 Develop Integrated Inventory and Monitoring Program
SEKI_N-030.010 Implement Natural Resource RX Burn Program
SEKI-N-171.001 Model Consequences of Restoring Fire

Positions Needed for GIS and Data Management

Positions are listed by priority for funding.

Phase	Position	Branch Priority	Project Statement No.	FTE(s)
1	Chief Office of GIS/Data Management and Information Management, GS-150-12 promoted from GIS Systems Coordinator, GS-150-11 (Existing)	1	SEKI-N-130.050	0.0
	Database Specialist, GS-334-11 Responsible for developing a park Database Management Plan, coordinating all natural resource databases, and providing consultation in the application development.	1	SEKI-N-130.050	1.0
2	Cartographer, GS-1370-09 Responsible for precompilation tasks, manual or photogrammetric compilation, assembling aerial photographs in mosaics, drafting, digitizing, and editing or reviewing for the GIS	2	SEKI-N-130.050	1.0
3	Information Specialist, GS-1001-09 (1.0 FTE) and Seasonal Information Specialist, GS-1001-05 (0.5 FTE) Responsible for communicating natural resource information and ideas through verbal, visual, and pictorial means.	3	SEKI-N-130.050	1.5
Total				3.5

Branch of Aquatic, Wildlife, and Geological Resources Management

Program Overview

The Branch of Aquatic, Wildlife, and Geologic Resources Management is responsible for all management of fauna, aquatic communities, and geologic resources. This includes identifying needed research; developing and implementing management programs for mitigating problems, restoring and/or maintaining natural systems; and monitoring both the effectiveness of programs, current status, and long-term resource trends. The program includes fiscal and administrative functions in support of field operations. The Branch works primarily within these parks, but also has a larger bioregional role working with adjacent agencies on a regional ecosystem approach.

Aquatic Resources

This program element includes inventory and management of wetlands, inventory and monitoring of water chemistry and water quality, fisheries management, control of exotic species in aquatic systems, restoration and maintenance of sensitive species, coordinating floodplain studies, and long-term maintenance of aquatic systems. The program is responsible for maintaining natural aquatic systems concurrent with widespread human use. The worldwide phenomenon of amphibian declines is being experienced here and threatens to reduce the parks' biodiversity. Human feces threaten water quality. Fishing, swimming and wading cause social trails in riparian areas, litter, substrate disturbance, and localized removal of streambank vegetation. Some park facilities like sewage spray fields threaten natural waters with nutrient enrichment and chemical contamination. The airshed threatens park waters with episodic pH depression, anthropogenic fertilization of the natural system, and deposition/uptake of agricultural contaminants. Fishing is a sensitive issue that influences natural systems as well as the quality of many visitors' recreation experience. The Branch is responsible for working with the California Department of Fish and Game on development of fishing regulations that preserve recreational opportunities while promoting the pristine distribution and abundance of native species. Sensitive species may require active restoration to insure their future. Exotic aquatic pests need to be evaluated and controlled in accordance with the severity of the need.

Wildlife Resources

Historically, this activity has dealt with mitigating adverse interactions between people and wildlife. Such management has overwhelmingly involved bears, but also includes other species such as deer, ground squirrels, and marmots. More recently, mountain lions have become a concern, as there has been a steady increase in close encounters between mountain lions and park visitors. Integrated Pest Management is included in the wildlife function.

Other activities include work with threatened and endangered species and control of exotic species. Between listed T & E species and sensitive species, there are about 58 species needing special consideration. An additional 178 species are rare or uncommon within these parks. Another 25 species have been introduced, and at least 20 of those are established. Some of these exotics like brown-headed cowbirds, feral pigs, and beaver are believed to be impacting the natural system; the impacts of others like opossum are less obvious; all need investigation. Some native species like California ground squirrels appear to have developed unnatural populations because of anthropogenic habitats and access to human food. Some species like bighorn sheep and yellow-legged frogs have been extirpated from portions of their natural range and need to be reintroduced.

The new emphasis is on treating the causes of problems and not the symptoms. Much of the wildlife program is directed at eliminating access to human food through food-storage facilities and public education. The program needs to evolve from responding to nuisances and "urgent need" toward community management. We need to evolve from managing individuals to managing populations. Wildlife populations need to be monitored for current status, long-term trends, and anthropogenic influences, especially in high-use areas. The wildlife function shares global concerns like the loss of neotropical birds, amphibian declines, insularization and loss of gene flow, loss of habitat near the parks, and pesticide contamination which still plagues the parks' peregrine falcons and possibly other species. The future is in prioritized fully funded interdisciplinary ecosystem programs based on good research and intense resource monitoring.

Geologic Resources

Cave and Karst Resource Management Program

The goal of the Cave and Karst Management Program is to protect and better understand the caves and karst systems of the two parks and the resources they contain. These resources include mineralogical features, karst hydrologies and landscapes, rare invertebrate animals, vertebrate animals, paleontological resources, archaeological resources, and visitor experiences.

The cave and karst management program has six main areas of emphasis (in no particular order): (1) production of quality maps of park caves that can be used to further proper management and scientific inquiry into park karst, caves and the features and resources they contain; (2) long-term monitoring of cave biotic communities; (3) protection and maintenance of all cave features through permits, registers, trip leaders, gate management, photo monitoring, cave restoration and restrictive access policies; (4) coordination of volunteers who assist with cave management projects; (5) the furtherance of scientific inquiry in park caves, and (6) the safety of park staff, visitors and volunteers while working or recreating in the cave environment.

The development of cave maps is a baseline data collection project. The maps provide basic geographic information concerning the extent, character and nature of park caves. Maps also create a spatial representation of rare cave features and resources and cave animal habitats and distribution. Maps for Lilburn Cave (the park's longest at 17 miles) and for caves in the Mineral King area are being produced by volunteer members of the Cave Research Foundation. Maps for other large park caves, including Crystal, Hurricane Crawl, Panorama and Soldiers are being produced by park staff.

Largely endemic cave invertebrates are being monitored and studied through a multi-faceted approach. Inventory plots for invertebrate presence and number have been established in five park caves, Crystal, Hurricane Crawl, Carmoe Crevice, Soldiers, and Clough. A park photographic file of images of these rarely seen animals has been established. The photos aid in identification and have been used for educational purposes. Collections of animals are made when taxonomists are available to study the animals.

Most cave features are considered to be non-renewable. These same features are often fragile and may be difficult to recognize in a dark, cramped cave environment. Delicate cave formations, bones, animal habitat and other features are easily disturbed and damaged. Permits are required for six caves and only a set number of permits per year are issued for several caves. Permit requirements create accountability for cavers visiting these caves and also provide park staff with an opportunity to discuss a cave's delicate features and resources with prospective visitors. Registers generate an informal list of people visiting a cave. This encourages accountability and creates a record of use. Trip leaders, known as Trustees at Sequoia and Kings Canyon, are required for four park caves that have particularly delicate features.

Trustees are responsible for the actions of people on their trips. Trustees attend annual meetings on management of the cave in question. Trustees also receive periodic mailings concerning issues at a respective cave. Gates provide an unprecedented level of security for a cave and its contents. While they are not fool proof, ten gates on six park caves with particularly sensitive features have generally excluded unauthorized people from these caves. Photo monitoring provides an unbiased assessment of damage done to a cave through time. Photo-monitoring points have been established in Crystal and Hurricane Crawl caves. Future plans call for more caves to be photo-monitored. Restoration of previous damaged caves has become an on-going process in many NPS administered caves. At sequoia restoration has focused on blast rubble removal in Crystal Cave, and cleaning dispersed sediments in Crystal, Clough. Lilburn and Soldiers Caves. Restrictive access policies written into the park Cave Management Plan and several plans for specific caves are the cornerstone of cave protection at Sequoia and Kings Canyon. Caves have restrictions placed upon their access to protect many features, including bat colonies, invertebrate populations, delicate cave formations, archaeological site, Pleistocene remains of animals, and sediments. Compliance is encouraged through the permit process, gates, and secrecy concerning location information.

Volunteers, mostly members of the National Speleological Society, are key component of the Sequoia and Kings Canyon Cave and Karst Management Program. Volunteers have produced many maps of park caves, conducted restoration projects in several park caves, have built gates, generated photo-monitoring pictures, and conducted research. More than 4000 hours of volunteer time per year are generally contributed by less than 100 cave management volunteers. The park produces a biannual newsletter (the *Cave Management Update*) on on-going cave management issues for volunteers and park staff

Scientific work is the key to proper and appropriate resource management. Scientific inquiries into park caves have revealed significant information that has assisted managers in determining resource practices. Studies have also revealed detailed information about the geomorphology and hydrology of Lilburn Cave. Sediments and calcite deposits in caves have yielded dates for cave passages and hydrologies. Future work in park caves may very well have bearing on the age and uplift rate of the Sierra.

Caves can be hazardous places for the inexperienced or ill prepared. The park issues permits only to qualified cavers, expects Trustees to carefully choose their team members based upon an individuals experience and skills, and carefully chooses experienced cavers to lead volunteer projects and efforts. Radon gas is a natural by-product of Uranium decay and occurs in many environments including carbonate rocks. Radon causes lung cancer in cases of significant exposure. The park oversees the SNHA program of radon monitoring and employee exposure records at Crystal Cave.

Current Funded Aquatic, Wildlife, and Geologic Resources Management Branch Base and Staffing.

Current FY 2000 ONPS Funding: $194,600 3.22 FTEs. FIREPRO Funding: $28,996 1.01 FTE. (See Project Statements SEKI-N-020.000, SEKI-N-040.000, and SEKI-N-060.000)

The current organization consists of the Fish and Wildlife Biologist (GS-401-11) who supervises the Wildlife Biologist (GS-486-09) and Cave Specialist (GS-1301-09). The Wildlife Biologist supervises seasonal Bear Technicians (GS-025-05; 0.22 FTE). This organization provides 11.0% of the needed staff based on the NR-MAP allocation of 30.46 FTEs.

Aquatic and Wildlife Resources Management Programs

This staff provides some bear management in the most severe areas of these parks. There is some intermittent monitoring and assessment of fisheries, a few sensitive species, and some exotic species. IPM is coordinated at a minimal level. The overall program relies heavily on volunteers, assistance from other Divisions and other agencies, donations, and project funding. There is some bioregional planning done with other agencies.

Geologic Resources Management Program

Cave management is the only active geological program. This program is largely liaison with the caving community, coordination and limited facilitation of cave research, and implementation of a permit program for managing use. There is a small cave restoration program. The work relies heavily on volunteers and independent research.

Unfunded Aquatic, Wildlife, and Geologic Resources Management Branch Base and Staffing.

The total NR-MAP allocation is 30.46 FTE. The existing shortfall is 27.10 FTE. Required total funding for personal services and support is estimated at $1,890,423 ($1,695,823 shortfall). These positions and how they would be organized and filled is summarized below and given in more detail in the Project Statements titled Aquatic Resources Management Program (SEKI-N-040.000), Wildlife Resources Management Program (SEKI-N-020.000), and Geologic Resources Management Program (SEKI-N-060.000). The staffing is organized into three phases or benchmarks.

Aquatic Resources Management Program (11.39 FTEs ONPS; 1.00 FTE FIREPRO)

The full NR-MAP allocation is 11.39 FTE. The NR-MAP allocation includes: 0.65 FTE for native aquatic plant management & monitoring, 2.02 for native aquatic animal management and monitoring, 0.65 for fisheries management, 0.97 FTE for T&E species, 0.54 FTE for restoration of extirpated species, 2.17 FTE for managing exotic animals in aquatic environments, and 4.39 FTE for water resources management. An additional 1.0 FTE would be added for fire effects monitoring on fires.

Phase I will fill the Aquatic Biologist (GS-408-11) position at the GS-11 level, create one permanent Biological Technician (GS-404-07) and create four seasonal positions (two GS-1316-05 and two GS-404-05). This phase would also include two Fire Effects Hydrological Technicians (0.5 FTE GS-1316-06 and 0.5 FTE GS-1316-05).

Phase II will increase the permanent staff. One seasonal Hydrological Technician (GS-1316-05) will be promoted to a GS-07 and made permanent. A Fishery Biologist (GS-482-11) and a Hydrologist (GS-1315-11) will be added to the staff.

Phase III will add much more technical support and another professional position. These new positions include two permanent Biological Technicians (GS-404-07), a Wetlands Biologist (GS-408-09), and four seasonal Biological Technician positions (0.5 FTE GS-404-06 and 1.39 FTE GS-404-05). The Aquatic Biologist will be upgraded (GS-408-12) due to the increased responsibility.

When all positions are filled, the Aquatic Biologist will manage three functions: Fisheries Management, Water Chemistry, and Wetlands. A professional with both permanent and seasonal support will head each function.

*Wildlife Resources Management Program (11.00 FTEs ONPS; 1.50 FTE FIREPRO***)**

The full NR-MAP allocation 11.00 FTE. The NR-MAP allocation includes: 1.62 FTE for native terrestrial animal management and monitoring, 1.08 FTE for T&E species, 0.54 FTE for restoration of extirpated species, 0.96 FTE for managing exotic animals in terrestrial environments, 6.04 FTE for bear management, and 0.76 FTE for Integrated Pest Management. An additional 1.5 FTE would be added for fire effects monitoring on fires.

As in the Aquatics Program, mostly technical staff will be added during Phase I. Two seasonal Bear Technicians (GS-404-05), three seasonal Biological Technicians (GS-404-05), a permanent Biological Technician (GS-404-07), and permanent Supervisory Bear Technician (GS-404-07) will be added during the first phase. The Wildlife Biologist (GS-404-09) will be upgraded to a GS-11. This phase would also include two Wildlife Fire Effects Technicians (1.0 FTE permanent GS-404-07 and 0.5 FTE seasonal GS-404-05).

During Phase II, three more seasonal Bear technicians (GS-025-05), an Entomologist (GS-414-09), a Vertebrate Biologist (GS-486-09), and two seasonal Biological Technicians (GS-404-05) will be added.

During Phase III, the Supervisory Bear Technician (GS-404-07) will be upgraded to a professional Wildlife Management Biologist (GS-486-11), and the Wildlife Biologist (GS-486-11) will be upgraded to a GS-12. Two seasonal Supervisory Bear Technicians (GS-025-06) two more seasonal Bear Technicians (GS-404-05) will be added to the staff.

When all positions are filled, the Wildlife Biologist will manage three professional positions. The Wildlife Management Biologist will be primarily responsible for Bear Management, but duties will also involve dealing with mountain lions, campground nuisances, parking lot marmots and other programs that involve public education and mitigation of adverse interactions between the public and wildlife. The Vertebrate Biologist and the Entomologist will be responsible within their respective fields for managing and monitoring threatened and endangered species, monitoring and controlling exotic species, and long-term population monitoring and mitigation of anthropogenic impacts to wildlife populations. The Entomologist will also be responsible for Integrated Pest Management.

*Geologic Resources Management Program (4.86 FTEs***)**

The full NR-MAP allocation is 4.86 FTE. This includes the entire allocation for geologic resources management.

The Cave Specialist (GS-1301-09) will be promoted to a GS-11, and a permanent Physical Science Technician (GS-1311-07) will be created during Phase I. The Cave Specialist will receive two seasonal Physical Science Technicians (GS-1311-05) and two seasonal Biological Technicians (GS-404-05 & GS-404-06) during Phase II. This organization will be completed during Phase III with the addition of a professional Geologist (GS-1350-12) to manage all geological resources.

Once all positions are filled, the bulk of the management effort will continue to be in cave management, but other activities will include managing mining-and-minerals issues, soils issues, geothermal issues, and impacts associated with rock climbing.

Administrative Support (3.21 FTEs)

The full NR-MAP allocation is 3.21 FTE. This includes 2.21 FTE of the clerical support for natural resources management and 1.0 FTE for management/supervision of natural resources management.

During Phase I, the permanent Office Automation Clerk (GS-326-06/07) will be added, and the Fish and Wildlife Biologist (GS-401-11) will be promoted to Wildlife Ecologist (GS-408-12). During Phase II, two seasonal Office Automation Clerks (GS-326-05) will be added to provide additional support for the increased professional and technical staff during summer and fall when the workload for data handling is at its maximum. During Phase III, another seasonal Office Automation Clerk (GS-326-05) will be added to the staff, and the Wildlife Ecologist (GS-408-12) will be promoted to a Management Ecologist (GS-408-12).

These positions will support the aquatics, wildlife, and geology programs. The Management Ecologist will provide overall leadership in Branch planning, direction, coordination, and integration. The clerical positions will provide clerical, fiscal, data entry, and other administrative support to the entire Branch.

Unfunded Aquatic, Wildlife, and Geologic Resources Management Project Statements

Wildlife Resources Management

Install Bear-Proof Food Storage Lockers, Sequoia District (SEKI-N-020.010)

Repair/Replace Bear-Proof Food Storage Boxes (SEKI-N-020.013)

Replace Garbage Facilities, Sequoia District (SEKI-N-020.014)

Replace Garbage Facilities, Kings District (SEKI-N-020.015)

Conduct Marmot Studies (SEKI-N-020.020)

Evaluate ecological Impacts of Exotic Fauna (SEKI-N-020.030)

Control of Exotic Fauna, Beaver (SEKI-N-120.032)

Construct Boundary Fence, Grunigen, Washburn, Other (SEKI-N-020.034)

Evaluate Ecological Impacts of Opossum (SEKI-N-020.035)

Evaluate Status of T & E/Sensitive Fauna (SEKI-N-020.040)

Study Rare and Extirpated Fauna (SEKI-N-020.041)

Restore Sierra Nevada Bighorn Sheep (SEKI-N-020.050)

Survey Migratory Bird Status (SEKI-N-020.060)

Inventory Bat Species (SEKI-N-020.070)

Inventory of Mammals (non-flying) (SEKI-N-020.071)

Inventory of terrestrial Amphibians and Reptiles (SEKI-N-020.075)

Inventory Insect and Arachnid Species (SEKI-N-020.080)

Assess Effects of Fire on Fauna (SEKI-N-020.100)

Study Mountain Lion Populations (SEKI-N-020.110)

Evaluate Threats to Western Pond Turtle (SEKI-N-020.120)

Aquatic Resources Management

Inventory of Aquatic Resources (SEKI-N-040.010)

Monitor Watersheds/Aquatic Ecosystem Monitoring (SEKI-N-040.020)

Determine Pristine Distribution of Fish Species (SEKI-N-040.030)

Study Genetics of Extant Rainbow Trout (SEKI-N-040.031)

Evaluate Status of Kern Rainbow Trout (SEKI-N-040.032)

Evaluate Impacts of Anthropogenic Nutrients, Streams (SEKI-N-040.040)

Evaluate Impacts of Anthropogenic Nutrients, Lakes (SEKI-N-040.041)

Evaluate Impacts of Anthropogenic Nutrients, Fate of Human Waste (SEKI-N-040.042)

Evaluate Threat and Control for *Hyalla* (SEKI-N-040.050)

Determine Distribution of High Elevation Amphibians (SEKI-N-040.060)

Evaluate Reintroduction of Foothill Yellow-Legged Frog (SEKI-N-040.061)

Restoration of Mountain Yellow-Legged Frogs (SEKI-N-040.063)

Implement Flood Plain Studies in Developed Areas (SEKI-N-040.070)

Water Rights Studies for Developed Areas (SEKI-N-040.080)

Geological Resources Management

Update Karst Inventory (SEKI-N-060.010)

Inventory of Cave Fauna (SEKI-N-060.011)

Paleontological Studies of Park Caves (SEKI-N-060.012)

Complete Soil Survey and Mapping (SEKI-N-060.020)

Abandoned Mine Lands Inventory and Permit Review (SEKI-N-060.030)

Crystal Cave Biological Evaluation (SEKI-N-062.002

Soldier's Cave Gate Reconstruction (SEKI-N-063.001)

Soldier's Cave Inventory and Mapping (SEKI-N-063.002)

Positions Needed

Positions are listed by branch priority for funding. Numbers following the position name indicate the number of positions to be filled. Numbers in parenthesis indicate number of seasonal positions.

Phase	Position	Branch Priority	Project Statement No.	FTE(s)
	Aquatics			
1	Aquatic Ecologist, GS-408-11	1	SEKI-N-040.000	1.00
	Biological Science Technician GS-404-05 (2)	2	SEKI-N-040.000	1.00
	Biological Science Technician, GS-404-07	9	SEKI-N-040.000	1.00
	Hydrology Technician, GS-1316-06 (1)	10	SEKI-N-040.000	0.50 FIREPRO
	Hydrology Technician, GS-1316-05 (1)	11	SEKI-N-040.000	0.50 FIREPRO
	Hydrology Technician, GS-1316-05 (2)	14	SEKI-N-040.000	1.00
2	Hydrology Technician, GS-1316-07 created from seasonal Hydrology Technician, GS-1316-05	16	SEKI-N-040.000	0.50 (new)
	Fishery Biologist, GS-482-11	21	SEKI-N-040.000	1.00
	Hydrologist, GS-1315-11	24	SEKI-N-040.000	1.00
3	Biological Science Technician, GS-404-05 (3)	26	SEKI-N-040.000	1.39
	Wetlands Biologist, GS-408-09	31	SEKI-N-040.000	1.00
	Biological Science Technician, GS-404-07	34	SEKI-N-040.000	2.00
	Biological Science Technician, GS-404-06	35	SEKI-N-040.000	0.50
	Aquatic Ecologist, GS-408-12 promoted from Aquatic Ecologist, GS-408-11	36	SEKI-N-040.000	0.00
Subtotal for Aquatics				11.39 1.00 FIREPRO
	Wildlife			
Existing	Wildlife Biologist, GS-486-09		SEKI-N-020.000	0.00
	Bear Technician, GS-404-05		SEKI-N-020.000	0.00
1	Wildlife Biologist, GS-486-11 promoted from Wildlife Biologist, GS-486-09	0.2	SEKI-N-020.000	0.00
	Bear Technician, GS-404-05 (2)	3	SEKI-N-020.000	0.90
	Biological Science Technician, GS-404-07	6	SEKI-N-020.000	1.00 FIREPRO
	Biological Science Technician, GS-404-05	7	SEKI-N-020.000	0.50 FIREPRO
	Biological Science Technician GS-404-05 (3)	8	SEKI-N-020.000	1.20
	Supervisory Bear Technician, GS-404-07	12	SEKI-N-020.000	1.00
	Biological Science Technician, GS-404-07	13	SEKI-N-020.000	1.20
2	Bear Technician, GS-404-05 (3)	15	SEKI-N-020.000	1.20
	Entomologist, GS-414-09	22	SEKI-N-020.000	1.00
	Biological Science Technician GS-404-05 (2)	23	SEKI-N-020.000	0.80
	Vertebrate Biologist, GS-486-09	25	SEKI-N-020.000	1.00
3	Bear Technicians, GS-404-05 (2)	27	SEKI-N-020.000	0.68
	Supervisory Bear Ranger, GS-025-06 (2)	30	SEKI-N-020.000	1.00
	Wildlife Management Biologist, GS-486-11 promoted from Biological Science Technician, GS-404-07	32	SEKI-N-020.000	0.00
	Wildlife Biologist, GS-486-12 promoted from Wildlife Biologist, GS-486-11	33	SEKI-N-020.000	0.00

Phase	Position	Branch Priority	Project Statement No.	FTE(s)
Subtotal for Wildlife				11.00 1.50 FIREPRO
Geology				
Existing	Cave Specialist, GS-1301-09		SEKI-N-060.000	0.00
1	Cave Specialist, GS-1301-11 Promoted from Cave Specialist, GS-1301-09	0.1	SEKI-N-060.000	0.00
	Physical Science Technician, GS-1311-07	4	SEKI-N-060.000	1.00
2	Biological Science Technician GS-404-05 (1)	17	SEKI-N-060.000	0.43
	Biological Science Technician, GS-404-06 (1)	18	SEKI-N-060.000	0.50
	Physical Science Technician, GS-1311-05 (2)	20	SEKI-N-060.000	0.93
3	Geologist, GS-1350-11	29	SEKI-N-060.000	1.00
Subtotal for Geology				4.86
Administration				1.00
Existing	Fish and Wildlife Biologist, GS-401-11		SEKI-N-020.000	0.00
1	Wildlife Ecologist, GS-408-12 promotion from Fish & Wildlife Ecologist, GS-401-11	0.3	SEKI-N-020.000	0.00
	Office Automation Clerk, GS-326-07	5	SEKI-N-020.000	1.00
2	Office Automation Clerk, GS-326-05 (2)	19	SEKI-N-020.000	0.80
3	Office Automation Clerk, GS-326-05 (1)	28	SEKI-N-020.000	0.41
	Management Ecologist, GS-408-13 promotion from Wildlife Ecologist, GS-408-12	37	SEKI-N-020.000	0.00
Subtotal for Administration				3.21
Total				30.46 2.50 FIREPRO

Branch of Fire Monitoring and Vegetation Monitoring

Program Overview

The Branch of Fire Monitoring and Vegetation Monitoring addresses the following issues:

- Disruption of natural fire regimes
- Planning and assisting in the use of fire natural to meet resource objectives
- Monitoring and studying the effects of fire
- Impacts of on threatened, endangered, and sensitive plants
- Impacts to park resources due to grazing of pack and saddle stock
- Mitigating the lack of basic information through vegetation mapping and monitoring of plant communities

Current Program and actions

Fire Effects Monitoring

Monitoring the effects of fire on vegetation is guided by the Western Region Fire Monitoring Handbook (1992 - revision in progress - available by field season 2000). The Handbook establishes minimum monitoring standards and protocols for all levels of fire monitoring, including long term fire effects. At Sequoia and Kings Canyon, fire effects monitoring beyond the minimum standards have been implemented to assess the effects of fire on giant sequoia mortality and recruitment, fire scar enlargement, sugar pine mortality and mitigation of fire effects, and to address other issues of concern. Monitoring studies and protocols beyond those contained in the Western Region Handbook must be approved by the Regional Fire Effects Monitoring coordinator for FIREPRO funding to be used. Additional studies not authorized by Region may still be undertaken by the park using ONPS or other funding sources.

The responsibility for fire event monitoring is being reorganized from SNRM to the Fire Management Office in FY 2000 as part of a program-wide reorganization.

Fire Research and Data Coordination

With the advent of an expanded fire program and increased landscape level application of fire in the mid-1990's, it became crucial that fire research and monitoring in these parks be conducted in a coordinated manner. The number, breadth, and types of projects being undertaken to both understand and assess the use of fire in park ecosystems became a significant new workload. This workload came at a time when management level research support was being withdrawn from park control through the creation of the USGS Biological Resources Division (BRD).

In 1995 a FIREPRO funded term Fire Ecologist position was created to coordinate and integrate fire research and monitoring projects and data. The primary functions performed by the position are: assess fire research and monitoring efforts needed to support the ecological application of fire, solicit funding and researchers to perform high priority projects, coordinate and integrate all efforts, consolidate parkwide fire research and monitoring data into a central point, and publish an annual report on the implementation and results of all fire research and monitoring programs.

The position was converted from term to permanent status in FY 1999.

Fire Management for Ecological Objectives

The fire management program consists of several program elements that are more fully described in the Fire Management Plan. The elements include; prevention, education, presuppression, suppression, prescribed burning, wildland fire use for resource benefit, monitoring, and research.

Various elements of the program are assigned to the Fire and Visitor Protection Division of the park while certain other elements of the fire management program are assigned to the Science and Natural Resources Management Division.

The bulk of funding for the fire management program in the park comes through a separate appropriation process know as FIREPRO. ONPS funding supports a core of fire management staff in both Divisions.

The elements of the fire management program reported in this section is the portion of FTE and base funding from both ONPS and FIREPRO appropriations, and from both divisions, that most closely pertain to the use of fire to meet resource objectives. These elements include; fire effects monitoring, fire behavior monitoring, fire research and data coordination, smoke management and monitoring, and some prescribed fire operations staff.

Threatened, Endangered, and Sensitive Plants

The current sensitive plant program is carried out as time allows by the native plant program plant ecologist. Actions are largely limited to obtaining and distributing information, performing informal surveys for sensitive plant populations while conducting unrelated fieldwork, and maintaining a database and GIS layer of known plant locations. Recent and ongoing actions include:

- Maintain and distribute a list of sensitive vascular plant species known or suspected to occur in SEKI.
- Update the sensitive plant database with current legal status of state and federally designated taxa.
- Maintain the GIS database of known locations of sensitive plant species.
- Share information with adjacent land managers and interested parties.
- When consulted, evaluate sensitive species that may be affected by proposed management actions.

Stock Use and Meadow Monitoring

The 1986 Stock Use and Meadow Management Plan is the primary document that currently guides stock use within Sequoia and Kings Canyon National Parks. The Wilderness Management Plan (in development) will eventually contain guidance for stock use and meadow management in these parks and will supercede the 1986 Stock Use and Meadow Management Plan.

Although most park meadows are open to grazing, there are some areas that are permanently closed to stock because of very heavy backpacker camping use, small size, research purposes, or relative sensitivity. In other areas, stock are permitted but feed must be packed in. All park meadows open to grazing are subject to seasonal opening dates, which are determined according to soil moisture conditions. While a few exceptions exist, in most cases there are no regulations concerning the maximum grazing nights per meadow. As a result, unacceptable impact may occur necessitating restrictive action. At the present time, restrictions only are imposed after damage has occurred.

The stock use and meadow monitoring program relies on a suite of complementary monitoring efforts that provide managers with both long term and short-term information on the condition of wilderness meadows. Long-term shifts in species composition are monitored in five pairs of grazed and ungrazed meadows representing a range of meadow types found in these parks. Production and groundcover, which serve as surrogates for a number of functional attributes, are monitored annually in 27 heavily used meadows through the residual biomass monitoring program. Stocking rates in individual meadows are tracked using a stock use reporting system that includes staff observations, self-reporting cards, and the wilderness permit system.

Vegetation Monitoring

The vegetation monitoring program exists only in a basic form at present, and is restricted to site and issue specific monitoring efforts such as the fire effects monitoring, forest pest monitoring, and meadow management. As a first step in understanding the resource, the development of a reliable

vegetation map, is underway. The project is expect to be substantially completed in 2003 and should provide both new information on park vegetation communities as well as a basis for establishing landscape scale monitoring strategies.

Giant Sequoia Management

Most of the elements of sequoia management are within the context of other programs, and the FTE and associated funding are included in those program descriptions contained elsewhere in this document. Sequoia resource specific needs are detailed under the *Strategies for Achieving Resource Objectives* section above. Program elements currently implemented consist of:

Interagency Research Cooperative. The park participates in an interagency giant sequoia research cooperative. This cooperative operates under an interagency agreement and its function is to identify and coordinate giant sequoia research efforts among various federal and state agencies. The cooperative, which meets twice a year, also provides a forum for sharing information on agency specific giant sequoia management actions and issues.

Fire Effects Monitoring. The parkwide fire effects monitoring program includes the giant sequoia resource. Additional studies and monitoring of the giant sequoia resource over and above other vegetation types are conducted to assess mortality of all size classes, fire scar formation, and reproductive success.

Prescribed Fire. An active fire management program conducts prescribed burns in giant sequoia groves to reduce fuel loads and move grove conditions towards reference standards. Naturally ignited fires are managed within groves where appropriate according to direction and standards contained in the Fire Management Plan.

Maintenance of Special Zones. According to the landscape plans for the General Grant Tree and General Sherman Tree, the responsibility for implementing those plans rests with the Maintenance division of the park in consultation with SNRM staff.

Current (FY 2000) Funded Fire Monitoring and Vegetation Monitoring Branch Base and Staffing.

Program Administration
Current ONPS Funding and FTE: $ 66,300 FTE: 0.9
- 1 - GS-401-12

The Supervisory Natural Resources Management Specialist supervises and provides direction to three program managers (GS-408-09-11 Ecologists). Other activities include coordinating updates to the Fire Management Plan, annual updates to the five year burn plan, reviewing all fire management activities for impacts to the park ecosystem, and managing the branch budget.

Fire Effects Monitoring
Current ONPS Funding and FTE: $ 50,000 FTE: 1.0
- 1- GS-408-09 Ecologist
Current FIREPRO Funding and FTE $ 70,844 FTE: 1.7
- 0.6 – GS-404-07 Bio Sci Tech (STF)
- 1.1 – GS-404-05 Bio Sci Tech (4 Seasonals)

Fire Research and Data Coordination

Current FIREPRO Funding and FTE: $ 66,930 FTE: 1.0
- 1 – GS-408-09 – Ecologist

Fire Management For Ecological Objectives
Current FIREPRO Funding and FTE $ 319,143 FTE: 5.1
- 1 – GS-401-11 Fire/Fuels Specialist
- 0.7 – GS-462-07 Forestry Tech (STF)
- 2 – GS-462-05 Forestry Tech (4 Seasonals)
- 1 – GS-462-09 Forestry Tech (Prescribed Fire)
- 0.4 – GS-462 Smoke Tech (Seasonal)

Threatened, Endangered, and Sensitive Plants
No funding or FTE is currently obligated for sensitive plant management

Stock Use and Meadow Monitoring
Current ONPS Funding and FTE: $ 49,900 FTE: 1.0

A substantial amount of the data collection and monitoring work is conducted by wilderness rangers who collect residual biomass data and monitor conditions in their patrol areas. FTEs contributed by the ranger division are accounted for within the wilderness management portion of this plan.

Vegetation Monitoring
No funding or FTE is currently obligated for sensitive plant management

Giant Sequoia Management
Current ONPS Funding and FTE: $ 625 FTE 0.1

There is no single position dedicated to giant sequoia management. Direct involvement in giant sequoia issues is usually limited to periodic involvement in the Interagency Giant Sequoia Research Cooperative by various SNRM staff.

Unfunded base (From NR-MAP analysis) (including ONPS and FIREPRO base)

Program Administration

NR-MAP Shortfall: 2.5 FTEs $ 156,443

Additional data management and clerical support will be required as the program areas within the branch evolve. NR-MAP has allocated 2.5 FTE for these support functions to include; budget management, travel, timekeeping, clerical (typing, filing, etc), and data management (data entry, storage, retrieval).

- 1 FTE – GS-318-05 Secretary
- 1 FTE – GS-326-04 Office Automation Clerk
- 0.5 FTE - GS-326-04 Office Automation Clerk (Seasonal)

Fire Effects Monitoring

The fire effects monitoring program funded by FIREPRO fulfills minimum NR-MAP program requirements. Additional studies are always required and additional funding is sought through project

funding requests or through other funding sources.

Fire Research and Data Coordination

The position funded by FIREPRO fulfills minimum NR-MAP program requirements. A full time research scientist position in addition to the current Data Coordinator position would be well utilized should additional funding become available.

Fire Management For Ecological Objectives

NR-MAP Shortfall: 2.24 FTEs $ 140,172

Additional base funding is needed to focus on the backlog of prescribed burn projects, fire monitoring studies, smoke management, fire planning, and project implementation.

- 1 FTE – GS-09-401 Ecologist (Rx fire planning and implementation)
- 1.24 FTE – GS-05-404 Bio Sci Tech (3 Seasonal – Rx fire evaluation, special studies, implementation)

Threatened, Endangered, and Sensitive Plants

NR-MAP Shortfall: 0.44 FTEs $ 27, 534

With increased support, the vegetation-monitoring program would be expanded to incorporate special status plant inventory and monitoring. The FTE represented by this shortfall would be combined with the general vegetation monitoring FTEs into a single organization and monitoring team.

Stock Use and Meadow Monitoring

NR-MAP Shortfall: 1.75 FTEs $ 109,510

Additional funding and staff are needed to bring the grazing monitoring (stock use and meadow monitoring) program up to a fully functional level. A subject to furlough Biological Science Technician will be hired to assist with field data collection, processing, and reporting.

- 1 FTE - GS-408-09 Plant Ecologist
Responsible for implementing meadow monitoring program.
- 0.75 FTE - GS-404-07 Biological Science Technician
Responsible for collecting and processing meadow monitoring data.

Vegetation Monitoring

NR-MAP Shortfall:	1.7 FTEs	$ 106,381
Additional Need*:	1.3 FTEs	$ 81,350
Total Program Shortfall:	3.0 FTE	$ 187,731

This program would implement a systematic community level vegetation-monitoring program. The FTEs allocated here would be combined with the special status plant monitoring program FTE (0.44) into a single functional monitoring team.

*Note: NR-MAP does not include an allocation for community level vegetation monitoring. An additional 1.3 FTEs have been included in addition to the NR-MAP allocation to cover this program area.

- 1 FTE - GS-408-09 Plant Ecologist
Responsible for implementing vegetation monitoring program.
- 1 FTE - GS-404-07 Biological Science Technician
Responsible for collecting and processing vegetation monitoring data.
- 1.44 FTE - GS-404-05 Biological Science Technician(3 seasonals)
Vegetation monitoring crew (T&E and vegetation community monitoring)

Giant Sequoia Management

There is no discrete NR-MAP allocation for giant sequoia management. As noted above, sequoia management is contained in a variety of other park programs. Any increases in those programs would provide incremental improvements in the parks' ability to manage the giant sequoia resource within goals and standards and to achieve the desired future conditions.

Unfunded Fire and Vegetation Monitoring Program

Program Element	**Current Program**	**Unfunded Program (R-MAP allocation minus current program)**	**Fully Funded Program (R-MAP allocation)**
Program Admin	0.9	2.5	3.5
Fire Effects Monitoring	2.70	0	2.70
Fire Research and Monitoring Coord/Data Management	1	0	1
Nat Resources Fire Use	5.1	2.24	7.34
T & E Plant Monitoring	0	0.44	0.44
Grazing Management (Meadow monitoring)	1	1.75	2.75
Native Vegetation Community Monitoring	0	1.7*	1.7*
Giant Sequoia Mgmt	0.1	0	0
Total FTE	10.8	8.63	19.43

Program Element	Current Program	Unfunded Program (R-MAP allocation minus current program)	Fully Funded Program (R-MAP allocation)
*Plus 1.3 additional need		9.93	

* NR-MAP does not make a separate allocation for ecosystem level vegetation monitoring. 1.7 FTE from the NR-MAP "Native Terrestrial Plant Management and Monitoring" allocation was used to cover this need. An additional 1.3 FTE is needed for a fully functional program.

Positions Needed

Positions are listed by priority for funding.

Phase	Position	Branch Priority	Project Statement No.	FTE(s)
1	GS-408-11 Fire Ecologist, Promotion from GS-408-09 Fire Ecologist	1	SEKI-N-080.000	0.0
	GS-408-09 Plant Ecologist (meadow monitoring)	1	SEKI-N-080.000	1.0
	GS-408-09 Plant Ecologist (T&E/Veg Mon)	2	SEKI-N-080.000	1.0
	GS-318-05 Secretary	3	SEKI-N-080.000	1.0
2	GS-404-07 Bio Sci Tech (meadow monitoring)	4	SEKI-N-080.000	0.75
	GS-404-06 Bio Sci Tech (vegetation monitoring)	5	SEKI-N-080.000	1.0
	GS-404-05 Bio Sci Tech Crew (3 seasonals)	6	SEKI-N-080.000	1.44
	GS-326-04 Office Automation Clerk (Seasonal)	7	SEKI-N-080.000	0.5
3	GS-05-404 Bio Sci Tech (3 Seasonal – Rx fire evaluation, special studies, implementation)	8	SEKI-N-030.000	1.24
	GS-326-04 Office Automation Clerk	9	SEKI-N-030.000	1
	GS-09-401 Ecologist (Rx fire planning and implementation)	10	SEKI-N-030.000	1
Total				9.93

Branch of Forestry and Vegetation Management

Program Overview

The Branch of Forestry and Vegetation Management is responsible for planning, implementing, and monitoring the tree hazard management, native vegetation management, exotic vegetation management, and disturbed area restoration/revegetation programs. These programs include fiscal and administrative support functions. The Branch is involved Parkwide in vegetation management issues, including mitigation of construction project impacts, which entails interaction with Denver Service Center (DSC) engineers/landscape architects, private contractors, as well as interagency contacts with foresters, pathologists, entomologists, and revegetation/nursery specialists.

Tree Hazard Management

This program includes surveillance of approximately 950 acres of frontcountry developed sites for tree hazards. Identified hazards are mitigated (hazard removed) or abated (target removed). Currently there is a backlog of approximately 50-75 unmitigated identified high priority tree hazards with an additional 250-300 high priority hazards being identified each year. Periodic outbreaks of native insects, such as those experienced roughly once per decade, inflate these numbers and increase backlog. Mitigation efforts involve application of highly technical climbing, rigging, topping, limbing, and felling skills, and result in an average of 200-250 high priority hazards treated annually.

There are 176 miles of road corridor and dozens of backcountry sites that receive neither regularly scheduled surveillance or mitigation. There currently exists numerous hazardous situations involving leaning snags threatening backcountry bridges and other targets. Data management for this program involves maintaining up-to-date records of surveillance/ mitigation for over 10,000 trees, and revising base maps to reflect current conditions. Field maps are digitized and drafted, using computer-assisted design software. A database of tree failure records dating back to 1970 is maintained.

Native Vegetation Management and Monitoring

This program includes inventorying and monitoring native plant populations, forest pest (biotic/abiotic) management, stand management (thinning), vista clearing, and mitigation of construction impacts. Native plant populations are monitored for incidence and severity of native and exotic insects and diseases, especially as these affect distribution, density, and forest species composition. Management actions include direct control in form of suppression activities involving native and exotic pathogens (e.g. dwarf mistletoe), and indirect control (through regulation of stand density or some other predisposing agent) in developed sites. Native insects and diseases are managed in the Development Zone, but not outside that zone. Exotic pests are managed in the Developed and Natural zones. This program also includes mitigation of impacts of construction projects to native vegetation as well as identification of potentially hazardous and "high risk" (low vigor) trees for removal prior to development. The Branch is responsible for cruise-marking virtually all trees removed from construction projects, and for developing timber sales, as appropriate, to dispose of surplus timber.

Exotic Vegetation Management

This program includes monitoring (detection/mapping) and eradication of exotic plants. Recently completed field surveys have resulted in identification of 154 exotic, naturalized plant species. At present, there is no organized control program.

Disturbed Area Restoration/Revegetation

This program in recent past (last 15 years) has concentrated on revegetating disturbance associated with on-going construction projects. Funding sources have been either line-item construction or Federal Land Highways Program (FLHP). Majority of work has been associated with Package 200 Clover Creek (Wuksachi Village), involving re-location of entire Giant Forest development to Clover Creek and subsequent restoration of Giant Forest sites. A nursery facility was developed at Ash Mountain Headquarters to support this and other projects. Except for efforts of trail crews revegetating trails re-located out of meadows, and some relatively small-scale efforts involving primarily volunteers there has been no formal program for dealing with restoration of abandoned roads, denuded/eroded backcountry campsites/trails, river corridors, campgrounds, picnic areas, or

abandoned landfills/mines/borrow pits in over 20 years. It is intended that current program, with addition of base-funding, could be expanded to address above needs.

Current FY 00 Funded Forestry and Vegetation Management Branch Base and Staffing

Current ONPS Funding: $224,300 4.50 FTEs (See Project Statement SEKI-N-010.000, SEKI-N-100.030, and SEKI-N-110.020)

The current organization consists of the Supervisory Forester (GS-460-11), Forest Ecologist (GS-408-09), Biological Technician (GS-404-07), Tree Worker Leader (WL-5042-09), Tree Worker (WG-5042-09), and Tree Worker (WG-5042-07). This organization provides 24% of the required staffing, based on the NR-MAP allocation of 18.76 FTEs.

Tree Hazard Management

Current staffing is sufficient to survey >95% of the approximately 950 acres identified in the Developed Zone at a minimum frequency of once every three years. Computerized database of surveillance data is maintained and maps upgraded and drafted with CAD software. Roadsides and backcountry sites currently are not being surveyed on a routine basis. Mitigation staffing is woefully inadequate to cope with existing backlog plus annual increment of high priority tree hazards. Multi-year droughts and associated bark beetle (*Dentroctonus* spp.) outbreaks in pines (such as those experienced in mid-70's and late-80's/early 90's) plus recent (1997-99) Douglas-fir tussock moth (*Orgyia pseudotsugata*) outbreak in white fir accelerate tree mortality and exacerbate the tree hazard problem.

Native Vegetation Management and Monitoring

Currently, monitoring is restricted to: limited mapping of conifer species distribution; surveys for incidence of exotic pathogen white pine blister rust (*Cronartium ribicola*); minimal surveys and plot installation/ evaluation for ozone effects on yellow pines, in coordination with the Air Resources Specialist; monitoring/ mitigation of construction impacts; and, identification/cruise-marking of hazardous/"high risk" plus trees within clearing limits on construction projects.

Exotic Vegetation Management

Current management program is restricted primarily to part-time (June-September) volunteer detection/eradication efforts of one individual, concentrating on two to three established introduced species of concern at two to three locations. BRD has completed surveys and is in process of developing comprehensive, prioritized, annotated, GIS-linked database. However, current, inadequate funding/staffing levels preclude significant expansion of program.

Disturbed Area Restoration/Revegetation

Currently, the estimated 0.7 FTE (ONPS) devoted to this activity is involved with on-going/projected DSC/FLHP projects. Very little effort is being directed at other Park needs, except those efforts of trail crews in the backcountry.

Unfunded Forestry and Vegetation Management Branch Base and Staffing

The total NR-MAP allocation is 18.76 FTEs. The existing shortfall is 14.26 FTEs. Required funding for full (100%) implementation, including personal services and support is estimated at $1,173,935. Overall organization and positions are summarized below. More detail is contained in Project Statements entitled "Tree Hazard Management" (SEKI-N-110.020), "Native Terrestrial Vegetation Management and Monitoring" (SEKI-N-010.010), and "Disturbed Area Restoration/ Revegetation" (SEKI-N-100.030). Staffing is organized into three phases or benchmarks.

Tree Hazard Management (8.1 FTEs)

The full NR-MAP allocation is 8.1 FTEs, including 1.0 FTE for management/supervision and clerical support (2.9 FTEs funded in FY 00). The NR-MAP allocation includes 6.4 FTEs for mitigation, 0.7 FTE for surveillance, plus aforementioned administrative support (1.0 FTE).

Phase I will create permanent Office Automation Clerk (GS-326-05/06), upgrade Tree Worker Leader (WL-5042-09) to Tree Worker Foreman (WS-5042-08), extend permanent (subject-to-furlough) Tree Worker (WG-5042-09), extend permanent (subject-to-furlough) Tree Worker (WG-5042-07), and create new permanent (subject-to-furlough) Tree Worker (WG-5042-09).

Phase II will create two seasonal Sawyers (WG-5042-05), create one permanent (subject-to-furlough) Forestry Technician (GS-462-07), and create one seasonal Forestry Technician (GS-462-05).

Phase III will create two seasonal Axemen (WG-5042-04), create one additional permanent (subject-to-furlough) Tree Worker (WG-5042-07), upgrade Supervisory Forester (GS-460-11) to GS-12, and upgrade Ecologist (GS-408-09) to GS-11.

Native Vegetation Management and Monitoring (3.32 FTEs)

The full NR-MAP allocation is 3.32 FTEs, including 0.4 FTE for management/supervision and clerical support (0.8 FTE funded in FY 00).

Phase I will create permanent Office Automation Clerk (GS-326-05/06), and create permanent (subject-to-furlough) Biological Science Technician (GS-404-07).

Phase II will create permanent (subject-to-furlough) Forestry Technician (GS-462--07), and create seasonal Forestry Technician (GS-462-05).

Phase III will create one additional seasonal Forestry Technician (GS-462-05), upgrade Supervisory Forester (GS-460-11) to GS-12, and upgrade Ecologist (GS-408-09) to GS-11.

Exotic Vegetation Management (0.54 FTE)

The full NR-MAP allocation is 0.54 FTE (0.05 FTE funded in FY 00).

Phase I will create permanent (subject-to-furlough) Biological Science Technician (GS-404-07).

Phase II will create permanent (subject-to-furlough) Forestry Technician (GS-462--07), and create seasonal Forestry Technician (GS-462-05).

Phase III will create one additional seasonal Forestry Technician (GS-462-05).

Disturbed Area Restoration/Revegetation (6.8 FTEs)

The full NR-MAP allocation is 6.8 FTEs, including 0.6 FTEs for management/supervision and clerical support (0.7 FTEs funded in FY 00).

Phase I will create permanent Office Automation Clerk (GS-326-05/06), extend permanent (subject-to-furlough) Biological Science Technician (GS-404-07), create permanent (subject-to-furlough) Horticulturist (GS-437-07), and create permanent Restoration Ecologist (GS-408-09).

Phase II will create two seasonal Biological Science Technicians (GS-404-05/06).

Phase III will create four seasonal Biological Technicians (GS-404-04/05), create permanent (subject-to-furlough) Gardener (WG-5042-05), upgrade Supervisory Forester (GS-460-11) to GS-12, upgrade Restoration Ecologist (GS-408-09) to GS-11, upgrade Biological Science Technician (GS-404-07) to GS-09, and upgrade Horticulturist (GS-437-07) to GS-09.

Unfunded Forestry and Vegetation Management Project Statements:

Tree Hazard Management

SEKI-N-110.021 Reduce Tree Hazard Backlog

Exotic Vegetation Management

SEKI-N-100.040 Exotic Plant Management

Disturbed Area Restoration/Revegetation

SEKI-N-100.011 Remove and Restore Abandoned Road (North Fork/Hidden Springs)

SEKI-N-100.021 Rehabilitate High Priority Wilderness Sites/Trails/Camps

SEKI-N-100.031 Revegetate/Landscape Construction Sites

SEKI-N-100.032 Restore Two Impacted Montane Meadows

SEKI-N-100.033 Restore Acquired Lands to Natural Conditions

Positions Needed

Positions are listed by program, prioritized (Branch-wide), and identified by Phase in which they will be filled. Seasonal positions are indicated by the number of positions required in parentheses.

Phase	Position	Office Priority	Project Statement No.	FTE(s)
Tree Hazard Management				
Existing	Tree Worker Leader, WL-5042-09		SEKI-N-110.020	0.00
	Tree Worker, WG-5042-09		SEKI-N-110.020	0.00
	Tree Worker, WG-5042-07		SEKI-N-110.020	0.00
	Forester, GS-460-11		SEKI-N-110.020	0.00
	Forest Ecologist, GS-408-09		SEKI-N-110.020	0.00
1	Office Automation Clerk, GS-326-05 Provide word processing, data entry, fiscal assistance, and other clerical support for entire branch.	1	SEKI-N-110.020	0.50
	Tree Worker Foreman, WS-5042-08 (Promotion from Tree Worker Leader, WL-5042-09), Forestry Crew supervision.	2	SEKI-N-110.020	0.00
	Tree Worker, WG-5042-09 (Extension), Tree hazard climbing/removal.	4	SEKI-N-110.020	0.40
	Tree Worker, WG-5042-08 (Extension/Promotion from Tree Worker, WG-5042-07), Tree hazard climbing/removal.	5	SEKI-N-110.020	0.40
	Tree Worker, WG-5042-09 Tree hazard climbing/removal	6	SEKI-N-110.020	0.90
2	Sawyer, WG-5042-05 (2) Tree hazard removal.	11	SEKI-N-110.020	0.90
	Forestry Technician, GS-462-07 Tree hazard surveillance.	12	SEKI-N-110.020	0.30
	Forestry Technician, GS-462-05 (1) Tree hazard surveillance.	13	SEKI-N-110.020	0.30
3	Axeman, WG-5042-04 (2) Tree hazard removal clean-up/site rehab.	16	SEKI-N-110.020	0.90
	Tree Worker, WG-5042-07 (2) Tree hazard removal.	22	SEKI-N-110.020	0.90
	Supervisory Forester, GS-460-12 (Promotion from Forester, GS-460-11)	23	SEKI-N-110.020	0.00
	Forest Ecologist, GS-408-11 (Promotion from Forest Ecologist, GS-408-09)	24	SEKI-N-110.020	0.00
Subtotal for Tree Hazard Management				5.10
Native Vegetation Management and Monitoring				
Existing	Forester, GS-460-11		SEKI-N-010.010	0.20
	Forest Ecologist, GS-408-09		SEKI-N-010.010	0.40
1	Office Automation Clerk, GS-326-05 Provides word processing, data entry, fiscal assistance, and other clerical support to entire branch.	1	SEKI-N-010.010	0.20
	Biological Science Technician, GS-404-07, Inventory and monitoring native/exotic plant populations, effects of biotic/abiotic pathogens, and human impacts to vegetation.	9	SEKI-N-010.010	0.50

Phase	Position	Office Priority	Project Statement No.	FTE(s)
2	Forestry Technician, GS-462-07 Inventory and monitoring native/exotic plant populations, forest pathogens, and exotic plant control.	12	SEKI-N-010.010	0.30
	Forestry Technician, GS-404-05 (1) Inventory and monitoring native/exotic plant populations, forest pathogens, and exotic plant control.	13	SEKI-N-010.010	0.30
	Biological Science Technician, GS-404-07, Inventory and monitoring native/exotic plant populations, effects of biotic/abiotic pathogens, and human impacts to vegetation.	15	SEKI-N-010.010	0.40
3	Forestry Technician, GS-404-07, Inventory and monitoring native/exotic plant populations, forest pathogens, and exotic plant control	19	SEKI-N-010.010	0.30
	Forestry Technician, GS-462-05 (1) Inventory and monitoring native/exotic plant populations, forest pathogens, exotic plant control.	20	SEKI-N-010.010	0.46
	Supervisory Forester, GS-460-12 (Promotion from Forester, GS-460-11)	23	SEKI-N-010.010	0.00
	Forest Ecologist, GS-408-11 (Promotion from Forest Ecologist, GS-408-09)	24	SEKI-N-010.010	0.00
Subtotal for Native Vegetation Management and Monitoring				3.06
Disturbed Area Restoration/Revegetation				
Existing	Forester, GS-460-11		SEKI-N-100.030	0.25
	Biological Science Technician, GS-404-07		SEKI-N-100.030	0.45
1	Office Automation Clerk, GS-326-05 Provide word processing, data entry, fiscal assistance, and other clerical support to entire branch.	1	SEKI-N-100.030	0.30
	Restoration Ecologist, GS-408-09 Plans and oversees implementation/monitoring restoration/revegetation projects.	3	SEKI-N-100.030	1.00
	Biological Science Technician, GS-404-07, Directs implementation of seed/cutting collection, planting, post-planting care, and monitoring activities.	7	SEKI-N-100.030	0.50
	Horticulturist, GS-437-07 Plant propagation/growing (Nursery).	8	SEKI-N-100.030	1.00
2	Biological Science Technician, GS-404-05, Collects seeds/cuttings, installs plants, provides post-planting care, and collects data.	10	SEKI-N-100.030	0.60
	Biological Science Technician (Nursery), GS-404-05 (1), Propagates plants/provides nursery care.	14	SEKI-N-100.030	0.40
3	Biological Science Technician, GS-404-05 (2), Collects seeds/cuttings, installs plants, provides post-planting care, and collects data.	17	SEKI-N-100.030	1.00
	Biological Science Technician (Nursery), GS-404-05 (2), Propagates plants/provides nursery care.	18	SEKI-N-100.030	1.00

Phase	Position	Office Priority	Project Statement No.	FTE(s)
	Gardener, WG-5042-05 Provides plant care, weeding, watering, and general facility maintenance.	21	SEKI-N-100.030	0.40
	Supervisory Forester, GS-460-12 (Promotion from Forester, GS-460-11)	23	SEKI-N-100.030	0.00
	Restoration Ecologist, GS-408-11 (Promotion from Rest. Ecologist, GS-408-09)	24	SEKI-N-100.030	0.00
	Biological Science Technician, GS-404-09 (Promotion from Biol. Tech., GS-404-07)	25	SEKI-N-100.030	0.00
	Horticulturist, GS-437-09 (Promotion from Horticulturist, GS-437-07)	26	SEKI-N-100.030	0.00
Subtotal for Disturbed Area Restoration/Revegetation				6.90
Total				15.06

Branch of Air Resources Management

Program Overview

Addresses the following issues; (1) visibility impairment and biological damage caused by air pollution; and (2) lack of basic data. The Branch is involved in air resources management.

Air Resources Management Program

The goal of the air resources management program is to preserve, protect and enhance the natural, cultural and human resources affected by air pollution in these parks. Air pollutants transported from urbanized areas in California into these parks are damaging sensitive natural resources. Ozone levels frequently exceed health-based State and occasionally Federal air quality standards. Highly acidic late summer precipitation and spring snowmelt have been documented. Visibility is frequently obscured by airborne particulates.

The air resources management program has five main areas of emphasis: (1) monitor ambient levels and trends of air pollutants; (2) measure and monitor effects of air pollutants on vegetation; (3) maintain effective relations with the public and regulatory authorities; and (4) comply with air pollution control regulations; and (5) education.

The *Ambient Air Quality Monitoring Program* began in 1980 and currently consists of year-round monitoring of ozone (two sites), visibility (one camera), wet deposition (two sites), dry deposition (two sites), and various meteorological stations. The data are archived in various locations depending on the lead agency involved. Some of the data have been validated and reported. Remote monitoring of pollutants in the wilderness has been limited to infrequent special studies and is still in the experimental stages.

The *Air Quality Biological Effects Monitoring Program* includes studies to identify air pollution sensitive vegetation, and monitor those species for air pollution effects over time and space to detect changes in condition. Sensitivity studies are expensive and therefore, only a few species have been studied thus far. These are ponderosa and Jeffrey pines, black oak and giant sequoia. Acid deposition

studies by research staff have been on-going since 1982 and involve measurements of input and output chemistry, and effects on soils, vegetation and aquatic environments in three distinct watersheds.

Various outside research is facilitated through the program, adding to the parks' knowledge of dose response relationships and biological effects of air pollution.

The *External Relations Program* is the main tool for achieving the goals of the air resources management program. By maintaining active and effective relations with the public and air pollution control regulatory authorities, these parks are able to influence the prevention and mitigation of air pollution impacts on park resources. Park air quality data are used to review the impacts of regulatory plans, permits and rules and input is provided when needed. Meetings, workshops, hearings, conferences and public outreach activities are used as opportunities to increase public awareness of park air quality issues. The Federal Clean Air Partnership (FCAP), with members from the NPS, USDA Forest Service and Bureau of Land Management (BLM), coordinates air quality activities of Federal Land Managers in the Sierra. FCAP serves as a technical advisory group to park, forest and BLM managers.

The *Air Pollution Control Regulation Compliance Program* must comply with air pollution control regulations as specified by the Federal Clean Air Act. This involves reviewing regulations, attending hearings and workshops, permit application, fee payments, and meeting all deadlines and requirements of the regulations. Most in-park air pollution sources are operated by the Division of Maintenance. It is the task of the air resources management program to assist management by following regulation development, informing management of regulations that may affect park operations and assist as much as possible with the compliance process.

Current FY 2000 ONPS Funded Air Resources Management Program

Program Base and Staffing
Current ONPS Funding: Air Resources Management Program - ($56,800) 1.0 FTE (See Project Statement SEKI-N-050.000)

The air resources management program is managed by the Air Resources Specialist, GS-408-11. This position spends approximately 0.3 FTEs on the ambient air quality monitoring program, 0.2 FTEs on the air quality biological effects monitoring program, 0.3 FTEs on the external relations program, and 0.2 FTEs on the air pollution control regulation compliance program.

In addition, the program receives funds from the WASO Air Quality Division and California Air Resources Board. Funding for 0.5 FTE to collect ambient air quality data comes from the WASO Air Quality Division ($28,500) and California Air Resources Board ($10,500). Funding for UVB monitoring is provided from PRIMENet, a NPS/EPA partnership ($12,000)

Unfunded Air Resources Management Program Base and Staffing

Unfunded NR-MAP ONPS Program Base includes current Air Resources Specialist position (1.0 FTE and support): 3.89 FTEs (See Project Statements SEKI-N-050.000, and SEKI-N-120.011). This is the full NR-MAP buildout. Unfunded air resources management program $243,400.

The NR-MAP Target Organization for the air resources management program is characterized in the Staffing Plans section. The air resources management staff will be increased over time to meet the fully funded NR-MAP program (3.89 FTEs) for the Branch. This figure includes 1.0 FTE for

management/ supervision. Administrative support not included in the 3.89 figure is 1.0 FTE for clerical assistance. The fully funded program will adequately address air resources management. A total of two new permanent full time positions, as identified below will be hired.

Air Resources Management Program (3.89 FTEs, includes existing Air Resources Specialist)(Full NR-Map Buildout)

A permanent full time Physical Scientist, GS-1301-09 (1.0 FTE), and seasonal Physical Science Technician, GS-1311-05 (0.5 FTE), will be hired. The lead Physical Scientist will manage the air quality-monitoring program. The Physical Science Technician will provide technical support. More time for data validation and reporting will be available.

A permanent full time Biologist, GS-401-09 (1.0 FTE), and one seasonal Biological Science Technician, GS-404-05 (0.39 FTE), will be hired. The Biologist will manage the Air Quality biological effects monitoring program and the one Biological Science Technician will provide technical support. These positions will allow a more active biological effects program.

With the above positions in place, the currently funded Air Resources Specialist position will be able to spend more time on the external relations and air pollution control regulation compliance programs.

Administrative Support Program (1.0 FTEs)

An Office Automation Clerk, GS-326-05 (1.0 FTE), will be hired in Phase I to provide clerical support to the Branch.

The new permanent positions in the Branch of Air Resources Management are prioritized and identified by which phase they will be hired in the following table.

Unfunded Air Resources Management Projects

Air Resources Management

SEKI-N-170.121/PMIS No. Study Effects of Acid Deposition on Vegetation and Aquatic Ecosystem

SEKI-N-170.122/PMIS No. Study Effects of Air Pollution on Sensitive Plant System

Positions Needed

Positions are listed by priority for funding

Phase	Position	Branch Priority	Project Statement No.	FTE(s)
1	Air Resource Specialist GS-408-11. Promoted from GS-408-11	1		0.00
	Physical Scientist, GS-1301-11, (1.0 FTE) and one seasonal Physical Science Technicians, GS-1311-05 (0.5 FTEs) Responsible for the air quality monitoring program	1	SEKI-N-050.000	1.5

	Biologist, GS-401-09 and Biological Science Technician, GS-404-05 (0.39 FTEs) Responsible for the air quality biological effects monitoring program	2	SEKI-N-050.000	1.39
	Office Automation Clerk, GS-326-05, Responsible for clerical and other administrative duties for the Branch	4	SEKI-N-120.011	1.0
Total				3.89

Overall Prioritization of ONPS Staffing Needs

The purpose of this section is to provide and overall prioritization for all ONPS base positions for the Division of Science and Natural Resources Management. Prioritization for each office and branch are identified under the respective office and branch. Only Phase I positions are prioritized. Positions followed by numbers in parentheses are seasonal; the numbers are the number of positions.

Priority	**Position(s)**	**OFS Formulation System Statement Number/Project Statement Number**	**FTE(s)**
1	Aquatic Ecologist, GS-408-11 and Biological Technician, GS-405-05 (2) for the Aquatic Resources Management Program	5166A	2.0
2	Ecologist (Exotic Plants), GS-408-11 and Biological Technician, GS-404-6/5 for the Exotic Plant Management Program	5166A	2.5
3	Biological Science Technician, GS-404-07 for the Air Resources Management Program	5166A	1.0
4	Restoration Ecologist, GS-408-11 and Biological Technicians, GS-404-06/05 (4) for the Restoration Program	5166A	2.5
5	Physical Science Technician, GS-1311-07 for the Cave Management Program	5166A	1.0
6	Biological Technician, GS-404-07 for the Bear Management Program	5263A	1.0
7	Biological Technicians, 404-06/05 Seasonal positions for the Bear Management Program	5263A	3.2
8	Tree Worker, WG-5042-09/08 Conversion of two PLTFT positions to PFT for the Tree Hazard Mitigation Program	5263A	1.4
9	Sawyer, WG-5042-07 for the Tree Hazard Mitigation Program	5263A	0.5
10	Office Automation Clerk, GS-326-05Seasonal support for the Tree Hazard Mitigation Program	5263A	0.2
11	Ecologist, GS-408-11 for the Science Program	7072A	1.0
12	Data Administrator, GS-334-11 for the GIS/Information/Data Management Program	7072A	1.0
13	Biological Technician, GS-404-07 for the Wildlife Monitoring Program	7072A	1.0
14	Biological Technician, GS-404-05 for the Wildlife Monitoring Program	7072A	1.0

Priority	Position(s)	OFS Formulation System Statement Number/Project Statement Number	FTE(s)
15	Biological Technician, GS-404-07 for the Aquatic Resources Management Program	7072A	1.0
16	Ecologist, GS-408-11 for T&E Species/Vegetation Monitoring Program	7072A	1.0
17	Biological Technician, GS-404-07 for the Vegetation Monitoring Program	7072A	1.0
18	Biological Technicians, GS-404-05 Seasonal Crew for the Vegetation Monitoring Program	7072A	0.5
19	Physical Science Technician, GS-1311-05 for the Air Resources Monitoring Program	7072A	0.5
20	Information Specialist, GS-1001-05 for the Science/Research Program	7072A	0.5
21	Office Automation Clerk, GS-326-05 for the Science/Research Program	7072A	2.5
22	Physical Scientist, GS-1301-11 and Physical Scientist Technician, GS-1311-05 for the Air Resources Management Program	SEKI-N-050.000	2.5
23	Natural Resources Management Specialist for the Long-Term Ecological Monitoring Program	SEKI-N-190.010	1.0
24	Plant Ecologist, GS-408-09 for the Meadow Monitoring Program	SEKI-N-080.000	1.0
25	Biological Science Technician, GS-404-07 for the Revegetation Program	SEKI-N-100.030	0.50
26	Biologist, GS-401-09and Biological Technician, GS-404-05 for the Air Quality Bioeffects Monitoring Program	SEKI-N-050.000	1.39
27	Tree Worker, GS-5042-09 for the Tree Hazard Mitigation Program	SEKI-N-110-020	0.90
28	Biological Technician, GS-404-07 for the Long-Term Ecological Monitoring Program (native/exotic plants, effects of pathogens, and human impacts on vegetation)	SEKI-N-010.000	0.50
29	Horticulturist, GS-437-07for the Plant Nursery Program	SEKI-N-100.030	1.00
30	Office Automation Clerk, GS-326-05 for the Aquatic/Wildlife and Geological Resources Program	SEKI-N-020.000	1.00
31	Secretary, GS-318-05 for the Fire and Vegetation Monitoring Program	SEKI-N-030.000	1.0
32	Office Automation Clerk, GS-326-05 for the Forestry and Vegetation Management Program	SEKI-N-010.000	0.5
33	Office Automation Clerk, GS-326-05 for the Air Resources Management Program	SEKI-N-050-000	1.0

RESOURCE PROTECTION PROGRAM

Division of Fire and Visitor Management.

Overview of Current Division Program and Need

This section describes the current and fully funded (adequate) natural resource protection/wilderness management program of the Division of Fire and Visitor Management. Strategies to phase in the fully funded NR-MAP are identified.

The role of the Division of Fire and Visitor Management in managing of park resources is protection of those resources by managing visitors through patrol and enforcement of regulations, and by managing wilderness resources to preserve their wilderness character. Program components include fire management, bear management, backcountry patrol and management of the wilderness permit system, visitor and stock use management in wilderness, poaching and trespass grazing patrols, and enforcement of natural and cultural resource protection regulations. The Division works closely with the Division of Science and Natural Resources Management in all natural resources management programs.

The fire management program is funded by FIREPRO. NR-MAP only allocates staff for the use of prescribed fire ecosystem restoration. The prescribed fire management program for ecosystem restoration is covered in the Division of Science and Natural Resources Management section.

The programs listed below in the Division of Fire and Visitor Management are managed by the Chief Ranger, the Sequoia District Ranger, the Kings Canyon District Ranger, the Fire Management Officer, the Law Enforcement Specialist, and the Wilderness Coordinator.

Natural Resource Protection

This program includes proactive patrol for the prevention of poaching of park wildlife (bears, deer, and mountain lions), birds, and fuel wood; patrol of frontcountry trails; management of rock and alpine climbing; patrol of fishing activities in frontcountry and backcountry streams, and enforcement of fishing regulations; and patrol of 25 miles of boundary to prevent cattle and pig trespass. Poaching of wildlife is believed to occur throughout the year, but particularly during the fall hunting season and during the winter as fur-bearing animals become more valuable. Very few fishermen are checked for licenses or compliance with fishing-related restrictions.

Climbing is managed on Moro Rock and Chimney Rocks to protect the once endangered peregrine falcon. Park natural resources will be under increasingly greater threat as the population continues to grow and expand throughout the San Joaquin Valley and the state. Endangered species and parts of many animals, such as bears, are becoming extremely valuable in foreign markets. The motive to poach is increasing.

Wilderness Management

Each Division participates in wilderness management in some way without an organizational hierarchy supporting this function. The current wilderness management program is interdisciplinary, most directly involving Resource Management, Maintenance, Interpretation, Concessions, and Visitor

Protection Divisions. The program breakdown in the following sections addresses the Division of Fire Management and Visitor Protection's portion of that program.

Overflights by Military Aircraft

The Division of Fire and Visitor Management monitors low-level military aircraft above the park. Backcountry Rangers radio in reports to Fire Dispatch, who then fax the information to the Central Coordinating Facility at Edwards Air Force Base. This facility houses air traffic controllers for the R-2508 Complex who can identify the low-flyer from radar tapes.

The Chief Ranger and Wilderness Coordinator coordinate with staff at Edwards AFB, China Lake NAWS, and Lemoore NAS. They have made presentations at the R-2508 Complex Control Board and the R-2508 Joint Planning and Policy Board. Attendance at the annual Regional Airspace Management meeting provides a forum to voice concerns and solve problems.

The Aviation Management Specialist coordinates with the military on issues concerning safety, and during park emergencies such as fire and search and rescue activities, during which a Temporary Flight Restriction may be requested.

Current FY 2000 Funded Division Program Base and Staffing

The current organization consists of the Chief Ranger who supervises two District Rangers, a Fire Management Officer, a Law Enforcement Specialist, and a Wilderness Coordinator. The District Rangers are responsible for the complete spectrum of resource protection and wilderness management programs within their Districts, with staff support from the Wilderness Coordinator. Current ONPS funding for all of these programs supports 26.39 FTEs, meeting 82.6% of the needed 34.97 FTEs as identified by NR-MAP (includes clerical support and management/supervision).

Natural Resource Protection

Current ONPS Funding: The FY 1999 Natural Resource Protection budget as identified below supported 16.09 FTE. This program is sufficient to provide only minimal patrol and enforcement of regulations. There are some fishing and river patrols in the frontcountry, management of rock climbing on Moro Rock and Chimney Rock, and monitoring of cattle trespass in the North Fork of the Kaweah area.

Wilderness Management

Current ONPS Funding: The FY 99 Wilderness Management Program as defined below supported 10.3 FTEs and cost $494,983. FY 2000 figures will not be available until the park budget is allocated.

The Wilderness Management Program is managed by the Wilderness Coordinator, GS-401-12 (1.0 FTE). This position is directly involved in wilderness policy and planning, and serves as the focal point for internal and external coordination on wilderness issues affecting these parks. The following breakdown is for those people directly involved in wilderness management through the Division of Fire Management and Visitor Protection:

A permanent Wilderness Assistant, GS-303-07 (1.0 FTE), runs the Wilderness Office, consisting of a permanent subject-to-furlough GS-303-04 (0.67 FTE) Visitor Use Assistant, and one to two seasonal GS-025-04 Park Rangers (.33 FTE each). The Wilderness Office serves as the public's main contact point for wilderness information and permit reservations. Personnel services for 1999 cost $124,815.

Seasonal GS-025-05 or GS-025-07 Backcountry Rangers (0.33 FTE each) are stationed at backcountry ranger stations during the summer months. In 1999, there were 15 backcountry rangers. Their responsibilities include visitor protection (search and rescue, emergency medical services, fire, law enforcement), resource protection (trail patrols by foot and stock, meadow monitoring, campsite rehabilitation, trail clearing, law enforcement), and wilderness education for visitors. These seasonal rangers are supervised by two GS-025-09 Law Enforcement Rangers (1.0 FTE each), one in Sequoia National Park and one in Kings Canyon National Park. In 1999, personnel services cost $324,504; logistical support for these backcountry rangers cost $45,664.

Overflights by Military Aircraft

The following people are directly involved in the military overflight issue: the Chief Ranger, the Wilderness Coordinator, the Aviation Management Specialist, Fire Dispatchers, Backcountry Rangers, and Wilderness Office staff. Currently, no ONPS funding is targeted for addressing this issue.

Unfunded Division Program Base and Staffing

Natural Resource Protection

The unfunded part of this program is combined with wilderness management due to overlap of job responsibilities in backcountry/wilderness areas of the park.

Wilderness Management

In 1994, NR-MAP identified the current park staffing at 32.84 FTE with a workload of 34.97 FTE. In 1998 and 1999, through implementation of Ranger Careers, the seasonal backcountry rangers were upgraded to GS-7s, making it impossible to fully fund all positions for the duration of the busy summer season. The number of backcountry rangers was reduced from 16 to 15, and their seasons have all been reduced by at least one month.

A reassessment of the NR-MAP analysis needs to be done. Based strictly on the reduction of backcountry ranger FTEs through implementation of Ranger Careers, an additional 1.6 FTE are needed. The identified shortfall during 1994 was 2.13. Re-evaluating the current (1999) staffing level and comparing that to the projected workload need implies a shortfall of 8.58 FTE. The table below shows a breakdown by program area.

Overflights by Military Aircraft

No unfunded base or staffing has been identified at this time.

Overall Prioritization of Division ONPS Staffing Needs

Priority 1

- Extend seasonal backcountry ranger seasons and restore needed positions (GS-025-07 positions); 2.26 FTE
- Support prescribed burn operations; 0.54 FTE
- Provide clerical support for resource protection; 0.40 FTE

Priority 2

If poaching/theft of natural resources and trespass grazing are not adequately addressed through increased backcountry patrol:

- Prevent and control poaching/theft of natural resources; 2.49 FTE
- Prevent and manage trespass grazing; 0.26 FTE

Priority 3

- Provide frontcountry trail patrol; 0.11 FTE
- Manage climbing activities; 1.30 FTE

Division of Maintenance

Maintenance supports the natural resources/protection program through fence maintenance and wilderness/frontcountry trail restoration/rehabilitation, and wilderness/ backcountry campsite restoration/rehabilitation. The wilderness/frontcountry trail program consists of (1) rerouting trails out of sensitive areas, such as meadows, (2) constructing a new trail to replace the old trail in a less sensitive area, and (3) restoring/rehabilitating the old trail tread. There are 842 miles of trails in the wilderness/backcountry. Of these 842 miles, 50 miles are in need of removal from meadows or other sensitive areas and the old trail tread restored/rehabilitated. Some wilderness/backcountry campsites are in need of restoration/rehabilitation.

NR-MAP allocates .32 FTEs for fence maintenance and 4.86 FTEs for restoring/rehabilitating wilderness/frontcountry trails and wilderness/ backcountry campsites. There is no ONPS base staffing for fence maintenance and only FTEs for wilderness/backcountry/frontcountry trail restoration and rehabilitation and wilderness/backcountry campsite restoration/rehabilitation. The staffing needed is identified under the Branch of Forestry and Vegetation Management.

Environmental Compliance

Introduction

The purpose of this section is to describe the current and fully funded environmental compliance program and to identify strategies to meet the compliance needs of the parks. Strategies to phase the fully funded NR-MAP program in over time are identified. New NR-MAP positions are identified by priority and phase.

The environmental compliance program for the parks encompasses the mandates of the National Environmental Policy Act of 1969 (NEPA) and all other laws that require evaluation, documentation and disclosure, and public involvement, including the Endangered Species Act, Clean Water Act, Executive Orders on Floodplains and Wetlands, and others. All natural resources management and scientific activities, and activities by other divisions that impact the environment are subject to NEPA. All park planning documents (GMP, DCPs, and Project Plans etc.) and natural resource planning documents (Resource Management Plans, Vegetation Management Plans, Water Resources Management Plans, and Fire Management Plans), species control/restoration, research that requires sampling or manipulation, and similar actions are subject to scrutiny and must show that appropriate environmental compliance has been completed and that the required analysis have been undertaken.

The parks' Environmental Management Committee (EMC) provides oversight to all plans and projects that need compliance. The Sequoia and Kings Canyon National Parks Project and Environmental Compliance Guide provides direction to the Committee. Currently there is no fully dedicated staff or funding specifically assigned to the Environmental Compliance Program. The Division Chief of the Interpretation and Cultural Resources is the Chairperson of the EMC and provides oversight and direction to the Environmental Compliance Program. This is in addition to his other duties.

Program Overview

The environmental compliance program covers the mandates of the National Environmental Policy Act of 1969 (NEPA). It is responsible for ensuring that all park plans and projects are subject to the laws that require evaluation, documentation and disclosure, and public involvement, including the Endangered Species Act, Clean Water Act, Executive Orders on Floodplain and Wetlands and others. The EMC annually evaluates 10 Environmental Assessments and 15 Categorical Exclusions. One Environmental Impact Statement is reviewed and evaluated every five years.

Current Funded Environmental Compliance Program Base and Staffing

Current FY 2000 ONPS Funding: $10,500 .3 FTE (See Project Statement SEKI-N-120.030)

The Program is currently not staffed with a person to deal exclusively with Environmental Compliance. The Chief of the Division of Interpretation and Cultural Resources provides oversight and direction to the Environmental Management Committee. However, these duties are in addition to his regular duties.

Unfunded Environmental Compliance Program Base and Staffing

Unfunded NR-MAP ONPS Program Base: $62,600 1.0 FTEs (See Program Statement SEKI-N-120.030 includes current .3 FTE)

The NR-MAP Target Organization for the Environmental Compliance Program is characterized in the Staffing Plans Sections. A permanent less than full time Environmental Protection Specialist, GS-028-09 (0.6 FTE), will be hired to direct the Program and report to the Chief of the Division of Interpretation and Cultural Resources, GS-025-13. A seasonal Office Automation Clerk, GS-326-05 (0.4 FTE) will provide clerical support. These positions will relieve the Chief of Interpretation and Cultural Resources from becoming involved directly in the administration of the program. This will allow him to concentrate his time on higher priorities.

The Environmental Protection Specialist will work with all park divisions in completing Environmental Assessments and Categorical Exclusions. He/she will also be the park contact for all Denver Service Center (DSC) environmental documents and all documents from other agencies. He/she will ensure that the Division of Science and Natural Resources Management staff have reviewed these documents and will prepare the parks response from the input received. He will report to the Resource Planner, GS-401-12, in the Division of Science and Natural Resources Management. He will also function as the chair of the Environmental Management Committee.

Unfunded Environmental ONPS Base Funding Needs

None

Unfunded Environmental Compliance Program Project Statements

None

Positions Needed

Positions are listed by priority for funding

Phase	Position	Branch Priority	Project Statement No.	FTE(s)
1	Environmental Protection Specialist, GS-028-09 Responsible for administration and coordination of the environmental compliance program	1	SEKI-N-120.030	0.6
	Office Automation Clerk, GS-326-05 Responsible For providing clerical support for the environmental compliance program	2	SEKI-N-120.030	0.4
Total				1.0

NATURAL RESOURCES INTERPRETATION AND EDUCATION PROGRAM

Division of Interpretation and Cultural Resources Management

Introduction

The Division of Interpretation and Cultural Resources Management is involved in natural resource interpretation and education. This includes interpreting the value of the natural resources and processes to "the public." In this way, it enlists the public's understanding, appreciation, and protection of the natural resources, making it a key natural resource management partner. A major part of the interpretation will be developing a natural resource education program for schools. NR-MAP allocates staffing to interpret and educate "the public" about critical natural resource issues that impact the parks.

Program Overview

The Office of Natural/Cultural Resource Education is responsible for communicating to and educating the public on important natural and cultural resource issues effecting the parks and the greater region of the Sierra Nevada. At this time the Office does not have the funding or staff to support an aggressive science and natural resource management education program within or outside the parks.

Current FY 2000 Funded Interpretation and Natural/Cultural Resources Education Program Base and Staffing

There is 0.1 FTE to provide for interpreting and educating the public on the significant natural and cultural resource issues.

Unfunded Interpretation and Natural/Cultural Resources Education Program Base and Staffing

Unfunded NR-MAP ONPS Program Base (Includes positions and support): $131,400, 2.1 FTEs (See Project Statement SEKI-N-150.000)

The NR-MAP Target Organization for the Interpretation and Natural/Cultural Resources Program is characterized in the Staffing Plans Section. Education staff will increase over time to carry out a full scale interpretive and outreach education program communicating to the public and students critical resource issues. By reaching out to the general public and the residents of the San Joaquin Valley support will be gained to help solve regional issues such as air pollution, maintaining a natural fire regime, protecting black bears and preserving biological diversity within the parks.

The natural resources education program will be developed in two phases. Phase I will include the hiring of a Natural Resources Education Specialist GS-401-09 (1.0 FTE) to develop and initiate the program and Phase II would support two additional outreach Natural Resources Education Specialist GS-401-07 (1.1 FTE) for the implementation phase of the program. The program would involve sending the Education Specialists to schools in the valley covering an area from Fresno to Bakersfield. While the Education Specialists would conduct some programs for students, a significant portion of their time would involve conducting teacher workshops with the intent that teachers could conduct the program themselves.

Unfunded Interpretation and Cultural/Natural Resources Education Project Statements

None

Positions Needed

Positions are listed by priority for funding.

Phase	Position	Branch Priority	Project Statement No.	FTE(s)
1	Natural Resources Education Specialist, GS-401-09 Responsible for initiating education program.	1	SEKI-N-150.00	1.0
2	Natural Resources Education Specialist, GS-401-7 Responsible for conducting the outreach program.	2	SEKI-N-150.000	1.1
Total				2.1

WESTERN ECOLOGICAL RESEARCH CENTER FIELD STATION

Unfunded Scientific Research Base and Staffing

The total NR-MAP allocation is 10.37 FTE, which means we have an existing shortfall of 7.37 FTE. These positions, when funded, will be organized as follows.

Research Physical Scientist (GS-1301-13) position would be a hydrologist/atmospheric scientist whose primary responsibility would be maintaining the long term on-going watershed program. A significant part of their duties would be seeking outside funds through state, federal and private grants in order to staff research projects related to the watershed program.

Research Ecologist (GS-408-13) or Research Biologist with expertise in terrestrial wildlife biology would develop a new program in wildlife biology research pertinent to the park. This person would supervise a GS-11 grade research ecologist with broad expertise that included aquatic studies.

Research Ecologist (GS-408-11) would be added to the current programs in forest demography and fire. This person would have an extensive mathematical modeling background and provide the station with expertise capable of providing predictive models of ecological outcomes arising from alternative fire management practices. An additional Biological Science Technician (GS-404-06) with 0.8 FTE appointment would also contribute to this modeling program through a required expertise in GIS.

Research Ecologist (GS-408-11) would be added to our current programs on biodiversity and invasive plants. This person would ideally have some background in invasive animal work, which would broaden our approach. Contributing to this work would be a Biological Science Technician (GS-404-06) with 0.57 FTE.

Reliable administrative service will be added by the acquisition of a permanent administrative assistant at the grade of GS-6 (GS-303-06).

CULTURAL RESOURCES

Introduction

The wide range of cultural resources in Sequoia and Kings Canyon reflects the evolution of land use philosophy, from prehistoric human use of natural resources, through the Euro-American settlement, control, and extraction of resources, to the final conservation and preservation movements. The historic themes (or contexts) of most of the parks' cultural resources can be related to those identified in the planning guide *Revision of the National Park Service's Thematic Framework (1996).* These themes are delineated by time periods and geographic areas and serve as the frameworks within which individual resources are evaluated (e.g., Prehistoric Technology, Trade, and Cultural Change; California Trails and Settlement; and The Great Depression and Conservation).

The current knowledge of the parks' cultural resources varies depending upon the theme being addressed. The theme of conservation of natural resources, for example, is well understood with good documentation available for research. Other themes (e.g., resource extraction) are somewhat harder to identify and document given the nature of the physical resources, which are often ephemeral or not easily identifiable from surface examination. Knowledge relating to Native American occupation is

highly variable and similarly constrained by the level of field data. Extant site data for many sites is minimal and does not meet full standards for cultural resources recordation and management.

The cultural resources of the parks are of course vulnerable to impact from a wide variety of human and natural processes. Subsurface sites can be exposed through erosion or human activities such as camping, trail maintenance, roadwork, and unauthorized excavation.

The relationship of natural, prescribed, and wildfire on prehistoric archeological sites is not fully understood. A better understanding of the dynamics of fire on lithic scatters (stone tools and debris) is essential so predictive models can be designed to better locate and protect significant cultural resources.

The greatest threats to historical structures are the natural processes of decay and weathering that contribute to the continual challenge of keeping the structures maintained. Human impacts result from general use, insufficient funds to adequately maintain significant buildings, and in some cases lagging skills and training in appropriate historic preservation treatments.

The majority of the parks' museum collections is stored in a designated secure area on the ground level of the Ash Mountain administration building. Potential threats to the collections include the consequences of limited storage and work space, as well as infestation from rodents and insects. Oversized objects (primarily metal artifacts and rock specimens) are stored in the Ash Mountain Warehouse basement. The warehouse storage meets few of the standards set forth in NPS policies and guidelines.

Completing a museum backlog and securing year-round professional management of the collections continue to be major challenges. Substantial progress has been made however through the receipt of cyclical funds for use in addressing material weaknesses, for example, planning, assessments, treatments, and some backlog cataloging. A base-funded, full-time curator remains a top priority for staffing.

The Cultural Resources Management (CRM) program can address the above identified threats (These threats are elaborated upon in the previous Resources Conditions and Strategies section). Elements of the CRM program include:

(1) Knowing and Understanding the Condition of the Cultural Resources

An archeological overview and assessment is needed to synthesize the extant archeological data, with recommendations for future inventory. Once the parks have a comprehensive overview and assessment, a Research Design needs to be developed to provide the best informed guidance in preparing future survey and research projects.

Historic Resources Studies of the less documented areas are needed to develop the historic contexts and themes for both parks. These studies would serve to help evaluate the extensive collection of historic buildings from various time periods. A contextual history on the development of the parks' structures is also needed.

Cultural Landscape Reports should be prepared for the parks' major developed areas. Landscapes have not been considered in maintaining historic structures or in updating developed areas. Consideration should be given also to potential ethnographic landscapes.

Information concerning the ethnographic and contemporary Native American uses of the parks' resources is unevenly documented. An ethnographic overview and assessment is needed, one which involves extensive consultation with contemporary Native American groups. Native American communities have expressed an interest in utilizing the parks for the education of their members, as well as for park visitor education. The parks may see more requests for religious, gathering, and educational uses as local interests continue to grow.

In the 1970s, archeological surveys were conducted in Mineral King, Grant Grove, Cedar Grove and other development areas. Subsequently, survey work has been done in proposed development sites such as Red Fir, Giant Forest, and the Generals Highway. Most archeological survey work conducted in the parks is a result of Section 106 compliance requirements. The collective inventories over the decades have resulted in the preparation of 422 official site records (Prehistoric 312; Historic 110).

The extant inventories of cultural resources stand largely independent of each other. Sequoia and Kings Canyon remain unevenly understood relative to their collective prehistory. Nearly 95 percent of the parks are unsurveyed for archaeological resources using current standards.

As the basic inventory is expanded, cultural resources need to be evaluated for listing in the National Register of Historic Places, and monitoring programs need to be developed for listed or eligible sites and structures.

The various cultural resources databases (LCS, GIS, ANCS+) will need to be updated as inventories are completed. Although the old catalog records were transferred in 1998 into ANCS+, the quality of the original cataloging does not meet current standards. The museum collection has a standing backlog that needs to be cataloged, or recataloged, and entered. New accessions are entered into the ANCS+ database as they are received.

It is essential that the parks be more fully inventoried to better understand the complexity of their cultural resources, and to make appropriate management decisions that may affect those resources.

(2) Restoring Altered Cultural Resources

The National Register-listed properties (n=24) for the parks need individual preservation guides, as appropriate. Once the guides are written, a maintenance schedule needs to be developed to assure the best restoration and preservation of the corresponding structures.

A Historic Structures Report has been completed for the Giant Forest Historic District. This report was prepared as part of the mitigation negotiated to implement the Development Concept Plan at Giant Forest. Similarly, the Historic Resources Study for the Grant Grove area will help guide the management of that developed area.

(3) Maintaining Cultural Resources and System Functions

In recent years a Collections Management Plan (1994), a Collections Condition Survey (1997), and a Collections Storage Plan (1997) have been prepared. These planning documents provide guidance for the continued maintenance and growth of the museum collections.

Historic building maintenance is a recurring need that is not being met with the current level of funding and personnel. A fulltime Historic Architect is needed. Historic Structures Preservation Guides (HSPGs) are no longer written separately, but integrated into the Inventory, Condition and Assessment

Program (ICAP). The ICAP, including HSPGs, is needed for all structures listed in the National Register. Preservation maintenance has been preformed on many of these structures since 1983, and through to 1999. HSPG-level data would assist the maintenance division in continuing the proper maintenance of these structures by providing an evaluation of completed work, followed by instructions and schedules for future work.

(4) Protecting Cultural Resources

As cultural resources are identified and evaluated, programs will need to be developed to protect and monitor significant sites and structures.

Training is the key to proper resources protection. Archaeological Resources Protection Act (ARPA) training is needed to assist the Law Enforcement (Visitor Protection) ranger staff in protecting cultural resources. Historic preservation maintenance training is needed to assist maintenance staff in understanding proper techniques in maintaining historic structures.

Museum collections are monitored on a regular basis, but largely funded through the cultural cyclic program. Base funding is needed to guarantee continuation of the collection monitoring program, through the presence of a fulltime Museum Technician (i.e., an identified duty of the position).

Over the past five years minor vandalism to National Register properties has occurred, but it remains sporadic. Vandalism is usually in the form of physical destruction or graffiti. Random patrols by Law Enforcement and Maintenance staff are made for most frontcountry sites and structures. Backcountry resources are less frequently patrolled or monitored. A detailed monitoring plan is needed.

CRM training has been identified as a need parks-wide. Periodic training is needed for key park staff. Critical to these efforts are training in ARPA, NAGPRA, and general Section 106 compliance and curation responsibilities.

(5) Interpretation and Education of Cultural Resources

Interpretation of and education about cultural resources, their processes, and significance, for the benefit of both employees and visitors, increases awareness and can enhance protection of the resources.

Status of Cultural Resources Program

The following section presents a brief discussion of the current Cultural Resources Management (CRM) Program relative to individual park Divisions. A fully funded (adequate) program, as identified by analysis from the Cultural Resources Management Assessment Program (CR-MAP), is also outlined.

Division of Science and Natural Resources Management

The CRM program articulates routinely with a number of projects and initiatives within the Science and Natural Resources Division. Major coordination is undertaken yearly for the planning and execution of the division's prescribed fire program. Identifying, evaluating, and protecting significant cultural resources relative to the prescribed fire program require substantial involvement. Potential impacts to cultural resources are also considered in regard to the cave management program, hazard tree removal,

revegetation efforts, and disturbed lands restoration initiatives. The division coordinates the parks' GIS program, which entails CRM assistance for ongoing data updates.

Division of Maintenance

A substantial number of maintenance activities have the potential to effect cultural resources, especially frontcountry construction work (e.g., road building, new foundations, and underground utility trenching) and building maintenance (e.g., roofs, exteriors, and utility upgrades). Backcountry efforts frequently focus on trail construction or reconstruction but can include historic building maintenance too. Section 106 compliance is required for such Maintenance projects; routinely, project compliance needs are identified during Environmental Management Committee (EMC) review.

Division of Fire and Visitor Protection

The law enforcement (visitor protection), safety (structural fire fighting), and resource management (patrolling, prescribed fire) responsibilities of the division articulate in several key ways with the CRM program. Rangers routinely patrol selective archeological sites and historic buildings and are charged with enforcing regulations regarding trespass, vandalism, and theft. The Cultural Resources Specialist has been called upon to assist rangers with ARPA cases and other investigations of suspected resource damage. CRM involvement is very strong with the prescribed fire program, to where the majority of the funding for the Seasonal Archeologist comes from the Fire and Visitor Protection Division. CRM staff conduct training annually for law enforcement rangers, emphasizing not only regulatory concerns but recognizing also the educational opportunities inherent in the high degree of contact rangers have with park visitors.

CR-Map Program Analysis of the Parks

The Cultural Resources – Management Assessment Program (CR-MAP), like its natural resources counterpart (NR-MAP), was designed to provide an objective evaluation of the base funding (ONPS) and staffing needs of a park sufficient to support a fully functional (adequate) cultural resources program. CR-MAP identifies Fulltime Equivalents (FTEs) and their associated support costs. Using CR-MAP as a planning tool, the long-term goal is to bring the cultural resources management program to full funding and staffing, as identified through the CR-MAP assessments.

The current CRM program (Fiscal Year 2000) is base-funded at $100,600. These funds support a permanent fulltime (PFT) Cultural Resources Specialist, a subject-to-furlough (STF) Museum Technician, and one pay period of a Seasonal Archeologist. The Cultural Resources Specialist provides ongoing administrative support for the program. The Museum Technician provides routine collections care and management, including ANCS+ updates and new cataloging. The Seasonal Archeologist is funded to update critical program databases, including the archeological sites component of the GIS database. This current program represents 1.99 FTEs. The base funding is not adequate to fully manage and maintain the parks' cultural resources.

Cultural Cyclic funds, mixed with some Maintenance Division base funds, support a Maintenance Work Leader (STF), three seasonal Maintenance Workers, and one-half of a Painter's year. This small crew performs prioritized historic building repair and rehabilitation; it represents 3.25 FTEs.

Table 12: CR-MAP Analysis for the Cultural Resources Management Program

Cultural Resources Program Area	Current Park Staffing (FTEs)	Workload (FTE)	Difference (FTE)	% Staffed

Cultural Resources Program Area	Current Park Staffing (FTEs)	Workload (FTE)	Difference (FTE)	% Staffed
Archeology	0.25	0.95	0.70	26.0
Cultural Landscapes	0.00	0.25	0.25	0.00
Historic Structures	1.10	1.70	0.60	65.0
Ethnography	0.15	0.25	0.10	60.0
Museum Objects	0.97	1.95	0.98	50.0
C.R. Library	0.00	0.10	0.10	0.00
Studies and Reports	0.10	0.40	0.30	25.0
Compliance	0.20	0.30	0.10	66.0
External Assistance	0.00	1.00	1.00	0.00
Coordination with Natural Resources Management	0.05	0.10	0.05	50.0
Special Monitoring and Preservation	0.00	0.00	0.00	0.00
GIS/Data Management	0.05	0.10	0.05	50.0
Interpretation	0.00	0.25	0.25	0.00
Total	2.87	7.35	4.48	39.0

Cultural Resources Budget Summary by Goal and Funding Source.

The following tables display recent budget summaries for the CRM program by source (FY1998 to FY2002) and by pertinent long-term goals as identified in the parks' Strategic Plan.

Table 13: Cultural Resources Management Budget Summary by Funding Source

CULTURAL RESOURCES	FY 98 Actual ($000)	FY 99 Actual ($000)	Current FY Actual ($000)	FY 01 Estimated ($000)	FY 02 Projected ($000)
ONPS Base	99.2	97.1	100.6	103.0	106.0
ONPS Other	49.1	14.5	0.00	N/A	N/A
WASO/National (FLHP)	7.0	2.5	0.00	N/A	N/A
WASO/National (MCPPP)	19.5	0.00	0.00	N/A	N/A
WASO/National (Emerg. Stabil.)	0.00	10.0	0.00	N/A	N/A
WASO/National (Cult. Cyclic)	0.00	68.5	0.00	N/A	N/A
FIREPRO	10.0	8.0	7.0	8.5	9.0
Total	184.8	200.6	107.6	111.5	115.0

Table 14: Cultural Resources Management Budget Summary by Cultural Resources Long-Term Goals from the Strategic Plan

LONG-TERM GOAL	FY 98 Actual ($000)	FY 99 Actual ($000)	Current FY Actual ($000)	FY 01 Estimated ($000)	FY 02 Projected ($000)

LONG-TERM GOAL	FY 98 Actual ($000)	FY 99 Actual ($000)	Current FY Actual ($000)	FY 01 Estimated ($000)	FY 02 Projected ($000)
1a10 – Archeol. Resources	70.3	72.0	70.0	71.0	72.0
1a11 – Historic Resources	55.0	83.5	5.0	5.0	6.0
1a12 – Museum Collections	49.5	37.1	25.6	27.0	28.0
1c2 – Cultural Resources Inventory and Evaluation	10.0	8.0	7.0	8.5	9.0
Total	184.8	200.6	107.6	111.5	115.0

Proposed Cultural Resources Management Program

A comprehensive cultural resources management program in Sequoia and Kings Canyon should include a base-funded staff with professional and technical expertise to provide adequate management of all of the resources. This staff should consist of:

(1) A permanent full-time **Cultural Resources Management Specialist (GS-193-12)** who would be responsible for the planning, personnel, and administrative activities of the overall CRM Program, including Native American consultations; management of archeological and historic resources; coordination of research and interpretation relating to these resources; and oversight of the museum program. This person would work cooperatively with the Exhibits Specialist in planning the compliance needs, including preservation and restoration, of Historic Structures. This person would also be the key individual consulted when management activities may impact cultural resources (e.g., fire, maintenance, and construction projects).

(2) A permanent full-time **Park Archeologist (GS-193-09/11)** who would be responsible for the planning and administration of the daily archeological program. The work would include coordinating archeological compliance activities for routine maintenance projects and large scale development projects, monitoring on-going construction projects as necessary, supervising field crews, writing professional publications from the results of field surveys, inventorying and evaluating sites, and working cooperatively with researchers and the GIS program staff.

(3) Two **Seasonal Archeologists (GS-193-07)** who would be responsible for conducting field surveys and site evaluations and reporting on the results. These persons would form a small, seasonal crew and would report directly to the Park Archeologist. They would assist in report writing and database entries.

(4) A permanent full-time **Park Curator (GS-1015-11)** who would be responsible for the daily planning and administration of the museum collections. Activities would include accessioning and cataloging of objects and specimens, monitoring the collection environment, performing conservation techniques to preserve artifacts, and performing research for the identification of artifacts and the preparation of research reports. The position would also periodically supervise one or more individuals (Technicians) hired with special project funding.

(5) A permanent full-time **Museum Technician (GS-1016-07/09)** who would primarily (50%) assist the Park Curator in performing the daily activities of the museum operations. Secondarily (30%), this

individual would coordinate the ANCS+ database, responding to research request for photographs, slides, archival, and other materials. Thirdly (20%), undertake research using the museum collections and disseminate the results for the benefit of the general public.

A permanent full-time **Historian (GS-170-11)** who would be responsible for the planning and administration of the daily historic resources program. The work would include coordinating compliance activities effecting historic sites, structures, buildings, features, and landscapes. This person would plan and conduct fieldwork, write compliance reports, and undertake research and disseminate the results for the benefit of the general public.

A permanent full-time **Historical Architect (GS-808-09)** who would be responsible for coordinating the management of the parks' historic buildings. The work would include maintaining the List of Classified Structures, coordinating all historic building maintenance activities, and conducting compliance activities involving historic structures. This person would report directly to the Historian and assist the Historian in report writing and research.

(8) A permanent full-time **Exhibit Specialist (GS-1010-11)** who would be responsible for the planning and administration of the restoration program for historic structures. This person would provide technical expertise to park management and concessions. Activities would include inspection and assessment of work needed; research on architectural style and period fabrics, materials and techniques; planning and ordering for project needs; accomplishment of all required trades and crafts such as carpentry, plaster, and electrical; written documentation of work projects; and supervision of one to three separate work crews. The Exhibit Specialist would work cooperatively with the Historical Architect in the planning and compliance phase of historic restoration and preservation projects.

(9) One Subject-to-Furlough **Maintenance Work Leader (GS-4749-09)** who would work under the direction of the Exhibit Specialist in guiding crafts and trades people on the preservation and restoration of historic structures. Due to the remoteness of some specific jobs, the Work Leader must have knowledge of preservation techniques to be able to work independently with only occasional spot checks from the Exhibit Specialist.

(10) Four seasonal **Maintenance Workers (GS-4749-04, -07, and –09)** for seven months each to perform required tasks according to the guidelines set forth by the Exhibit Specialist. These positions would be field going and would report directly to the Maintenance Work Leader.

The comprehensive CRM program is addressed in project statement SEKI-C-001.100. However partial funding and specific components of the program are addressed in project statements SEKI-C-001.200 and SEKI-C-003.000.

ONPS base funding of a cultural resources management program would fully or partially address the following servicewide cultural resource issues:

Inadequate Archeological Survey and Inventory including Archeological Identification and Evaluation Studies.

Overviews and Assessments.

Incomplete Cataloging of Museum Collections (ANCS+).

Need for Historic Structures Reports and Assessment Conditions studies.

Inadequate Historic Structure Survey and Inventory (e.g., the List of Classified Structures).

Need for Specialized Studies for Unique or Complex Management Issues.

Inadequate Preservation Maintenance Program including Stabilization and Cyclic Maintenance.

Inadequate Cultural Resources Monitoring Program.

Insufficient Professional Staff.

Other - Inadequate Administrative Support.

Cultural Resource Issues That Need to Be Addressed With Project Funding

Increased project funding can address effectively the majority of the cultural resource issues. The top priorities include the following projects as identified in the most recent Project Management Information System (PMIS) database. The projects are listed in priority order.

SEKI-C-015.000	Survey/Review/Evaluate Archeology in Developed Zones
SEKI-C-020.000	Rehabilitate Historic Structures #7, #9, #11
SEKI-C-021.000	Catalog Museum Backlog
SEKI-C-013.000	Curatorial Cyclic Maintenance
SEKI-C-023.000	Rehabilitate Historic Structure #115
SEKI-C-011.000	Archeological Overview and Assessment
SEKI-C-019.000	Ethnographic Overview and Assessment
SEKI-C-024.000	Conservation of Museum Collections
SEKI-C-010.000	Contextual Study for Resource ID./Update National Register
SEKI-C-023.000	Correct Museum Storage Deficiencies
SEKI-C-051.000	Historic Resources Study - Ash Mountain
SEKI-C-050.000	Historic Resources Study - Redwood Canyon
SEKI-C-014.000	Document and Evaluate Rock Art Sites
SEKI-C-016.000	Prepare An Archeological Research Design
SEKI-C-015.000	Archeological Survey of the Upper Kern River
SEKI-C-031.000	Create Library Operating Policy
SEKI-C-016.000	Rehabilitate Superintendent's Residence/Research Building

SEKI-C-022.000	Collections Management Plans
SEKI-C-017.000	Draft Mineral King Cultural Resources Plan
SEKI-C-015.000	Archeological Survey of Cedar Grove/Kings River
SEKI-C-032.000	Upgrade Library Storage
SEKI-C-015.000	Conduct Archeological Study of Backcountry

CURRENT CULTURAL RESOURCES MANAGEMENT PROGRAM

This section briefly describes the current (FY2000) and fully funded (adequate) cultural resources management program for the most actively involved divisions within the parks. The discussions reflect the program that would be needed to meet the critical cultural resources issues outlined above. Organization charts (staffing) for both the current and fully funded programs are presented elsewhere.

Division of Interpretation and Cultural Resources Management

The CRM and Museum program within the division corresponds with the major program areas recognized by the CR-MAP analysis Table 12. The current program is defined as having 2.87 FTEs in eight program areas (five program areas currently receive no direct staffing). These 2.87 FTEs include 1.99 base-funded FTEs in the cultural resources/museum program and 0.88 FTE in the maintenance program. The key program areas that receive routine staffing efforts include archeology, historic structures, museum objects, and compliance actions.

The fully funded or adequate program as identified by the CR-MAP analysis consists of 7.35 FTEs. This level of staffing largely defines the full cultural resources and museum program, with minimal direct support from the Natural Resources Management program (0.10 FTE), the GIS/Data Management program (0.10 FTE), and the Interpretation program (0.25 FTE). Direct involvement with the parks' other divisions in key program areas (i.e., archeology, landscapes, structures, studies and reports, and compliance) would be carried out routinely by the CRM/Museum staff under the fully funded program. Current seasonal assistance and partial funding from other divisions would no longer be necessary. The CR-MAP analysis shows that 39 percent of the full or adequate program is currently funded and staffed. Several phases of staffing would be pursued, as additional funds become available, to bring the program to the fully funded level of 7.35 FTEs. The priority will be placed on acquiring the needed expertise in historic structures (Historical Architect), archeology (Park Archeologist), collections management (Museum Curator), history (Historian), and technical support (Museum Technician and two Field Archeologists).

Division of Fire and Visitor Management

Approximately five months (0.40 FTE) of the seasonal archeologist's time is currently funded by this division. The funding (FIREPRO) supports survey, site recordation, and reporting in advance of the implementation of prescribed fire projects (i.e., Section 106 compliance). The fully funded (ONPS) program would free the division from its direct financial involvement, supporting the addition of a permanent fulltime park archeologist and two seasonal archeologists. This team would then be charged with meeting all of the Prescribed Fire Program's compliance needs, including long-term planning and

monitoring. The adequate CRM program would also have available the services of a historian and historical architect, as needed. Other benefits from a fully funded CRM program include the ability to refine survey strategies, advance site predictability models, produce overviews and broader-focused assessments, and monitor project results and impacts. Of particular importance to the Prescribed Fire Program are issues relating to the affect of fires on stone tool (lithic) scatters and the post-fire monitoring of the success of site surveys.

Division of Maintenance

A substantial amount of Section 106 compliance is associated annually with proposed maintenance projects. The cultural resources specialist, with assistance from the seasonal archeologist, is responsible for addressing these compliance needs. Additionally, the division currently funds a maintenance work leader (0.88 FTE) whose efforts, supplemented by a 3-4 person seasonal crew, address the most critical historic structures needs (e.g., stabilization and cyclic maintenance). The fully funded CRM program would support a fulltime historic architect, a fulltime exhibit specialist, a subject-to-furlough work leader, and four seasonal crew members to better assure that all of the maintenance and historic structure needs of the parks are met.

Overall Prioritization of ONPS Staffing Needs

Of the ten positions outlined above for the proposed CRM program (i.e., ONPS fully funded), only the Cultural Resources Management Specialist position is currently funded as defined (PFT). The remaining positions are either not currently present, or if present, are funded at a level below that proposed or are funded from non-ONPS funds. As funding becomes available the staffing needs should be met in the following priority:

Park Archeologist (PFT)
Historical Architect (PFT)
Museum Technician (PFT)
Exhibit Specialist (PFT)
Seasonal Archeologists (2)
Park Curator (PFT)
Historian (PFT)
Maintenance Work Leader (STF)
Seasonal Maintenance Workers (4)

INTEGRATED NATURAL AND CULTURAL RESOURCE PROJECTS

There is one project in this plan that involves natural resources, cultural resources, and research. Develop Facilities for Natural/Cultural Resources Management and Research (project statement SEKI-I-001.000) is discussed below in the Staffing and Funding section.

SUMMARY OF ONPS STAFFING AND FUNDING NEEDS FOR NATURAL RESOURCES BASED ON NR-MAP

Division of Science and Natural Resources Management

This section summarizes the ONPS staffing and funding needs as identified by NR-MAP for a fully funded science and natural resources management program. The overall ONPS base staffing and funding

needs for the Division of Science and Natural Resources Management is $5,836,600 and 64.8 FTEs (includes funding for office and storage space). This allocation is broken out by office and branch below. Specific staffing and funding needs for each office and branch are identified under each office/branch.

The following increases will be needed in each program :

Office of Science and Natural Resources Management Planning/Management/Supervision and Administrative Support

A one time increase of $1,783,000 (SEKI-I-001.000) to construct adequate office and storage space and provide increased administrative support to natural and cultural resources management and research.

An ONPS base increase of $250,300 and 4.0FTEs (SEKI-N-190.010) to meet critical management/supervision, administrative support, science administration, and inventory and monitoring needs of the Division. $40,100 of the need is identified in OFS Number 5166A as a Office Automation Clerk, GS-026, 05 – 1 FTE.

Office of GIS/Data and Information Management

An ONPS base increase of $219,800 3.5 FTEs (SEKI-N-130.010 and 130.0.050) to meet critical GIS/data and information management needs.

Branch of Aquatic, Wildlife, and Geologic Resources Management

An ONPS base increase of $1,695,800 27.10 FTEs (SEKI-N-020.000, SEKI-N-040.000, and SEKI-N-060.000) to meet critical aquatic, wildlife, and geological resources management issues. $102,500 of this increase is identified in OFS Number 5166A for an Aquatic Ecologist, GS-408-11 – 1 FTE and 1.0 FTE of a seasonal crew for the Aquatic Resources Management Program; and $49,800 for Cave Technician, GS-1311-07 – 1 FTE for the Cave Management Program.

Branch of Fire Monitoring and Vegetation Monitoring

An ONPS base increase of $621,400 and 9.93 FTEs (SEKI-N-010.031, SEKI-N-030.000, SEKI-N-030.010, SEKI-N-030.021, and SEKI-N-080.000) to meet critical prescribed monitoring, prescribed burning, grazing management, T & E plant monitoring, and vegetation ecosystem monitoring issues.

Branch of Forestry and Vegetation Management

An ONPS base increase of $893,300 and 14.26 FTEs (SEKI-N-010.010, SEKI-N-100.030 and SEKI-N-110.020) to meet critical tree hazard, exotic plant management, restoration/revegetation, and native plant management and monitoring issues. $112,000 of this increase is identified in OFS Number 5166A for a Botanist, GS-430, 11 – 1 FTE, and a seasonal exotic plant control team – 1.5 FTEs, and $123,800 for a Restoration Ecologist, GS-408-11 – 1 FTE, and a seasonal restoration crew – 1.5 FTEs.

Branch of Air Resources Management

An ONPS base increase of $243,400 and 3.89 FTEs (SEKI-N-050.000 and SEKI-N-120.011) to meet critical air resource issues. $49,800 in this increase is identified in OFS Number 5166A for a permanent Air Quality Technician, GS-404-07.

Division of Fire and Visitor Management

An ONPS base increase of $536,900 and 8.58 FTEs.

Environmental Compliance

An ONPS base increase of $62,600 and 1 FTE.

Division of Interpretation and Cultural Resources (Natural Resource Education)

An ONPS base increase of $131,400 and 2.1 FTEs (SEKI-N-150.000) to meet critical science and natural resource education issues.

Division of Maintenance

Identified under the Division of Science and Natural Resources Management

Division of Research (Western Ecological Resource Center, BRD)

A base increase of $461,100 and 7.37 FTEs (SEKI-N-170.000) to meet critical natural research issues.

SUMMARY OF ONPS STAFFING AND FUNDING NEEDS FOR CULTURAL RESOURCES BASED ON CR-MAP

ONPS Base Program

An ONPS base increase of $456,800 and FTEs (SEKI-C-001.200, 001.100 and 001.300) to enable the parks to address the most critical cultural resource issues at the basic level.

High Priority Projects

Project funding of $50,000 over three years (SEKI-C-015.000) to conduct an archeological survey of developed sites throughout the parks.

Project funding of $310,000 (SEKI-C-020.000) over four years to rehabilitate historic structures 5, 7, 9, and 11.

Project funding of $7,000 over four years (SEKI-C-003.000) to complete cataloging of backlogged museum objects.

Project funding of $10,000 (SEKI-C-013.000) to prepare a Collection Management Plan.

Project funding of $60,000 (SEKI-C-018.000) over a three year period to provide Historic Structure Reports for National Register properties.

Project funding of $30,000 (SEKI-C-011.000) to prepare a comprehensive Archeological Assessment and Overview.

Project funding of $40,000 (SEKI-C-019.000) for and Ethnographic Overview and Assessment of local American Indian needs and concerns.

Project funding of $40,000 (SEKI-C-010.000) to prepare a contextual study to identify significant cultural resources for listing on the National Register.

Project funding of $10,000 (SEKI-C-014.000) to document rock art throughout the parks.

Project funding of $70,000 (SEKI-C-016.000) to rehabilitate the old Superintendent residence now serving as the Research Center.

Project funding of $25,000 (SEKI-C-017.000) to prepare a cultural resources plan for Mineral King.

Project funding of $25,000 (SEKI-C-012.000) to update the National Register and LCS.

PROJECT STATEMENTS

NUMBERING SCHEME FOR NATURAL RESOURCES PROJECT STATEMENTS

The following numbering system is base in the NR-MAP program breakout.

010.XXX VEGETATION MANAGEMENT
010.01X NATIVE TERR. PLANT MGMT/MONIT
010.02X NATIVE AQUATIC PLANT MGMT/MONIT
010.03X T & E PLANT
010.04X EXOTIC PLANT MONITOR/CONTROL
010.05X REINTRO OF EXTIRPATED PLANTS
010.06X SUBSISTENCE USE MANAGEMENT - PLANTS
010.07X AGRICULTURAL USE MANAGEMENT

020.XXX WILDLIFE
020.01X BEAR MGMT
020.02X NATIVE WILDLIFE STUDIES
020.03X EXOTIC FAUNA
020.04X T & E/RARE FAUNA
020.05X NATIVE FAUNA REINTRODUCTION
020.06X MIGRATORY BIRDS
020.07X BATS
020.08X INSECT/ARACHNIDS
020.09X RACCOONS
020.10X FIRE EFFECTS ON FAUNA
020.11X MOUNTAIN LIONS
020.12X POND TURTLE

030.XXX PRESCRIBED FIRE
030.01X PRESCRIBED FIRE BURN OPERATIONS
030.02X PRESCRIBED FIRE LONG TERM EFFECTS
030.03X PRESCRIBED FIRE WILDFIRE EFFECTS

040.XXX WATER RESOURCES
040.01X INVENTORY
040.02X MONITORING
040.03X FISHERIES
040.04X NUTRIENTS
040.05X EXOTIC AQUATIC FLORA
040.06X AMPHIBIANS
040.07X FLOOD PLAINS
040.08X WATER RIGHTS

050.XXX AIR RESOURCES

060.XXX GEOLOGIC RESOURCES
060.01X KARST/CAVE/PALEO
060.02X SOILS
060.030 MINING/MINERALS

070.XXX PALEONTOLOGY

080.XXX GRAZING MANAGEMENT
080.01X RECREATIONAL/ADMINISTRATIVE
080.02X COMMERCIAL

090.XXX FENCE

100.XXX DISTURBED AREA REHAB
100.01X ROADS
100.02X BACKCOUNTRY
100.03X FRONTCOUNTRY/DEVELOPED ZONE

110.XXX PEST AND HAZARD MANAGEMENT
110.01X IPM
110.02X HAZARDOUS WASTE
110.03X TREE HAZARD

120.XXX ENVIRONMENTAL PLANNING/COMPLIANCE
120.01X EXTERNAL COORDINATION
120.02X PARK PLANS
120.03X COMPLIANCE DOCUMENTS

130.XXX NATURAL RESOURCE COLLECTIONS/DATA MANAGEMENT
130.01X COLLECTIONS CATALOGING
130.02X COLLECTIONS CURATION/CARE
130.03X LIBRARY CATALOGING
130.04X LIBRARY CURATION/CARE
130.05X GIS/DATA MANAGEMENT

140.XXX RESOURCE PROTECTION
140.01X POACHING/THEFT
140.02X BACKCOUNTRY/RIVER PATROL
140.03X FRONTCOUNTRY PATROL
140.04X OPEN WATER BOAT PATROL
140.05X WILDERNESS PERMITTING
140.06X ROCK CLIMBING MGMT
140.07X ALPINE CLIMBING MGMT
140.08X FISHING ENFORCEMENT
140.09X HUNTING/TRAPPING ENFORCEMENT
140.10X TRESPASS GRAZING
140.11X RIGHT-OF-WAY/EASEMENTS
140.12X FIRE SUPPRESSION

150.XXX RESOURCE INTERPRETATION

160.XXX SCIENCE CONSULTATION/OVERSIGHT

170.XXX RESEARCH
170.01X NATIVE TERRESTRIAL PLANT
170.02X NATIVE AQUATIC PLANT

170.03X T & E PLANT
170.04X EXOTIC PLANT
170.05X FIRE
170.06X NATIVE TERRESTRIAL ANIMAL
170.07X NATIVE AQUATIC ANIMAL
170.08X T & E ANIMAL
170.09X EXOTIC ANIMAL
170.10X HYDROLOGY
170.11X OCEANOGRAPHY
170.12X AIR QUALITY
170.13X PALEONTOLOGY
170.14X GEOSCIENCE
170.15X SOCIAL SCIENCE
170.16X GLOBAL CHANGE

190.XXX MGMT/SUPERVISION NATURAL RESOURCES PROGRAM
190.01X RESOURCE MANAGEMENT
190.02X RESOURCE PROTECTION
190.03X RESEARCH

NATURAL AND CULTURAL RESOURCES PROJECT STATEMENT LISTS

NATURAL RESOURCES PROJECT STATEMENTS BY PROGRAM AREA

Administration

SEKI-N-140.151 Study Sociology of Park Visitors
SEKI-N-170.010 National Biological Survey - Research Administration
SEKI-N-190.010 Science and Natural Resources Management/Supervision/Administrative Support
SEKI-N-190.011 Develop Integrated Inventory and Monitoring Program

Air Resources Management

SEKI-N-050.000 Air Resources Management Program
SEKI-N-170.121 Study Effects of Acid Deposition on Vegetation and Aquatic Ecosystems
SEKI-N-170.122 Study Effects of Air Pollution on Sensitive Plant Species

Collections and Data Management Program

SEKI-N-130.010 Manage Natural Resource Collections
SEKI-N-130.050 GIS, Data & Information Management Program
SEKI-N-130.055 Digitize Sequoia Tree Inventory (GIS)
SEKI-N-170.011 Expand Geographic Plot Inventory
SEKI-N-170.012 Develop Vegetation Map

Disturbed Area Rehabilitation

SEKI-N-100.011 Rehabilitate Abandoned Road to Hidden Springs
SEKI-N-100.021 Rehabilitate High Priority Wilderness Sites/Trails/Camps
SEKI-N-100.030 Disturbed Area Restoration/Revegetation Program
SEKI-N-100.031 Revegetate/Landscape Construction Sites

Environmental Planning and Compliance

SEKI-N-120.011 Bioregional/Natural Resource Planning Program
SEKI-N-120.010 Assess Impacts of Development Near the Parks' Boundary on Park
SEKI-N-120.030 Environmental Compliance Program

Fence Maintenance

SEKI-N-020.034 Construct and Repair Boundary Fence

Fire Management

SEKI-N-020.100 Assess Effects of Fire on Fauna
SEKI-N-030.000 Administer Fire and Vegetation Monitoring Branch
SEKI-N-030.010 Implement Natural Resource Prescribed Burn Program
SEKI-N-030.021 Monitor Fire Effects
SEKI-N-140.120 Manage Wildland Fire Program
SEKI-N-170.010 Study Fire Ecology of Subalpine Forests
SEKI-N-170.051 Study Fire History/Ecology of Giant Sequoia Ecosystem
SEKI-N-170.052 Study Fire Ecology of Low Elevation Forests
SEKI-N-170.053 Study Effects of Fire on Sequoia-Mixed Conifer Forests
SEKI-N-170.055 Develop GIS Based Fire Spread Modeling Program

Geologic Resources Management

SEKI-N-060.000 Geologic Resources Management Program
SEKI-N-060.010 Update Karst Inventory
SEKI-N-060.011 Inventory of Cave Fauna
SEKI-N-060.012 Paleontological Studies of Park Caves
SEKI-N-060.020 Complete Soil Survey and Mapping
SEKI-N-060.030 Abandoned Mine Lands Inventory and Permit Review
SEKI-N-060.031 Reopen Stone Quarry

Grazing Resources Management

SEKI-N-080.000 Monitor Meadow and Rangeland Condition

Natural/Cultural Resources Education

SEKI-N-150.000 Natural and Cultural Resources Education Program

Natural Resource Protection

SEKI-N-140.000 Natural Resource Protection Program

Pest and Hazard Management

SEKI-N-110.010 Survey White Pine Blister Rust
SEKI-N-110.020 Tree Hazard Management Program

Research

SEKI-N-170.031 Study Ecology of Rare and Sensitive Flora
SEKI-N-170.054 Fire Effects Research Program
SEKI-N-170.161 Evaluate Effects of Global Climate Change Sierran Ecosystems

SEKI-N-170.162 Evaluate Effects of Global Climate Change-Sierran Ecosystems Forest Dynamics/Modeling
SEKI-N-170.163 Evaluate Effects of Global Climate Change-Sierran Ecosystems Predict Effects
SEKI-N-170.164 Predict Effects of Global Change: Species-Habitat Relations and Modeling
SEKI-N-170.165 Predict Effects of Global Change: Hydrological, Watershed and Micro-Climate Models

Vegetation Management

SEKI-N-010.000 Native Plant Management and Monitoring Program
SEKI-N-010.030 Monitor Special Status Plant Species
SEKI-N-010.31 Monitor Vegetation - Community Level

Water/Aquatic Resources Management

SEKI-N-040.000 Inventory of Aquatic Resources
SEKI-N-040.020 Watershed/Ecosystem Monitoring Project
SEKI-N-040.030 Determine Pristine Distribution of Fish Species
SEKI-N-040.031 Study Genetics of Extant Rainbow Trout
SEKI-N-040.032 Evaluate Status of Kern Rainbow Trout
SEKI-N-040.040 Evaluate Impacts of Nutrients on Lakes and Streams
SEKI-N-040.050 Evaluate Threat and Control for Hydrilla
SEKI-N-040.060 Determine Distribution of High Elevation Amphibians
SEKI-N-040.061 Evaluate/Reintroduce Foothill Yellow-Legged Frog
SEKI-N-040.070 Implement Flood Plain Studies in Developed Areas
SEKI-N-040.080 Water Rights Studies for Developed Areas

Wilderness Management

SEKI-N-140.020 Manage/Evaluate Backcountry Resources
SEKI-N-140.052 Evaluate Wilderness Use Impacts and Use Patterns

Wildlife Management

SEKI-N-020.00 Wildlife Resources Management Program,
SEKI-N-020.010 Expand Inventory of Bear-Proof Food Storage Boxes,
SEKI-N-020.011 Replace Existing Garbage Facilities with Improved Facilities,
SEKI-N-020.012 Continue Development of Bear-Proof Canisters,
SEKI-N-020.013 Repair/Replace Bear-Proof Food Storage Boxes,
SEKI-N-020.020 Conduct Marmot Studies,
SEKI-N-020.030 Evaluate Impacts of Exotic Species,
SEKI-N-020.031 Evaluate Ecological Impacts of Brown-Headed Cowbird,
SEKI-N-020.032 Evaluate Impacts and Control of Exotic Beaver,
SEKI-N-020.035 Evaluate Ecological Impacts of Opossum,
SEKI-N-020.040 Evaluate Status of T & E Fauna,
SEKI-N-020.041 Study Rare and Extirpated Fauna,
SEKI-N-020.050 Reintroduce Bighorn Sheep,
SEKI-N-020.070 Survey Migratory Bird Status,
SEKI-N-020.080 Inventory Insect and Arachnid Species,

SEKI-N-020.090 Study Raccoons,
SEKI-N-020.100 Assess Effects of Fire on Fauna,
SEKI-N-020.110 Study Mountain Lion Populations,
SEKI-N-020.120 Evaluate Threats to Western Pond Turtle,

CULTURAL RESOURCES PROJECT STATEMENTS BY PROGRAM AREA

[This section may be provided in a future plan revision]

SCIENCE AND NATURAL RESOURCES MANAGEMENT PROGRAM OFS (OPERATING FORUMULATION SYSTEM STATEMENTS)

Park Priority	Statement	Number	Amount
2	Mitigate Threats to Natural Resources	OFS-5166A	$367,000
2	Control and Monitor Exotic Plants	OFS-5166A	$112,000
10	Mitigate Tree and Bear Hazards	OFS-5263A	$405,000
14	Preserve Natural Resources Using Scientific Information	OFS-7072A	$495,000

RESOURCE PROTECTION PROGRAM OFS (OERATING FORMULATION SYSTEM STATEMENTS)

Park Priority	Statement	Number	Amount
9	Protect Wilderness	OFS-5165A	$371,000

CULTURAL RESOURCE PROGRAM OFS (OPERATING FORMULATION SYSTEM STATEMENTS)

Park Priority	Statement	Number	Amount
17	Preserve Historic Structures	OFS-7076A	$335,000

STAFFING PLANS FOR NATURAL AND CULTURAL RESOURCES

NATURAL RESOURCES PROJECT STATEMENTS

CULTURAL RESOURCES PROJECT STATEMENTS

INTEGRATED RESOURCES PROJECT STATEMENTS

APPENDIX A: CULTURAL RESOURCE STATUS SUMMARY CHARTS

SUMMARY CHART FOR ARCHEOLOGICAL SITES

Significance			**Condition**					**Impacts**				**Documentation**		
	Total	Acreage	Good	Fair	Poor	Des.	Unk.	Sev.	Mod.	Low	Poor	Good	Fair	Poor
National														
State and Regional	2		1	1					2			2		
Local														
Not Evaluated	420		100	100	20		200		45	75	300	200		220
TOTALS	422		101	101	20		200		47	75	300	202		220

*Approximately 5% of Sequoia and Kings Canyon National Parks has been surveyed.

SUMMARY CHART FOR STRUCTURES

Significance		**Condition**				**Impacts**				**Documentation**		
Level	Total	Good	Fair	Poor	Unk.	Sev.	Mod.	Low	Unknown	Good	Fair	Poor
National												
National Cont.												
State	3	3				1	1	1			2	1
Local	86	40	41	5		15	69	2		71	15	
Undetermined	75	20	50	5		5	60	10		65	10	
TOTALS	164	63	91	10		21	130	13		136	27	1

93 structures are included in the List of Classified Structures (LCS) as of FY2000. 71 structures are included in the General Grant National Park Historic District, three of which are also in the LCS.

SUMMARY CHART FOR OBJECTS

Documentation	Arch.	Ethn.	Hist.	Archv.	Biol.	Paleo.	Geol.	Total
Registration Data Only								
Registration & Catalog Data	7225	33	17289	204533	10539	20	115	239754
Total Items Cataloged	7225	33	17289	204533	10539	20	115	239754
Backlog to be Cataloged	3832	75	28468	46311	3019	0	362	82067
Total Collection Summary	11057	108	45757	250844	13558	20	477	321821

*Form 10-254 Submitted to National Catalog at Harper's Ferry.

Condition	Arch.	Ethn.	Hist.	Archv.	Biol.	Paleo.	Geol.
Excellent							
Good	75%	90%	50%	85%	60%	100%	75%
Fair			35%	15%	35%		
Poor					5%		
Unknown	25%	10%	15%				25%

**The Percentage of Collection in the Following Categories

APPENDIX B: CULTURAL RESOURCE DOCUMENTATION CHECKLIST

Title	Current and Approved	Needs Revision	Needed
PLANNING DOCUMENTS			
Preauthorization and Authorization			
Statement for Management (SFM)	Draft		
Outline for Planning Requirements (OPR)			
General Management Plan (GMP)			X
Development Concept Plan (DCP)	X		
Resources Management Plan (RMP)	X		
Interpretive Prospectus (IP)	X		
SERVICEWIDE INVENTORIES, LISTS, CATALOGS, AND REGISTERS			
Cultural Resources Bibliography (CRBIB)			X
Cultural Sites Inventory (CSI)	X		
List of Classified Structures (LCS)	X		
National Catalog of Museum Objects	X		
National Register of Historic Places		X	
BASIC CULTURAL RESOURCE DOCUMENTS			
Archeological Overview and Assessment		X	
Archeological Identification Studies			X
Archeological Evaluation Studies			X
Ethnographic Overview and Assessment			X
Ethnographic Oral Hist. & Life Hist.			X
Ethnographic Program			
Historical Base Map	GIS		
Historic Resource Study(HRS)(multiple)	GG		
Park Administrative History			X
Scope of Collection Statement	Draft		
SPECIAL RESOURCE STUDIES AND PLANS			
Archeo. & Ethno. Collections Studies			
Archeological Data Recovery Studies			
Collection Management Plan	X		
Collection Storage Plan	X		
Collection Condition Survey	X		
Cultural Landscape Report (CLR)			X
Ethnohistory			X
Exhibit Plan			
Historic Furnishings Report			X
Hist. Struct. Preservation Guide (HSPG)			X
Historic Structure Report (multiple)			X
Social Impact Study			
Special History Study			
Traditional Use Study			X

APPENDIX C: CURRENT PLANNING DOCUMENTS

PARK-WIDE GENERAL PLANS:

Master Plan for Sequoia and Kings Canyon National Parks. 1971. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

Statement for Management for Sequoia and Kings Canyon National Parks. 1976. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

General Management Plan for Sequoia and Kings Canyon National Parks and Environmental Impact Statement.. 2000 (in prep*).* Sequoia and Kings Canyon National Parks, U. S. Department of the Interior.

Wilderness Management Plan and Environmental Impact Statement. 2000 (in prep). Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior

AREA PLANS - KINGS CANYON NATIONAL PARK:

Cedar Grove Development Concept Plan. 1980. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

Grant Grove/Redwood Mountain Development Concept Plan and Final Environmental Impact Statement. 1988. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

AREA PLANS - SEQUOIA NATIONAL PARK

Giant Forest/Lodgepole Development Concept Plan and Final Environmental Impact Statement. 1979. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

Clover Creek Comprehensive Design Plan. 1985. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

Mineral King Comprehensive Management Plan and Environmental Assessment. 1980. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

LAND PROTECTION PLANS

Mineral King Land Protection Plan and FONSI. 1984. Sequoia and Kings Canyon National Parks, National Park Service, U. S. Department of the Interior.

Wilsonia and Oriole Lake Areas Land Protection Plan and categorical exclusion. 1988. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

RESOURCES MANAGEMENT PLANS

Natural Resources Management Plan and Environmental Assessment. 1976. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Resources Management Plan. 1994. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Resources Management Plan. 1999 (in prep). Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

The following natural resources management implementation plans are addenda to the *Resources Management Plan*:

Bear Management Plan. 1987. Sequoia and Kings Canyon National Park, National Park Service, Department of the Interior.

Development Zone Vegetation Management Plan. 1987. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Fire Management Program (Prescribed Natural Fire) Environmental Assessment. 1989. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Fire Management Plan (1992 Revision). 1992. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Fire Management Plan and Environmental Assessment. 2000 (in prep). Sequoia and Kings Canyon National Parks, Department of the Interior.

Wildlife Management Plan. 1987. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Aquatic/Water Resources Management Plan and Environmental Assessment for Fisheries Management. 1986. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Bighorn Sheep Management Plan and Environmental Assessment. 1987. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Little Kern Golden Trout Management Plan and Environmental Assessment. 1984 and EA 1979. Sequoia National Forest, U. S. Forest Service, U. S. Department of Agriculture, and Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Backcountry Management Plan and Environmental Assessment. 1987. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Stock Use and Meadow Management Plan and Environmental Assessment. 1986. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

Cave Management Plan and Environmental Assessment. 1992. Sequoia and Kings Canyon National Park, National Park Service, Department of the Interior.

Cultural Resources Management Plan. 1982. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior (Plan is now part of the revised 1992 revised *Resources Management Plan.*

INTERPRETIVE PLANS

Statement for Interpretation. 1992. Sequoia and Kings Canyon National Parks, National Park Service, Department of the Interior.

APPENDIX D: NR-MAP AND CR-MAP PROFILES

APPENDIX E: DETAILED DESCRIPTIONS OF NATURAL RESOURCES

[This section may be provided in a future plan revision]

Topics to include:

- State of understanding
- How resources fit into the regional context
- Species list
- Karst resources
- Others?

APPENDIX F: LONG-TERM MONITORING PROGRAM

INTRODUCTION

An indicator is a measure of the condition of a resource. For example, the concentration of lead is a measure of water quality. The standard is the worst condition of an indicator that can be accepted. When conditions fall outside standard, management actions should be triggered to bring the indicator back within standard. If the condition of the resource is within standard, then the desired future condition has been achieved. As used herein, the term "standard" is synonymous with "trigger point".

The General Management Plan (GMP) establishes desired future conditions for the resources. Presumably the GMP will at least establish a conceptual policy that visitor-caused impacts will be kept within acceptable levels. It is expected that the GMP will give some broad guidelines about what constitutes acceptable impacts to the resources. At least some desired future conditions and standards will be incorporated into the long-term monitoring program. The GMP may assess the desirability and the impacts of keeping – or not keeping – impacts within an acceptable range. If not, then those tasks would fall to some implementation plan.

Additional guidance in preparing the long-term monitoring program can be found in (Dubrasich 1999), in various NPS and USGS publications on monitoring for carrying capacity in national parks. Further guidance will be provided by various working groups within the National Park Service. An example of a long-term monitoring program is the Long-Term Ecological Monitoring Conceptual Plan for the North Cascades National Park Complex (National Park Service 1999). This report is also available at http://www.cfr.washington.edu/usgs/cacadia/research/noca_ltem.

SCOPE OF VITAL SIGNS MONITORING PROGRAM

Vital signs monitoring is one component of long-term monitoring. Vital signs are a relatively small group of key indicators that measure overall ecosystem health. The trend in abundance of an apex predator such as a mountain lion might be a measure of ecosystem health.

The hallmark of vital signs monitoring is that it focuses on ecosystems. The population monitoring in vital signs programs should be designed to represent other similar taxa and relate demographic data to environmental factors and processes. The selected taxa in the vital signs program should represent the entire array of trophic structure from primary producers, filter feeders, and detritivores, to apex predators and people in a system. It should also include a representative cross-section of life forms and natural history strategies for the whole system. Vital signs should have a clear basis in a conceptual model of the park ecosystem.

Monitoring of vital signs may provide an early warning of ecosystem stress before significant damage has occurred. However, it is not intended to diagnose the cause of that stress. At best, it can identify potential agents of change. Intensive follow-up research studies are generally required to diagnose the cause of the stress and to prescribe appropriate corrective action.

The vital signs monitoring program does *not* provide all the monitoring data that a park requires. There will be many other monitoring projects. Monitoring that focuses on populations or isolated physiochemical parameters is *not* part of the vital signs monitoring program. Monitoring that is intended to diagnose the cause of ecosystem stress is *not* part of the vital signs program. Monitoring that is intended to prescribe corrective action is *not* part of the program.

Monitoring of stressors – even anthropogenic stressors – is outside the scope of vital signs monitoring. Vital signs monitoring should be aimed at the health of the resource; not at measuring potential causes of stress. It's the difference between monitoring the condition of meadow vegetation and monitoring for the number of stock.

The health of the natural resources is a central focus of the vital signs monitoring program. But the parks are also required to consider the health of the cultural resources. This will presumably be incorporated in the vital signs monitoring program. There will probably also be vital signs for the influence of the park on humans, the quality of the visitor experience.

The parks are required by law to implement carrying capacity. Vital signs monitoring and carrying capacity are integral concepts. Therefore, the concept of carrying capacity will probably be incorporated in the vital signs monitoring program.

GOALS OF VITAL SIGNS MONITORING PROGRAM

Before proceeding too far in preparing the monitoring program, it will be necessary to establish the goal of the program. One very specific goal that has been offered is to monitor indicators as a measure of our performance in natural resource stewardship.

Alternative goals that have been offered are to:

- Determine the status and trends of ecosystem health
- Establish empirically the normal ranges of variation of ecosystem resources and processes
- Provide early diagnoses of abnormal conditions that require intervention
- Identify potential agents of abnormal change to guide research and prescribe treatments

Once precise goals are formulated, they can be used to keep the monitoring focused. Without such focus, it will be difficult to decide where to expend the limited funds available for monitoring. For example, it could be argued that all natural resources are vital signs since all components of all natural resources are represented in the conceptual model of the park ecosystem. That would be consistent with good stewardship, but it might not be affordable, at least initially. We need to figure our what our focus is and use it to guide the monitoring effort.

QUESTIONS OF INTEREST

Long-term monitoring is not a goal in and of itself. A major purpose of vital signs monitoring is to inform management action. The goal of long-term monitoring is to answer questions of interest with a certain degree of confidence. If the monitoring data is unable to answer the questions of interest with the desired degree of confidence, than that monitoring was not particularly productive. It would be misguided to collect the data first and then determine what questions to ask of that data. Rather we begin by stating the questions of interest. Then monitoring protocols can be prepared to answer those questions in the most efficiently manner.

After the questions of interest have been prepared, a preliminary monitoring protocol will be developed for each question. Grouping related questions under a single protocol will sometimes result in data collection efficiencies. The approximate cost of each protocol will be estimated. The total number of questions of interest will likely be larger than the amount of funds available to answer them. Once a data-collection cost has been attached to each question or group of questions, they can be ranked in priority order.

It may be that some questions of interest cannot be answered in the first stages of monitoring. This is not to say that a question is not worth answering. All monitoring is good; more data is always better. But if faced with limited funds, monitoring should be concentrated on those questions that provides the most value, the most return for the funds spent. As an example, we might put the highest priority on that monitoring which directly informs management of the parks' resources. If that were the case, then monitoring to determine the effect of stock on meadows might have a higher priority than monitoring to determine the trend in neotropical migrants. Monitoring the effect of trampling on sequoia roots might have a higher priority than monitoring climate change.

MONITORING PROTOCOL

Final steps in preparing the vital signs monitoring plan will include:

- Design the sampling system and sampling protocols
- Prepare the data management systems
- Plan the analysis and interpretation systems
- Develop a reporting system

In preparing a vital signs monitoring program, we will have to recognize that the parks are only a portion of the ecosystem. We will have to consider the surrounding area and what is happening there. To the extent practical, we will need to involve resource management outside of the park boundary. There may already be monitoring going on that we can tap into. Vital sign monitoring outside of the parks' boundary by others would also provide a better understanding of what is happening within the parks.

One of the most important parts of each monitoring protocol will be the sampling scheme. In preparing the monitoring program, we have to decide whether to report on the overall health of the resource or to monitor areas where resource trouble is expected. For poaching, should we monitor a dozen representative sites across the park or would we sample primarily where poachers are expected? This is not an academic question. How we structure the sampling will have a major effect on the cost. It will also determine how we can interpret the monitoring results. The answers to these issues should flow from the questions of interest.

It's not enough to document change in an indicator. We have to attempt to explain the cause of that change. How does it reflect on our stewardship? The cause for change of some indicators (increase in Hispanic visitors, decline in bat or bird numbers) may require some effort to determine. It's fine to collect this data, but we need to keep in mind what our goals are and how we will use the results. Again, this should come from the questions of interest.

Coliform bacteria may be chosen as an indicator of human activity since humans are a direct source of coliform bacteria. But they are not the only source. For example, an increase in the number of hikers can drive out wildlife and actually reduced the level of coliform bacteria in the streams. The monitoring protocol – and the establishment of standards – will have to keep such complexities in mind.

It's not enough to record data on indicators. We also have to record variables that might effect an indicator. Was the regional economy in the doldrums? Did gas prices shoot up suddenly? Were visitor facilities under construction or closed? Was bat population down throughout the region? Were there more inversions than normal? Did El Niño rear its ugly head? Did smoke hold down use? Were the high trails late to open? The easiest time to collect those data sets (or at least reference them) is when

we're trying to explain the season's monitoring results. The longer we wait, the harder it will be to find the data and the more likely that we'll overlook the relationship. It gets messy fast when we start monitoring indicators that are sensitive to a wide variety of inputs. That's one more reason why we need to stay focused on what are the goals of the monitoring.

A critical part of each monitoring protocol will be to regularly interpret the monitoring results. The longer we put it off, the harder it will be to figure out what caused the observed results. Monitoring is an iterative process. We have to formally assess the results of one season in order to implement improvements for the next monitoring season. A side benefit of such analysis is the opportunity to produce an annual state of the parks report that discusses the health of park resources.

STATUS OF THE PARKS' VITAL SIGNS MONITORING PROGRAM

Work to prepare a vital signs monitoring program for the two parks has already begun. A vital signs workshop for the parks was held on April 13-16, 1999. From that workshop, a list of questions of interest can be developed. A very rough draft of those questions follows:

Atmosphere and Meteorology

- For each day of the year and for each of numerous federal and state air quality standards, are there occasions when ambient air pollution in the parks exceeds the standard?
- For each of several gaseous and aerosol pollutants, are there temporal trends and cycles in deposition in the parks?
- For rivers and streams in total and for each of several gaseous and aerosol pollutants (including nutrients, acidic deposition, and pesticide drift), are there temporal trends and cycles in deposition?
- For high mountain lakes in total and for each of several gaseous and aerosol pollutants (including nutrients, acidic deposition, and pesticide drift) are there temporal trends and cycles in deposition?
- For each of several gaseous and aerosol pollutants, are there spatial variations in deposition in the parks?
- For wetlands in total (including meadows, bogs, and marshes), are there temporal trends and cycles in air pollution deposition?
- For each of numerous wetlands (including meadows, bogs, and marshes) and each of several impacts from human-induced climate change, are there temporal trends and cycles, especially in alpine zones?
- For each of numerous river and stream reaches and for each of several measures of human-induced climate change, are there temporal trends and cycles in impacts?

Geologic, Soils, and Paleontological Resources

- For each of numerous river and stream reaches, are there temporal trends and cycles in floodplain connectivity?
- For each of numerous river and stream reaches, are there temporal trends and cycles in channel morphology?
- For each of numerous stream and river reaches, are there temporal trends and cycles in sediment transport either on an annual basis or after large-scale events (including floods, large storms, and fires)?

- For each of numerous stream and river reaches, are there temporal trends and cycles in channel sedimentation either on an annual basis or after large-scale events (including floods, large storms, and fires)?
- For each of numerous hillsides, are there temporal trends and cycles in the rate or volume of hillside soil movement?
- For each of numerous caves and for each year, has there been any new damage to cave speleothems
- For each of numerous wetlands (including meadows, bogs, and marshes) and for each of several human impacts (including alteration or diversion of surface flows, canalization, erosion, and sedimentation transport), are there temporal trends and cycles in impacts?

Water Resources

- For each of numerous karst springs and for each of several measures of water quality, are there temporal trends and cycles?
- For each of numerous river and stream reaches and for each of several measures of water quality, are there temporal trends and cycles in abundance?
- For each of numerous wetlands (including meadows, bogs, and marshes) and for each of several measures of water quantity, are there temporal trends and cycles in impacts?
- For each of numerous wetlands (including meadows, bogs, and marshes) and for each of several human impacts (including water quality and nutrient availability), are there temporal trends and cycles in impacts?
- For each of numerous wetlands (including meadows, bogs, and marshes), are there temporal trends and cycles in animal wastes?
- For each of numerous river and stream reaches and for each of several human use impacts on water resources (including human waste, soap, insect repellent, sun block, and water diversions and impoundments), are there temporal trends and cycles in impacts?
- For each of numerous high mountain lakes and for each of several human use impacts on water quality (including human waste, soap, insect repellent, sun block), are there temporal trends and cycles in impacts?

Vegetative Resources

- Are there unanticipated temporal trends and cycles in landscape pattern (including ecotones, patches, and grain)?
- For each of numerous plant communities, are there unanticipated temporal trends and cycles in composition, structure, or spatial pattern?
- For each of numerous river and stream reaches and for each of several key representatives of the biota, are there temporal trends and cycles in abundance?
- For each of numerous species of concern, are there unanticipated temporal trends and cycles in abundance?
- For each of numerous river and stream reaches and for each of several key riparian vegetation species, are there temporal trends and cycles in abundance?
- For each of numerous wetlands (including meadows, bogs, and marshes), are there temporal trends and cycles in species composition of vascular vegetation?
- For each of numerous wetlands (including meadows, bogs, and marshes), are there temporal trends and cycles in aquatic fauna in standing water?

- For each of numerous river and stream reaches, are there temporal trends and cycles in loss of plant biodiversity?
- For each of numerous river and stream reaches, are there temporal trends and cycles in trampling?
- For each of numerous high mountain lakes, are there temporal trends and cycles in trampling?
- For each of numerous high mountain lakes and for each of several exotic plant species (including *Elodea* spp.), are there temporal trends and cycles in impacts?
- For each of numerous wetlands (including meadows, bogs, and marshes) and for each of several species of exotic plants, are there temporal trends and cycles in abundance?

Wildlife Resources

- For each of numerous caves and for each of numerous cave invertebrates, are there temporal trends and cycles in abundance?
- For each of several areas of the park, are there temporal trends and cycles in abundance of Aplodontia?
- For each of numerous habitats and for each of numerous diurnal bird species, are there temporal trends and cycles in abundance?
- For each of numerous areas of the parks and for each of numerous terrestrial vertebrates, are there temporal trends and cycles in abundance?
- For each of numerous areas of the parks and for each of numerous mid-sided carnivores, are there temporal trends and cycles in abundance?
- For each of numerous areas of the parks and for each of three large mammals, (mountain lion, bighorn sheep, and deer), are there temporal trends and cycles in abundance or sex ratio?
- Are there temporal trends and cycles in the number of bear-human incidents?
- For each of several proactive bear-related management actions (including implementing bear-resistant facilities), what is the effect on the number of bear-human incidents?
- For each of numerous caves and for each of several bat species, are there temporal trends and cycles in abundance?
- For each of several bat species, what is the habitat usage?
- For each of numerous areas of the park and for each of numerous terrestrial invertebrates (insects), are there temporal trends and cycles in abundance?
- For each of numerous wetlands (including meadows, bogs, and marshes), are there unexpected temporal trends and cycles in wildlife impacts?
- For each of numerous river and stream reaches, are there temporal trends and cycles in loss of wildlife biodiversity?
- For each of numerous high mountain lakes and for each of several exotic vertebrates (including fish) and invertebrates (including *Hyalella azteca*), are there temporal trends and cycles in impacts?
- For each of numerous river and stream reaches and for each of several exotic animal species (bullfrogs, trout, sunfish, etc), are there temporal trends and cycles in impacts?
- For each of numerous areas of the foothills and for each of numerous exotic animal species (including feral pigs) and for each of several measures of disturbance/damage by those species (including competition with native wildlife, increase in erosion, and altering of plant communities), are there temporal trends and cycles?
- What is the threshold for controlling feral pigs?

Miscellaneous

- For each of several reaches of the Kern River, and for each of several direct and indirect effects of beaver on hydrology (including flooding of meadows and woodlands), vegetation (including species composition or abundance especially of streamside willows, cottonwoods, and aspen), and animals (including changes in species composition and the Kern golden trout), are there temporal trends and cycles in those impacts? Have any of those impacts to the native system become unacceptable?
- For each of numerous wetlands (including meadows, bogs, and marshes) and for each of several human impacts (including trampling by humans and stock, social trails, campsites, changes in fire regime, or roads), are there temporal trends and cycles in impacts?
- For each of numerous areas of the parks and for each of several types of resources and for each of numerous human influences or impacts to that resource, are there temporal trends and cycles in those influences or impacts?
- For each of numerous areas of the parks and for each of several types of visitor and for each of numerous park influences or impacts on humans, are there temporal trends and cycles in those influences or impacts?

APPENDIX G: LIITERATURE CITED

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APPENDIX H: NATURAL AND CULTURAL RESOURCE CONSULTANTS

Natural Resources Consultants, Sequoia and Kings Canyon National Parks

1. John Austin, Resource Planner
2. Larry Bancroft, Chief of Science and Natural Resources Management
3. Cathy A. Bleggi, Budget Assistant
4. Tony Caprio, Ecologist
5. Athena Demetry, Ecologist
6. Joel Despain, Cave Management Specialist
7. Daniel Duriscoe, Ecologist
8. Annie Esperanza, Air Quality Specialist
9. Karen Folger, Cartographic Technician
10. David Graber, Science Advisor
11. Sylvia Haultain, Ecologist
12. Mary Beth Keifer, Ecologist
13. Pat Lineback, GIS Specialist
14. Jeff Manley, Supervisory Natural Resources Management Specialist
15. Donna Meisky, Biological Technician
16. Ralph Moore, Wilderness Coordinator
17. Rich Thiel, Biological Technician
18. William Tweed, Chief of Interpretation and Cultural Resources
19. Tom Warner, Forester
20. Harold Werner, Fish and Wildlife Biologist

Cultural Resources Consultants, Sequoia and Kings Canyon National Parks

21. Thomas L. Burge, Cultural Resources Specialist
22. Ward Eldredge, Museum Technician

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23. Jon Keeley, Station Director
24. Nate Stephenson, Research Ecologist
25. Claudette Moore, Biological Technician

APPENDIX I: GLOSSARY OF TERMS

[Additional terms may be added in a future plan revision]

Exotic species. Species that humans intentionally or unintentionally introduced into an area outside of a species' natural range. Species occurring in a given place as a result of direct or indirect, deliberate, or accidental actions of humans. The term is synonymous with alien, introduced, nonindigenous, and nonnative species.

Indicator. A measure of the condition of a resource.

Standard. The worst condition of the indicator that can be accepted. When conditions fall outside standard, management actions will be triggered to bring the indicator back within standard. If the condition of the resource is within standard, then the desired future condition has been achieved. As used herein, the term "standard" is synonymous with "trigger point".

Vital signs. A relatively small group of key indicators that measure overall ecosystem health.

APPENDIX J: DESCRIPTION OF MISSION AND LONG-TERM GOALS

MISSION GOAL Ia: Natural and cultural resources and associated values are protected, restored, maintained in good condition and managed within their broader ecosystem and cultural context.

This goal which encompasses the broad mandate of the NPS Organic Act includes the concepts of biological and cultural diversity and the perpetuation of natural processes. Broader ecosystem and cultural context includes both natural systems and cultural systems that extend beyond the park unit to nearby lands. Park cultural context refers to ensuring that park resources are preserved and interpreted in relationship to other historical events or cultural processes. Sequoia and Kings Canyon National Parks biosphere reserve designation is considered part of the broader cultural and/or ecological context. The enabling legislation for the parks requires the protection of the scenic grandeur of landscapes.

Long-term goals related to this mission goal include: restoring and maintaining natural fire regimes; controlling alien species; restoring disturbed lands; restoring aquatic ecosystems; improving the status of threatened/endangered and sensitive species; protecting and preserving cave resources; restoring Giant Forest; reducing non-conforming uses; and preserving archeological, historic structures, and museum collections.

Long Term Goal Ia1. Natural Fire Regimes - 2.8% of the burnable ecosystems (particularly giant sequoia groves), based on the 1997 burnable acreage, are restored and/or maintained by fire.

Fire places a natural role in the ecosystems, particularly in the giant sequoia ecosystem, within Sequoia and Kings Canyon National Parks. This role includes seed bed preparation, nutrient recycling, influencing plant succession, providing a mosaic of age classes and vegetation succession, modifying wildlife habitat, reducing numbers of trees susceptible to attack by insect and disease, reducing fire hazard, and perpetuating the giant sequoia. This goal focuses on restoring fire to its natural role through allowing prescribed natural fires and conducting prescribed burn. This goal will be tracked by the Chief of Science and Natural Resources Management and the Chief Park Ranger.

Long Term Goal Ia2. Alien Species - At least 25% of all new potentially invasive alien species, as of 1997, are controlled.

Exotic, alien, or non-native plant and animal species threaten the parks because they often replace native species, disrupt natural processes, and otherwise destroy natural systems. According to the 1996 NR-MAP Profile for there are an estimated 117 alien plants and 16 alien animals in the parks This goal improves resource conditions by controlling invasive alien species. This goal will be tracked by the Chief of Science and Natural Resources Management.

Long Term Goal Ia3. Disturbed Lands - At least 5% of known non-significant disturbed or abandoned sites; including abandoned roads, trails, campgrounds and picnic areas, and disturbed backcountry meadow sites etc.; as of 1997, are restored.

Park lands, where natural processes have been significantly altered by past land use practices, administrative activities, and visitor use need to be restored to their natural condition. Impacts from such land use practices, administrative activities, and visitor use include: disturbances from roads, dams, and other abandoned sites; and overuse in campgrounds, picnic areas trails, and backcountry meadows. This goal improves natural resource condition by restoring these disturbed sites. This goal

will be tracked by the Chief of Science and Natural Resources Management and Chief of Maintenance.

Long Term Goal Ia4. Aquatic Ecosystems - At least 5% of lakes, as of 1997, are restored.

There are an estimated 1,500 miles of surface permanent rivers and streams, 900 acres of natural lakes, and 40,000 acres of palustrine environment within the parks according to the 1996 NR-MAP Profile. These aquatic resources need to be preserved and restored when necessary. This goal restores aquatic ecosystems by controlling visitor and administrative use and by monitoring the impacts of park facilities on aquatic ecosystems. This goal will be tracked by the Chief of Science and Natural Resources Management.

Long Term Goal Ia5. Air Quality - Air quality in at least 50% of the parks improves or does not degrade from 1997 baseline conditions.

Air pollution is one of the major threats to the resources of Sequoia and Kings Canyon National Parks. This goal tracks visibility, ozone, particulates, and nitrate deposition; and ensures that information from the air quality monitoring program is relayed to the air pollution regulatory agencies. This goal will be tracked by the Chief of Science and Natural Resources Management.

Long Term Goal Ia6. Threatened/Endangered and Sensitive Species - At least 100% of the 1997 identified park populations of federally listed threatened and endangered with critical habitat on park lands or requiring NPS recovery actions have an improved status, and an additional 100% have stable populations.

Threatened and endangered and sensitive species in the parks, such as the Little Kern golden trout and the peregrine falcon are integral to the natural systems the parks are charged to protect. This goal assesses the status and stability of populations of federally listed threatened and endangered and sensitive species, identified in 1997 and recorded in the T&E Database. The populations consists of those species requiring recovery efforts and monitoring. This goal will be tracked by the Chief of Science and Natural Resources Management.

Long Term Goal Ia7. Cave Resources - At least 90% of known park caves, as of 1997, are protected and preserved for long-term ecosystem integrity and structure, with emphasis on the extremely fragile and irreplaceable nature of the physical and biotic resources.

Cave (karst) resources are among the most fragile resources in these parks. There are over 190 caves in Sequoia and Kings Canyon National Parks, which represent a significant national resource in cave systems and karst geology. This goal protects and preserve the cave (karst) resources through administrative and regulatory actions involving the establishments of guidelines, regulations, a permit system, a monitoring and classification system for park caves; all of which are designed to insure protection of the cave resource and safety for the cave visitor. This goal will be tracked by the Chief of Science and Natural Resources Management.

Long Term Goal Ia8. Giant Forest - At least 90 % of the disturbed sites at Giant Forest, as of 1997, are restored.

Giant Forest is the premiere giant sequoia grove within Sequoia and Kings Canyon National Parks and is impacted by over 200 buildings. These buildings will be removed and the grove restored. This goal tracks the restoration of Giant forest to create a structure and composition of vegetation at the restoration sites within the range of natural variability if development had not taken place and if fire

had not been suppressed. This goal will be tracked by the Chief of Park Maintenance and the Chief of Science and Natural Resources Management.

Long Term Goal Ia9. Non-Conforming Uses - Impacts of illegal and non-conforming uses on park natural and cultural resources are reduced by 25% from 1997 levels.

There are many illegal and non-conforming uses within Sequoia and Kings Canyon National Parks that impact the natural and cultural resources. These uses include: poaching, trespass grazing, rights-of-way and easement violations, and rock climbing. This goal reduces the impacts of illegal and non-conforming uses on park natural and cultural resources. This goal will be tracked by the Chief Park Ranger.

Long Term Goal Ia10. Archeological Resources - 75% of the archeological sites listed on the National Register or eligible are in good condition.

Park archeological sites include: bedrock mortars, lithic scatters, rock art, and villages. To preserve recorded sites, monitoring is necessary and additional actions to enhance preservation may be required. As of 1997 only about 3% of the parks (RMP-1994) have been surveyed for archeological sites. Currently there are 193 recorded sites (RMP-1994). Currently, condition is reported for 50% of the recorded sites with 50% of these reported to be in good condition. Good condition indicates that the site is not deteriorating due to natural processes, such as erosion, or due to human impacts, such as vandalism or looting. This goal increases the number of recorded archeological sites listed on the 1996 CR-MAP Profile. This goal will be tracked by the Chief of Interpretation.

Long Term Goal Ia11. Historic Structures - 50% of the historic structures on the 1998 List of Classified Structures that appear to be eligible for National Register listing are in good condition.

Park historic structures include: residences, ranger stations, bridges, cabins, the Generals Highway, and stone bridges. Twenty seven historic districts/structures in Sequoia National Park and 16 historic district/structures in Kings Canyon National Parks are on the list of Classified Structures (LCS), (RMP-1994). There are an additional 196 structures that are 50 years old or older that have not been evaluated. Other buildings that need to be evaluated include private inholdings that are currently in leases. Maintaining these structures in good condition responds to the NPS Organic Act, the National Historic Preservation Act, and the cultural resource integrity of the National Park System.

Current LCS data indicate that 30% of the inventoried structures are in good condition; 70% are in poor, fair, or unknown condition. Good condition is defined as the structure and significant features need no repair, but only routine or cyclic maintenance. This goal would increase the number of structures in good condition, while maintaining those currently in good condition. It continues the present trend in the management of these resources. This goal will be tracked by the Chief of Interpretation.

Long Term Goal Ia12. Museum Collections - 90% of preservation and protection conditions in park museum collections meet professional standards.

Park museum collections include archeological artifacts, historic artifacts, archival collections; and biological, geological, and paleontological objects. Currently there are 9,017 archeological artifacts, 174 ethnology objects, 9,979 cataloged historic artifacts, 1,370 catalog records in the archival collection; and 9,000 cataloged biological specimens, 19 cataloged paleontological collections, and 115 cataloged geological specimens. The preservation and protection of these museum collections is essential to the park's mission. The environmental, security and fire protection conditions necessary to

preserve and protect museum objects are identified in the NPS Checklist for Preservation and Protection of Museum Collections. Corrected deficiencies will be tracked annually. As of 1997, 61% of the conditions on the checklist were met. This goal continues the present trend in the management of these resources. This goal will be tracked by the Chief of Interpretation.

MISSION GOAL Ib: Legally designated and proposed Wilderness is managed to meet the standards and ideals of the Wilderness Act and as a component of a larger regional wilderness area.

This goal encompasses the mandates of the Wilderness Act regarding wilderness values in designated or proposed wildernesses. To preserve scenic grandeur and wilderness values in a natural area, or the integrity of a cultural landscape, incompatible influences must be minimized.

Long-term goals related to this mission goal include: reducing administrative use of stock and helicopter in the Wilderness; using the "minimum tool" for all actions within the Wilderness; and reducing the signs of human use in the Wilderness.

Long Term Goal Ib1. Administrative Use in Wilderness - Administrative use of stock and helicopters in the wilderness is reduced by 20% over 1997 levels.

Some 75% of Sequoia and Kings Canyon National Parks is designated Wilderness and another 20% is backcountry and is managed as wilderness. Administrative helicopter and stock use in the Wilderness and backcountry is an intrusion and needs to be controlled. This goal reduces the amount of administrative stock and helicopter use in the Wilderness and backcountry. This goal will be tracked by the Chief Park Ranger.

Long Term Goal Ib2. Minimum Tool in Wilderness - The "minimum tool" is used for 100% of the actions in the Wilderness.

The "minimum" tool must be used in the Wilderness and backcountry in order to mitigate resource impacts and solitude. This goal ensures that the "minimum" management tool is used in the Wilderness and backcountry. This goal will be tracked by the Chief Park Ranger.

Long Term Goal Ib3. Wilderness Solitude - 90% of wilderness/backcountry visitors, as of 1996, have access to wilderness/backcountry information.

This goal ensures that wilderness visitors find solitude and little or no sigh of human use in the Wilderness. This goal will be tracked by the Chief Park Ranger.

MISSION GOAL Ic: The parks contribute to knowledge about natural and cultural resources; management decisions about resources and visitors are based on adequate scholarly and scientific information.

The ultimate long-term goal for resource stewardship within the parks is the preservation of our natural and cultural heritage for future generations. Achievement of that goal requires knowledge of the functioning and condition of those resources. The measure of success for that long term goal is that the natural and cultural resources within parks function as healthy systems, within an acceptable range of variation, as part of larger dynamic systems. To have a complete understanding of the system, humans and their culture through time must be understood to be a part of that system.

The parks need a basic understanding of the normal or natural range of variation of resources, and assessments of the existing condition of resources in order to evaluate necessary actions to remain within or move towards the ultimate goal of resources functioning within their normal range of variation. For natural resources that range of variation needs to be determined from ranges within the dynamics of ecosystem functioning over time. For cultural resources, the normal range of variation may exist as established standards, as well as understandings of changing conditions and different cultural values over time.

The parks also have a need for information for making decisions about managing natural and cultural resources within the parks, as well as making contributions to scholarly and scientific research. To meet this goal scholarly and scientific research and consultation is used to determine how a proposed action or activity would affect the park's resources.

Long-term goals that focus on research, inventory and monitoring of natural resources, and cultural resources inventory and evaluation, along with those that link research data to decision making, are supported by this mission goal.

Long Term Goal Ic1. Natural Resources Inventory and Monitoring - 90% of the biological and physical resource components and their vital signs, as of 1997, are known.

It is essential to know the natural resources and to monitor their condition over time to preserve them. In order to accomplish this vital signs need to be identified and monitored. Vital signs are defined as those key resource components necessary for an understanding of ecosystem and resource functioning, which provide adequate surrogates for the full range of components to develop an assessment of ecosystem condition. Vital signs serve as a model for overall system functioning. This goal inventories selected biological and physical resources and monitors their vital signs over time. This goal will be tracked by the Chief of Science and Natural Resources Management and the Senior Scientist.

Long Term Goal Ic2. Cultural Resources Inventory and Evaluation - The 1997 baseline inventory and evaluation of each category of cultural resources is increased by 5%.

Knowledge about cultural resources and their conditions is crucial to managing them well. Cultural resources categories include archeological sites (Archeological Sites Management Information System), historic and prehistoric structures (List of Classified Structures), museum collections (Automated National Catalog System), and ethnographic resources (Ethnographic Resources Inventory). For each category of park cultural resources, a database exists for documenting these resources. Each of these inventories is currently at a different level of completion, but will increase its listed number of resources by 2%. This goal continues the present trend in the management of these inventories. This goal will be tracked by the Chief of Interpretation

Long Term Goal Ic3. Visitor Demographics - The visitor use statistics are complete and accurate and the demographics and expectations of 70% of the frontcountry and backcountry visitors are known.

Visitors use statistics are necessary in order to understand visitor satisfaction and expectations. This goal acquires visitor use demographics. This goal will be tracked by the Chief of Interpretation.

Long Term Goal Ic4. Data Sets - 8 of the 12 outstanding data sets identified in 1997 of basic natural resource inventories for the parks are acquired.

The preservation of natural resources requires a wide range of information. This information is contained in twelve data sets including: historical data base (bibliography); flora and fauna (including

threatened and endangered species); species distributions; digitized vegetation maps; digitized cartographic data; digitized soils maps; digitized geological maps; inventory of water bodies and use classifications; water quality and basic water chemistry for key water bodies; identification of nearest air quality monitoring stations and sources; list of air quality-related values; and meteorological data. This goal acquires or develops outstanding natural resource data sets. This goal will be tracked by the Chief of Science and Natural Resources Management.

MISSION GOAL IIa: Visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of park facilities, services, and appropriate recreational opportunities

Enjoyment of the parks and their resources is a fundamental part of the visitor experience. Visitor enjoyment and safety are affected by the quality of park facilities, services, and recreational opportunities; whether provided by the parks, a concessioner, or a contractor. Availability of park facilities and services refers to convenient locations and times of operation that fit visitors' transportation and schedule needs. Facilities also must be made accessible for special populations.

Long-term goals related to this mission goal include: ensuring that visitors are satisfied with park facilities, services, and experiences; converting Giant Forest to a day-use area; ensuring that Wuksachi Village is in full operation; reducing the visitor safety incident rate; making park facilities accessible; providing security for facilities, property, resources, and people; and providing visitors with access to orientation information.

Long Term Goal IIa1. Visitor Satisfaction - 80% of park visitors are satisfied with appropriate park facilities, services, and recreational opportunities

Park facilities and services include: campgrounds, roads, trails, and water systems, and interpretive walks. Park visitor evaluations of park facilities and services are important and useful in improving visitor services. Visitor feedback about the park's facilities, services, recreational opportunities, and programs comes from visitor surveys and other techniques, such as focus groups. Visitors rating the quality of the facilities and services as good and very good are defined as satisfied. This goal improves visitor satisfaction. This goal will be tracked by the Chief Park Ranger and Chief of Maintenance.

Long Term Goal IIa2. Giant Forest Conversion - 99% of the 350 buildings in Giant Forest, as of 1997, are removed and the area converted to day-use.

The long-term goal in the Giant Forest is to remove the majority of buildings and to restore the area to natural conditions. As part of this goal Giant Forest will become a day-use area. This goal tracks the progress of converting Giant Forest to a day-use area. This goal will be tracked by the Chief of Maintenance.

Long Term Goal IIa3. Wuksachi Village - 100% of the new visitor facilities at Wuksachi Village, as of 1997, are in full operation.

Wuksachi Village is a new development that replaces the facilities that were formerly in the Giant Forest. This goal tracks the progress of bringing Wuksachi Village in to full operation. This goal will be tracked by the Chief of Maintenance and Chief Park Ranger.

Long Term Goal IIa4. Visitor Safety - Reduce the visitor accident/incident rate by 10% from the SEKI 5 year (FY 1992 - FY 1996) average.

More than 2 million recreational visits to Sequoia and Kings National Parks occurred in FY 1997. The park's incident rate in 1997 was one incident per (to be determined) visitors, which included (to be determined) injuries and or illnesses and (to be determined) visitor fatalities. The actual number of visitors injured each year is probably higher because many injuries go unreported.

The parks will determine their 5-year average visitor accident rate (accidents per 100,000 visits) as a baseline for the 10% reduction. Analysis of Case Incident Report files identify the primary sources of accidents and where the greatest improvements in visitor safety can be made. This goal improves the safety of park visitors. This goal will be tracked by the Chief Park Ranger.

Long Term Goal IIa5. Accessibility - At least 20% of existing park buildings meet accessibility standards.

Accessibility for special populations refers to their accommodation where appropriate when visiting park and concession-operated facilities in accordance with Uniform Federal Accessibility Standards. This goal ensures that park buildings meet accessibility standards. This goal will be tracked by the Chief of Park Maintenance.

MISSION GOAL IIb: Broad public awareness of the significance of park natural and cultural resources and values, the effect of human activities upon them, and the need for personal commitment to their protection is promoted.

Visitors' experiences grow from enjoying the parks and their resources by understanding why the parks exists and what is significant about the resources. The outcome of satisfactory visitor experiences is public support for preserving the park's resources. Support for the parks also comes through recognition of the parks as a Biosphere Reserve.

Long-term goals related to learning and understanding park and resource purpose and significance are related to this mission goal. These long-term goals include: providing visitors with the opportunity to gain knowledge about the parks; increasing information from interpretive programs; and developing and effective outreach program.

Long Term Goal IIb1. Visitor Understanding and Appreciation - 60% of the park visitors understand and appreciate the significance of the parks.

Visitors' experiences grow from enjoying the park and its resources and having the opportunity to gain knowledge about the parks. Information, orientation, interpretation, and education, are park activities that help visitors discover the most significant meanings to them in the park. Using an annual report, the parks currently assesses the number of visitors participating in interpretive opportunities. A park baseline that will give a stronger indication of the percentage of visitors who actually learn and benefit from visitor services is being developed.

This goal measures the opportunity visitors have in gaining knowledge about the parks. This goal will be tracked by the Chief of Interpretation.

Long Term Goal IIb3. Outreach Programs - The number of individuals reached by the park's outreach program is increased by 50% over the 1997 level.

Outreach programs to schools and other organizations is important for improving public understanding about the parks and their mission and significance. This goal increases the number of individuals contacted in outreach programs. This goal will be tracked by the Chief of Interpretation.

MISSION GOAL III: The parks use current management practices, systems, and technologies to accomplish its mission; works cooperatively with as a part of a greater National Park System organization; and increases its effectiveness with other agencies, organizations, and individuals.

To become more responsive, efficient, and accountable, the parks must integrate its planning, management, accounting, reporting, and other information resource systems. Integrating or interfacing these systems will provide better cross-communication during daily operations and help the parks develop its required Annual Performance Plan in compliance with the Government Performance and Results Act. Improvements in the areas of workforce diversity, employee safety, employee housing, employee safety, employee training, and employee performance standards will help the parks accomplish its mission. Long-term goals pertaining to organizational responsiveness, efficiency, and accountability are related to this mission goal.

The parks also pursues maximum public benefit through contracts, cooperative agreements, contributions, and other alternative approaches to support park operations and partnership programs. Partners include nongovernment organizations, such as friends groups, foundations, cooperating associations; as well as federal, state, and local government organizations.

Long-term goals include developing park management strategies and funding sources through cooperation with other government and nongovernment organizations and private donors; increasing volunteer hours; increasing the return from concession contracts; and increasing the receipts from park entrance fees.

Long Term Goal IIIa2. Employee Performance - 100% of employee performance standards are linked to appropriate strategic and annual performance goals.

Every employee has a required performance plan and is rated annually on the achievement of its critical results. This goal relates employee performance to the organization by directly tying individual performance goals to the parks annual performance goals (outcomes). This goal will be measured annually by supervisors/managers certifying that performance plans are related to the park's long-term and annual performance goals set forth in the Strategic and Annual Performance Plans. This goal will be tracked by each Division Chief.

Long Term Goal IIIa3. Workforce Diversity - Increase by 25% over the 1998 levels the representation of underrepresented groups in each of the targeted occupational series in the park's permanent workforce.

The parks workforce has not reached parity for all Equal Employment Opportunity groups in all occupations and grade levels with their percentage of representation in the civilian labor force for those same or similar occupations. The parks are committed to increasing diversity in its workforce. The parks will recruit and hire women, minorities, and individuals with disabilities in all occupational series and grade levels where they are under represented to achieve consistency with their percentage of representation in the civilian labor force. This goal assures that permanent and term employees' performance agreements and employees' performance standards are linked to the parks' Strategic and Annual Performance Plans. This goal will be tracked by each Division Chief.

Long Term Goal IIIa4. Employee Housing - 35% of employee housing units, classified as being in poor or fair condition in 1997 have been removed, replaced, or upgraded to good condition.

The parks have historically provided employee housing in remote locations or other places where it is advantageous to the parks. While the living conditions have improved more improvement is needed. Based on current inventory information, some 174 of a total of 201 park housing units are in fair condition. None are in poor condition. This goal improves the condition of employee housing within the parks. Housing is provided to better protect park visitors and resources. This goal will be tracked by the Chief of Maintenance.

Long Term Goal IIIa5. Employee Safety - Reduce by 50% from the SEKI 5-year (FY 1992-FY 1996) average, the SEKI employee lost time injury rate.

The employee lost-time injury rate was 8.69 in 1996 and the worker's compensation costs was (to be determined) in 1996. This goal reduces the employee lost-time injury rate (the rate of injuries resulting in employee lost time due to on-the-job injuries/illnesses). This goal will be tracked by the Safety Officer.

Long Term Goal IIIa6. Volunteer Hours - Increase by 25%, over the 1997 level, the number of volunteer hours.

Park volunteers provide diverse kinds of assistance from maintenance, resource management, ranger activities, and interpretation to administration. The parks Volunteers in parks (VIP) program allows the parks to accept and use voluntary help in ways mutually beneficial to the parks and the volunteers. In 1997, 70,000 hours of volunteer time was donated. This goal increases the total number of hours contributed to the parks' volunteer program. This goal will be tracked by the Chief of Interpretation.

Long Term Goal IIIa7. Donations and Grants - Increase by 10% over 1997 levels the dollar amount of donations and grants.

Partnerships with the Sequoia Natural History Association that sell books and other educational materials in parks, friends groups, service organizations, universities, corporations, and individuals benefit the parks. The increased donations will produce increased services and projects in maintenance, interpretation, education, resources management, and research. This goal increases the dollar amount of donations and grants given to the parks. This goal will be tracked by the Chief of Interpretation.

Long Term Goal IIIa9. Fee Receipts - The amount of receipts from park entrance, recreation, and other fees is increased 20% over the 1997 levels.

The parks collects approximately $2,800,000 annually. This goal increases receipts from park entrance and recreation fees. Data collection with tracking and analysis will be conducted by the Chief Park Ranger.

Long Term Goal IIIa10. Work with other Government and Nongovernment Entities - The amount of time park staff works with other parks, public and private cooperators for the greater good is increased 5% over the 1997 level.

Developing partnerships with government and nongovernment entities is essential if the parks are to preserve and protect the resources and provide enjoyment for the visitors. These partnerships include: the Sierra Federal Mangers, Biodiversity Council, Sequoia Natural History Association, Sequoia

Foundation, Regional Advisory Committees, and the Resources Management and Science Task Force. This goal increases the amount of time the park staff works with other parks, and the public and private cooperators. This goal will be tracked by each Division Chief.

Long Term Goal IIIa11. Employee Training and Development - The amount of ONPS dollars spent for employees for training and development is increased by 10% over 1997 levels.

Employee training and development was one of the most important areas identified by park staff in initial strategic planning that needed to be increased. This goal will be tracked by each Division Chief.

Long Term Goal IIIa12. Employee Competencies - 100% of employees within the 16 key occupational groups have essential competency needs identified for their positions.

APPENDIX K: FLORA SPECIES LIST

APPENDIX L: VERTEBRATE SPECIES LIST

APPENDIX M: OPERATIONS FORUMULATION SYSTEM (OFS) SUBMISSIONS FOR NATURAL, CULTURAL, AND WILDERNESS RESOURCES