1999 Annual Fire Report
Research, Inventory, and Monitoring

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Contents

1999 Annual Fire Report - Research, Inventory, and Monitoring: Sequoia and Kings Canyon National Parks

Executive Summary

Sequoia and Kings Canyon National Parks have been a leader in fire research and the implementation of a fire management program emphasizing both prescribed management ignitions and prescribed natural fire (now called *wildland fire used for resource benefit* - WFURB). Objectives of the program were originally centered on the reduction of unnatural fuel accumulations but more recent emphasis has combined fuel reduction with restoration of ecosystem structure and function within ecosystems. Coupled with the fire management program has been an active research, inventory and monitoring program conducting a variety of fire related studies. These studies and their results are important in providing information about short- or long-term resource responses and impacts when burning and whether the planned objectives for the burn program are being met. This information feeds back into management planning and permits modification and fine tuning of the burn program. Additionally, it provides up-to-date information to the public and policy makers.

In past years this annual report summarized research, inventory, and monitoring activities within the East Fork drainage associated with the Mineral King Risk Reduction Project (MKRRP). Beginning in 1999 this and future reports will compile and describe work carried out from throughout the Parks, in addition to work relating to the ongoing MKRRP. Because of the research and monitoring emphasis placed on the MKRRP the majority of the projects described in this report focus on the East Fork. The MKRRP was originally initiated out of a need to assess the operational requirements and cost effectiveness of large scale prescribed burning for wildland management in a setting altered by a century of fire suppression. Because the scale of the project is unprecedented, a number of integrated monitoring and research projects were initiated to assess the impacts and responses of key components of the watershed to prescribed fire. Additional projects have also been initiated to utilize this opportunity to gain additional insights into fire's role in Sierran ecosystems.

Several noteworthy observations or findings were made by the various research and resource studies. Fire effects plots show overstory tree mortality vary by vegetation type: from 24% in red fir forest, to 49% in sequoia mixed-conifer forest (no mortality of overstory sequoias was noted), to 66% in low elevation mixed-conifer forest. Fuel reductions in the fire effects plots varied from 77% in sequoia mixed-conifer forest to 97% in ponderosa pine forest one year postfire. Watershed sampling completed its second full water year of sampling, providing preburn data on trends within the East Fork. Initial results suggest similar annual shifts in flow, pH, and ANC (acid neutralization capacity) when compared to other unburned Sierran watersheds. Fire history sampling indicates there were dramatic differences in the frequency of pre-Euroamerican settlement fire by aspect. Sampling in the East Fork drainage suggests differences were about three times greater in lower elevation conifer forest on south aspects than in comparable vegetation on north aspects. Research looking at fire and vegetation diversity indicates that in both ponderosa pine and mixed conifer forests patches of high fire intensity exhibit increases in species richness. Additionally, these patches are also the most susceptible to invasion by exotics.

The Park's area encompasses 349,676 ha (864,067 ac) with elevations ranging from 485 to 4,392 m (1,600 to 14,495 ft). Vegetation of the area is diverse, varying from foothills chaparral and hardwood forests at lower elevations to alpine vegetation at elevations above about 3,100 m (10-11,000 ft).Burning in the Parks during 1999 amounted to 2,437 ha (6,019.1 ac) with 554 ha (1,369 ac) in the East Fork drainage associated with the MKRRP. Of all park area burned 343 ha (848 ac) were wildland fires and 2,094 ha (5,171.1 ac) were prescribed fire.

1. Project Year Synopsis: Accomplishments for 1999 projects.

- **Fire Effects Plots** - Fuels and vegetation monitoring has been part of Sequoia and Kings Canyon National Parks' fire management program for the last two decades. The fire effects monitoring program is critical to: (1) evaluate the achievement of fire management objectives; (2) detect any unexpected or undesirable changes in vegetation that may be a result of prescribed burning; and (3) provide the above information to fire managers, other park staff, and the public. The plots provide feedback to park managers on whether they are meeting management objectives and help to refine goals of future burn plans. Twenty plot remeasurements and 5 immediate postburn visits were accomplished in 1999. An addition 2 new plots were installed, one in the Lower Deadwood unit and one in the Upper Deadwood unit of the MKRRP. The plot in the Lower Deadwood unit burned out of prescription (rainfall occurred while the plot was still burning) and will be removed. Data analysis showed overstory tree mortality varied by vegetation type: from 24% in red fir forest, to 49% in sequoia mixed-conifer forest (no mortality of overstory sequoias was noted), to 66% in low elevation mixed-conifer forest. Fuel reductions in the fire effects plots varied from 77% in sequoia mixed-conifer forest to 97% in Ponderosa pine forest one year postfire

- **Wildlife Monitoring** - Four permanent small mammal live-trapping plots have been established between 1995 and 1999 with three of these resampled during 1999. Understanding changes in the composition and numbers of common small mammals is important because they represent an important component in the food chain for less-common wildlife species and thus make good indicators of habitat status. Rodent populations respond readily to changes in vegetation structure and composition due to fire, they are easy to handle, and are a cost-effective tool for monitoring fire effects. The plots are located in sequoia/mixed-conifer forest (Atwell), chaparral/oak shrubland (Traugers), in ponderosa pine/black oak transition forest (Camp Conifer), and Jeffery pine (Mineral King). Both the Atwell sequoia-mixed conifer plot, burned in November 1995, and the ponderosa plots, burned in November 1997, have been resampled annually since the burns. Serendipity trapping (non-permanent trap locations) was also carried out at a number of locations in the watershed. Several additional colonies of *Aplodontia* have also been located extending the known range of the species.

- **Watershed Sampling: Stream Chemistry and Hydrology** - Stream chemistry and hydrological information have been collected in both the Middle Fork and East Fork drainages of the Kaweah watershed by the Sequoia and Kings Canyon Field Station - USGS (prior to 1994 work was conducted by the Park's Research Office). Work in the Mineral King drainage includes studies on large woody debris, annual runoff coefficients for the study catchments, and annual volume-weighted mean (VWM) solute concentrations. Analysis of post-fire hydrologic changes observed in the Giant Forest's Tharp's Creek following a 1990 burn show striking differences in runoff between a burned and unburned catchments monitored over a sixteen year period (pre-burn n=7, post-burn n=9). Reference forest stand data document changes in post-fire forest structure and are related to observed changes in post-fire hydrologic responses.

- **Fire History** - Fire history samples have been obtained from most elevation, aspects, and vegetation types within the East Fork from 1995 to 1999. These samples will become part of an effort to reconstruct the spatial scale and pattern of pre-European settlement fire events from throughout the East Fork watershed and to provide baseline data on past fire occurrence in a variety of habitats, vegetation types, and aspects in the drainage. Predictions of past fire occurrence in the Sierra Nevada based on computer models suggest differences in burn patterns/frequencies on different aspects with these differences most notable between south and north slopes. However, until this sampling almost no data existed on pre-European settlement fire history for north aspect forests in the southern Sierra Nevada. Thus information collected in the East Fork will be important in

verifying these models, in addition to providing park staff with better information about fire over the landscape. The current analysis suggests striking differences in fire frequency between conifer forest low elevation south aspects (fire return interval (FRI) of ~9 yr) and similar locations on north aspects (FRI of ~30 yr).

- **Giant Sequoia Fire Scars and Fuel Loading** - A total of 60 giant sequoia trees (30 scarred and 30 unscarred) have been measured in the Atwell Grove to help determine the effects of prescribed burning on fire scar formation and how changes in fire scar dimensions and bark charring relate to the fuel accumulations and consumption of the fuels surrounding trees by prescribed burning. All trees examined within the study area burned during November 1995 and were resampled during 1996 with fuels remeasured during 1997. No sequoia mortality resulted from the fire although small new fire scars were noted on some trees.

- **Fuel Inventory and Monitoring** - The purpose of this study is to improve the parks GIS fuels theme and collect data on forest canopy characteristics that can be used to develop tree height and height to live crown based GIS themes. These will be used in *FARSITE* to model crown fire activity (torching, spotting, and crowning). Since 1995 forty permanent fuel plots have been established within the East Fork drainage with supplemental data gathered from photo series. In addition to estimating fuel loads at each plot, other forest attribute measurements were obtained on tree height, basal area, height to lowest branches, and on litter and duff depths.

- **Red Fir (Pitcher) Plots** - In the late 1970's Donald Pitcher (graduate student at UC Berkeley) established three permanent plots in red fir forest along the Tar Gap Trail near Mineral King to study forest structure and composition (what species are present and how are they arranged in a forest), and fuel dynamics (fuels available for burning). These plots were relocated in 1995 and where resampled prior to the burning of the Tar Gap segment. In 1999 these plots provide long-term data from red fir forest on changes in forest structure and composition, and fuel loads over a 20 year period. Initial preburn estimates indicate a significant increase in fuel loads and 22% mortality of all saplings/trees in the plots (most mortality, 75%, is a result of the death of young seedling and sapling as the forest naturally thins itself over time). Postburn sampling of these plots will also provide detailed information on forest changes and fire effects which have been little studied in this forest type.

- **Landscape Analysis - Fire and Forest Structure** - Kurt Menning's (graduate student at UC Berkeley) research will address questions revolving around the means and the landscape-scale consequences of selecting differing mechanisms for restoring forest structure to something near pre-Euroamerican conditions. Using high resolution aerial imagery and field sampling he will describe the current structure and pattern of mixed conifer forest over the landscape and then how the qualities of these change as fire is restored to the ecosystem.

- **Repeat Photography** - This project attempts to reconstruct historical changes in southern Sierran plant communities over the past 125 years. The general study area for the repeat photographs encompasses foothill and forest plant communities from the Stanislaus River south to the Kern River. Within this large large geographic area three foci have been established in order to better facilitate completion of a useable project in two field seasons. The focus projects center on Kings Canyon – Yosemite Valley comparison, the chaparral-conifer ecotone, and giant Sequoia groves.

- **Diversity and Invasive Plant Species in Sierran Forests** - Disturbances that create a disequilibrium in distribution of resources may alter species composition through shifts in resource availability, which in turn may create conditions favoring invasion of non-native species and deletions of native species. Two important disturbance factors in the Western U.S. are grazing and fire. Both have been linked to plant invasions. Within the Parks this research program has concentrated on the role of fire in both ponderosa pine and mixed coniferous forests. At the sites sampled in these vegetation types species richness is not immediately altered by fire but within the first three

years, high fire-intensity patches exhibit highly significant increases in species richness. Concomitantly, these patches are also the ones most susceptible to invasion by non-native plant species.

- **Landscape Scale Fuels Management Planning for the southern Sierra** - This project focuses on developing and testing an approach to incorporate wildland fuels information management into an interagency, landscape-scale planning over 4.7 million acres in the southern Sierra. A spatial and attribute information system is being created for coordinated fuels management planning within an integrated Geographic Information System (GIS) framework. The primary goals are to reduce fiscal costs to government agencies and the public and to improve attainment of ecological and hazard reduction goals. The project focuses on utilizing geographic information and related technologies to overcome institutional and organizational barriers to interagency fuels management within large diverse ecosystems. Common geographic data is being developed including comprehensive planning maps and analyses that prioritize areas for treatment based on value, hazard, and risk criteria. This framework will develop and test procedures to manage and update complex spatial information and to institutionalize the coordinated planning efforts.

- **Vegetation Mapping** - 1999 marked the beginning of a multi-year initiative to classify and map the terrestrial vegetation of Sequoia and Kings Canyon National Parks. The need for a comprehensive, accurate vegetation map for resource planning, management and research has long been recognized by SEKI managers and cooperators. This is especially true for the fire management program, which relies on accurate vegetation mapping to drive predictive fuels models. The goal is to develop a highly accurate vegetation map that meets scientific Federal Geographic Data Committee (FGDC) standards, is based on a hierarchical classification scheme consistent with the National Vegetation Classification, and has a level of detail that is useful to park managers and cooperators. Initial funding for project has been provided by FirePro because of the importance of an accurate vegetation and fuels map in fire management planning and operations.

- **Cheatgrass** - Two reports are included on exotic annual cheatgrass. During the late summer of 1998, NPS resource managers became concerned about the apparent spread of cheatgrass (*Bromus tectorum* L.) following prescribed burning in the Cedar Grove area of Kings Canyon National Park. Prescribed burns were suspended until information could be gathered on the potential of this highly invasive species to spread in response to fire-related disturbance. In the fall of 1998, preliminary surveys were conducted to assess the distribution and abundance of cheatgrass on the valley floor. In the winter of 1999 a literature search was contracted and a recommendations report for the Parks was prepared compiling information from the literature, field survey data, and results from several other types of sampling carried out in Cedar Grove. In the early summer of 1999 a preliminary study looking at spring burning in cheatgrass was conducted in Cedar Grove. The study addressed two questions regarding cheatgrass abundance in the westside ponderosa pine community. First, whether burning cheatgrass that has cured just prior to seed drop significantly reduces the seed bank (and thus cheatgrass abundance) during the following year. And second, whether such early season burning has a negative effect on native perennial grasses. Results from resampling in the spring of 2000 suggest little impact from the burning on cheatgrass with negative impacts on the native perennials.

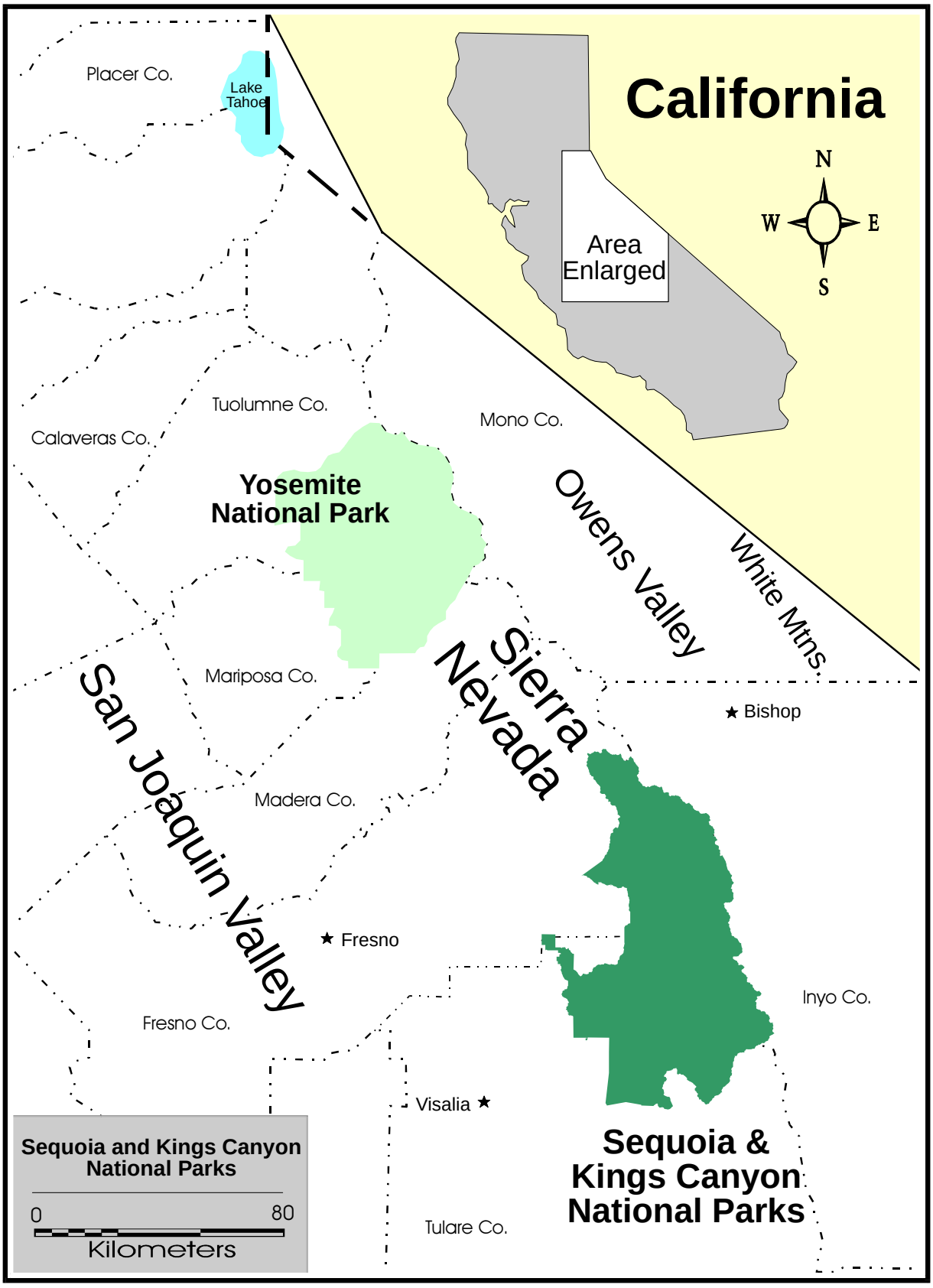

Figure 1-1. Location of Sequoia and Kings Canyon National Parks in the southern Sierra Nevada of california.

2. Park Burn Program

2.1 - Objectives

Overall Park Burn Program Objectives - The fire management policy of the National Park Service supports the overall resource management goal, which is to restore or maintain natural ecosystems. Fire management also provides for protection of public safety, cultural and natural resources, and developments from wildfire. Fire management operations include WFURB (formerly known as "prescribed natural fire"), prescribed burning, suppression, presuppression, and prevention activities (from 1991 revision Sequoia and Kings Canyon NP Fire Management Plan).

Fire is one of the most important processes affecting the ecosystems of these Parks, and its presence in past centuries in western forests is well established (Agee, 1973). Surface fires are thought to have been a common occurrence in the mixed-conifer region of California. These generally low intensity fires kept the forests open (Biswell 1961; Weaver 1967, 1974; Hartesveldt and Harvey 1967; Kilgore 1971, 1972).

Natural fire played a variety of roles that included: (1) seed bed preparation, (2) recycling of nutrients, (3) affecting plant succession, (4) providing a mosaic of age classes and vegetation types, (5) modification of wildlife habitat, (6) reduction of numbers of trees susceptible to attack by insects and diseases, and (7) reduction of fire hazard (Kilgore 1973).

Since the arrival of Europeans to the Southern Sierra in about 1858, vegetation has been influenced by such activities as logging, grazing, and fire suppression (Kilgore and Sando 1975; Kilgore and Taylor 1979; Parsons and DeBenedetti 1979; and Vankat 1970).

Concern over this resource exploitation led to the establishment of Sequoia and General Grant National Parks in 1890, to protect the natural resources but also to preserve their wilderness character and their vegetation, with emphasis on the giant sequoia forest. With establishment of these Parks came protection from all types of fire, including that of natural origin.

After some 50 to 80 years of fire exclusion, an understory buildup of fuel and young shade tolerant trees has occurred, threatening the giant sequoia with unnaturally intense wildfire (Bonnicksen and Stone 1978; Kilgore and Sando 1975). The changes in forest conditions were noted by the Advisory Board on Wildlife Management in the National Parks (Leopold et al. 1963), which stated:

"Today much of the west slope is a dog-hair thicket of young pines, white fir, incense cedar, and mature brush - a direct function of overprotection from natural ground fires. Within the four National Parks - Lassen, Yosemite, Sequoia and Kings Canyon - the thickets are even more impenetrable than elsewhere. Is it possible that the primitive open forest could be restored, at least on a local scale?"

In 1968, the Park Service changed its policy from fire control to fire management. Sequoia and Kings Canyon National Parks began a prescribed natural fire management program in 1968 and a prescribed burning program in 1969.

Within the framework of the National Park Service fire management policy, the overall goals of the fire management program at Sequoia and Kings Canyon National Parks are:

• protect public safety, cultural and natural resources, and developments from wildfire, through the use of prescribed burning around developments, as well as prevention, presuppression, and suppression activities, and

• restore or maintain the natural fire regime to the maximum extent possible so that natural ecosystems can operate essentially unimpaired by human interference. This will be done with prescribed natural fire and with prescribed burning, as well as through the suppression of wildfires.

“Fire regime" is defined as the interaction of fire and biotic and physical elements of the environment. It includes the timing, spatial distribution, size, duration, behavior, return interval, and effects of natural fires. It is not a goal to return to some historic point in time, but rather to allow natural fire to operate as a process as fully as possible without causing unnatural effects.

The goals will be accomplished through the following objectives:

A. Wildfire Suppression
• Protect human health, safety, and developments during all phases of the fire management program.
• Suppress all wildfires and minimize detrimental impacts on natural resources from wildfires.
• Maintain an active fire prevention program to reduce the incidence and threat of wildfire.

B. Prescribed Fire Management
• Allow prescribed natural fires to burn, provided they will achieve natural resource management goals and fire management objectives.
• Expand the prescribed burning program to all ecosystems that have been significantly affected by historic fire suppression, especially into lower mixed conifer forest and giant sequoia groves.
• Use prescribed fire to remove unacceptably high fuel loading, where natural ecosystems have been altered by human interference. Fuel surveys and hazard assessments will determine priorities for this activity.
• Use prescribed fire to reduce hazardous fuels around developed areas.

C. Research and Monitoring
• Monitor and evaluate the effects of fire management on park ecosystems to further refine objectives.
• Conduct research necessary to determine natural fire regimes, fire effects, lightning strike frequency, input for fire spread models, and other studies as necessary to more effectively implement the fire management program.

D. Special Management Areas
• Balance natural process restoration in giant sequoia Special Management Areas with the need to preserve the prime scenic value and vistas.

E. Interpretation
• Provide interpretive and educational programs designed to enhance public and staff understanding and awareness of the fire management program.

F. Public Involvement
• Provide periodic public review of the fire management program as needed as part of an on-going refinement process of the program.

• Provide current information on wildfire and prescribed fire activity to the public, neighboring agencies, and to the park staff.

G. Cultural Resources and Threatened and Endangered Species
• Mitigate or minimize impacts to archaeological and historic resources, and to threatened and endangered species unless cleared in advance by the proper authorities.

H. Air Quality
• Mitigate and prevent unacceptable impacts of the prescribed fire program on public health and visibility.
• Manage smoke from prescribed fire in accordance with Federal, State, and local regulations

Mineral King Risk Reduction Project - The direct objectives of the Mineral King Risk Reduction Project (MKRRP) for Sequoia and Kings Canyon National Parks (SEKI) focus on reducing unnatural fuel accumulations that have resulted from a century of both direct and indirect fire suppression activities in southern Sierran ecosystems (NPS 1995, Stephenson 1995). In many instances these fuel accumulations create hazardous conditions for visitors, developments, and natural resources. The overall objectives of the project are to assess the operational requirements and cost effectiveness of large scale prescribed burning for wildland management (NPS 1995). The latter evaluation will be accomplished through the use of information derived from the field operations and their outcome within SEKI.

The conditions resulting from unnatural fuel accumulations have resulted in wildland managers being called upon to modify fuels in order to reduce wildland fire hazard and restore ecosystems to some semblance of pre-Euroamerican conditions. Current national management issues are forcing land managers to use two main tools for fuels management: mechanical removal (cutting) and/or prescribed burning. However, both of these tools remain controversial and managers are being asked to justify their choices. These issues motivated a major effort by the National Interagency Fire Center (NIFC) to begin an assessment of the operational requirements and cost effectiveness of using large-scale prescribed burning as a tool in fuels management. As part of this effort NIFC funded Sequoia and Kings Canyon National Parks to carry out a watershed-scale burn program with an objective of prescribed burning about 12,000 ha (30,000 acres) over a five year period (1995-2000) in the East Fork of the Kaweah River (**Fig. 2.1-1**). A collateral objective of the burn project is to evaluate the cost effectiveness of a hazard fuel reduction program of this magnitude by Colorado State University.

Since the scale of the burn project is unprecedented a number of integrated resource related studies are being undertaken and are an integral part of the project. These research, inventory, and monitoring projects in the Mineral King burn are designed to meet the following objectives (Stephenson 1995) :

> ***To supply the information needed to practice adaptive management*** *(1) by determining whether the burn program's objectives are being met, (2) by identifying unexpected consequences of the program on the ecosystem, and (3) if objectives are not being met, by suggesting appropriate program changes.*
>
> ***To provide information for public education, response to public and governmental inquiries, and to document legal compliance.***

These research and monitoring objectives are particularly important because SEKI's watershed scale burn program will be one of the first national attempts at using fire on a watershed scale for fuels management. The various research and monitoring studies are being integrated with the project's management objectives. Support for new studies that compliment or enhance the currently implemented studies are being sought (for example, proposals for funding for a watershed sediment transport study are being developed by the Biological Resource Division of the USGS). Additionally, unsolicited studies by non-MKRRP funded researchers (primarily from universities) are also integrated with the overall project goals to the greatest degree possible consistent with the study objectives. Descriptions of studies and the East Fork are available in the 1995, 1996 and 1997 MKRRP Annual Reports (Caprio 1996, 1997, 1998).

2.2 - Project Area Descriptions

Park Project Area - Sequoia and Kings Canyon National Parks are located in the south central Sierra Nevada (**Fig. 1-1**) and encompass some 349,676 ha (864,067 ac) extending from the Sierra crest to the western foothills on the eastern edge of the San Joaquin Valley (**Fig. 2.2-1**). Topographically, the area is rugged, with elevations ranging from 485 to 4,392 m (1,600 to 14,495 ft). The Parks are drained by the Kern, Kaweah, Kings and San Joaquin Rivers. The elevation gradient from the foothills to the higher peaks is steep on both the east and west margins of the Sierra, with rapid transitions between vegetation communities. Three broad vegetation zones dominate the Parks (slightly over 200,000 ha are vegetated by forest, shrub or grassland communities)– foothills (485 to 1,515 m) composed of annual grasslands, oak and evergreen woodlands and chaparral shrubland, conifer forest (1,515 to 3,030 m) with ponderosa (Pinus ponderosa Dougl.), lodgepole (P. contorta Dougl. var Murrayana Englm.), giant sequoia (Sequoiadendron giganteum [Lindl.] Buchholz), white fir (Abies concolor Lindl. & Gord.) and red fir (A. magnifica Murr.) forests, and high country (3,030 to 4,392 m) composed of subalpine forests with foxtail pine (P. balfouriana Jeff.), white-bark pine (P. albicaulis Englm.), alpine vegetation and unvegetated landscapes. A variety of classification schemes have been defined for vegetation within the Parks (Rundel and others 1977; Stephenson 1988; Vankat 1982).

The climate is Mediterranean, with cool, moist winters and warm summers with rainfall limited to sporadic summer thunderstorms associated with monsoonal flow from the Southwest. Precipitation increases as elevation increases, to about 102 cm (40 in) annually, from 1,515 to 2,424 m on the west slope of the Sierra, decreasing as one moves higher and to the east (Stephenson 1988). Substantial snow accumulations are common above 1,515 m during the winter. Total annual precipitation during the period of record has varied from 30 to 130 cm at Ash Mountain in the foothills and from 38 to 214 cm in Giant Forest at a mid-elevation location.

European settlement of the area began in the 1860s with extensive grazing, minor logging and mineral exploration. Sequoia National Park and Grant National Parks (now part of Kings Canyon National Park) were founded in 1890 with the intent of protecting sequoia groves from logging. Over time, significant new areas have been added to the Parks, including the Kern Drainage (1926), while much of the upper portion of the upper Kings drainage was set aside as Kings Canyon National Park (1940 and 1965) (Dilsaver and Tweed 1990 ; Farquhar 1965).

East Fork Project Area - The East Fork watershed (**Fig. 2.2-2**) which encompasses the MKRRP is one of five major drainages comprising the Kaweah River watershed which flow west (historically but is now heavily diverted for agriculture) into the Tulare Lake Basin in the southern Central

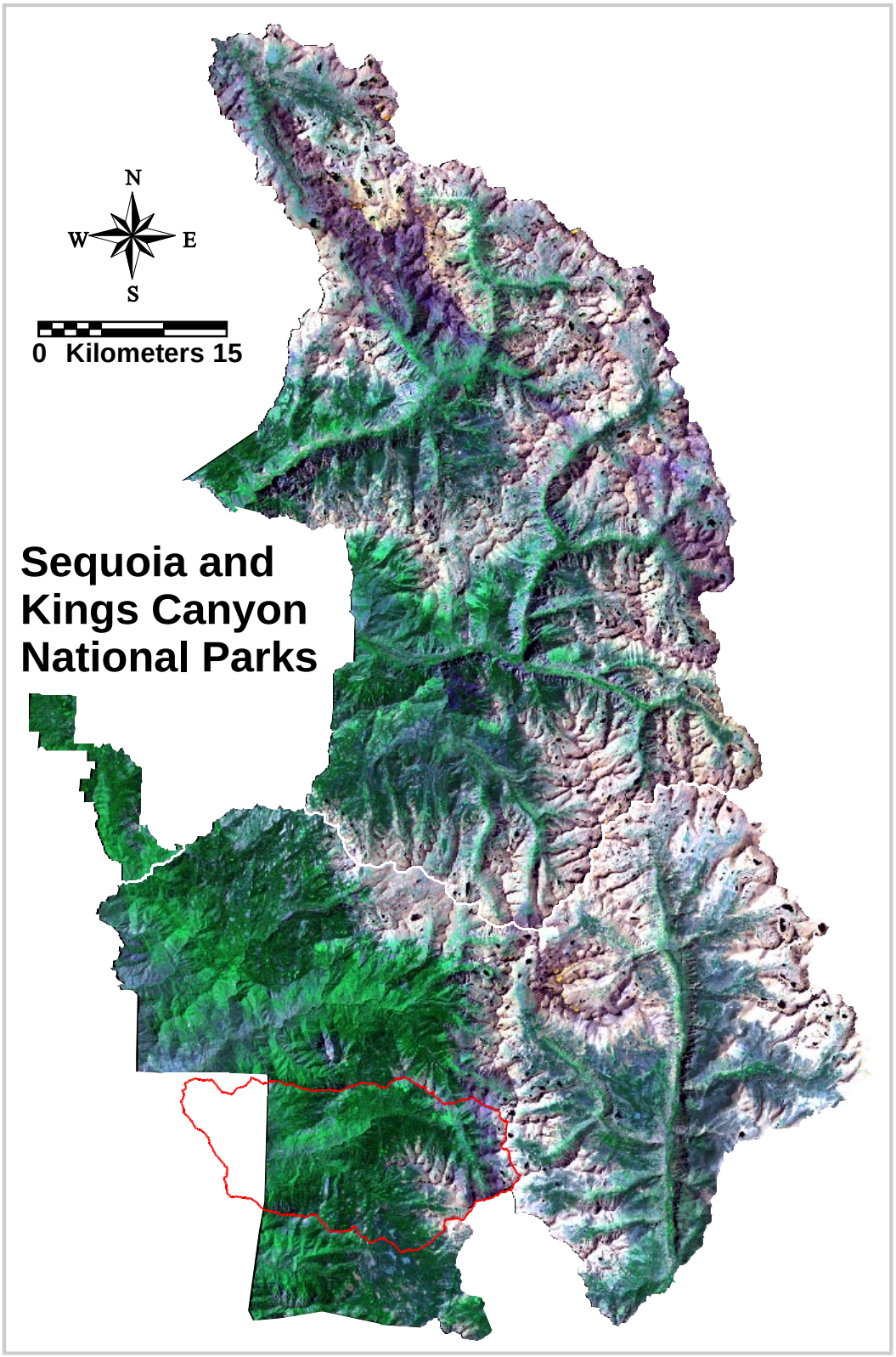

Figure 2.1-1. TM scene of Sequoia and Kings Canyon National Parks. Green areas are vegetated areas of the landscape. The East Fork drainage, where the Mineral King Risk Reduction Project is located, is outlined in red on the lower portion of the map.

Valley. Terrain in the watershed is rugged, elevations range from 874 m (2,884 ft) to 3,767 m (12,432 ft) within the project area. The watershed, 21,202 ha (52,369 ac) in size, is bounded by Paradise Ridge to the north, the Great Western Divide to the east, and Salt Creek Ridge to the south. Major topographic features of the watershed include the high elevation Mineral King Valley, Hockett Plateau, Horse Creek, the high peaks producing the Great Western Divide, and the Oriole Lake subdrainage (with an unusually low elevation lake for the Sierras at 1,700 m elevation).

Table 2.2-1. Segment number, size (approximate - revised 1999) and percent of area vegetated .

Segment	Hectares	(Acres)	% Veg.
Oriole Lake (#1)	2,352	(5,811)	94.4
Lookout Point (#2)	439	(1,084)	91.0
Atwell Grove (#3)	962	(2,377)	96.8
Redwood (#4)	289	(716)	98.5
Deadwood (#5)	121	(300)	100.0
Silver City (#6)	135	(335)	100.0
Purple Haze (#7)	989	(2,445)	93.7
High Bridge (#8)	121	(299)	96.9
Empire (#9)	2,917	(7,210)	34.1
Tar Gap (#10)	6,577	(16,252)	90.9
Eden Grove (#11)	5,325	(13,153)	94.3

Eleven burn segments have been outlined within the watershed by fire management staff (**Table 2.2-1** and **Fig. 2.1-1**). Eight segments were designated on the south facing slope (north side of the East Fork) and three large segments on the more remote north slope (south side of the East Fork). Segment locations were established to facilitate prescribed burning operations and protection of primary developments within the watershed.

Vegetation of the area is diverse, varying from foothills chaparral and hardwood forest at lower elevations to alpine vegetation at elevations above 10-11,000 feet (**Fig. 2.2-3** and **Fig. 2.2-4**). About 80% of the watershed is vegetated with most of the remainder rock outcrops located on steep slopes and at high elevations. Lower elevation grasslands and oak woodland, while common at low elevations in the Kaweah drainage, are uncommon within the park's portion of the East Fork watershed. Sequoia groves within the project area include Atwell, East Fork, Eden, Oriole Lake, Squirrel Creek, New Oriole Lake, Redwood Creek, Coffeepot Canyon, Cahoon Creek, and Horse Creek. Vegetation is dominated by red and white fir forest with pine and foothill types of somewhat lesser importance (**Table 2.2-2**). No endangered species are known from the watershed although several sensitive species have been located during surveys (Norris and Brennan 1982).

Vegetation Class	Hectares	(Acres)
Foothills Chaparral	1,119	(2,764)
Foothills Hardwoods &	1,432	(3,536)
Ponderosa Pine Mixed Conifer	1,919	(4,741)
White Fir Forest	3433	(8,479)
Red Fir Forest	4,042	(9,983)
Xeric Conifer Forest	1,342	(3,315)
Montane Chaparral	473	(1,167)
Mid-Elevation Hardwood Forest	170	(420)
Lodgepole Pine Forest	935	(2,310)
Subalpine Forest	96	(237)
Meadow	130	(320)
Giant Sequoia	994	(2,454)
Other (primarily water)	97	(241)
Barren Rock	4,092	(10,109)
Missing or No Data	130	(320)

Table 2.2-2. Updated vegetation type classification for the East Fork watershed and the area occupied by each class.

Access to the area by road is limited to the narrow winding Mineral King Road, 25 miles long. The Mineral King Valley is popular with backpackers and packers as a starting point for many high country trips. Higher elevations of the watershed receive considerable

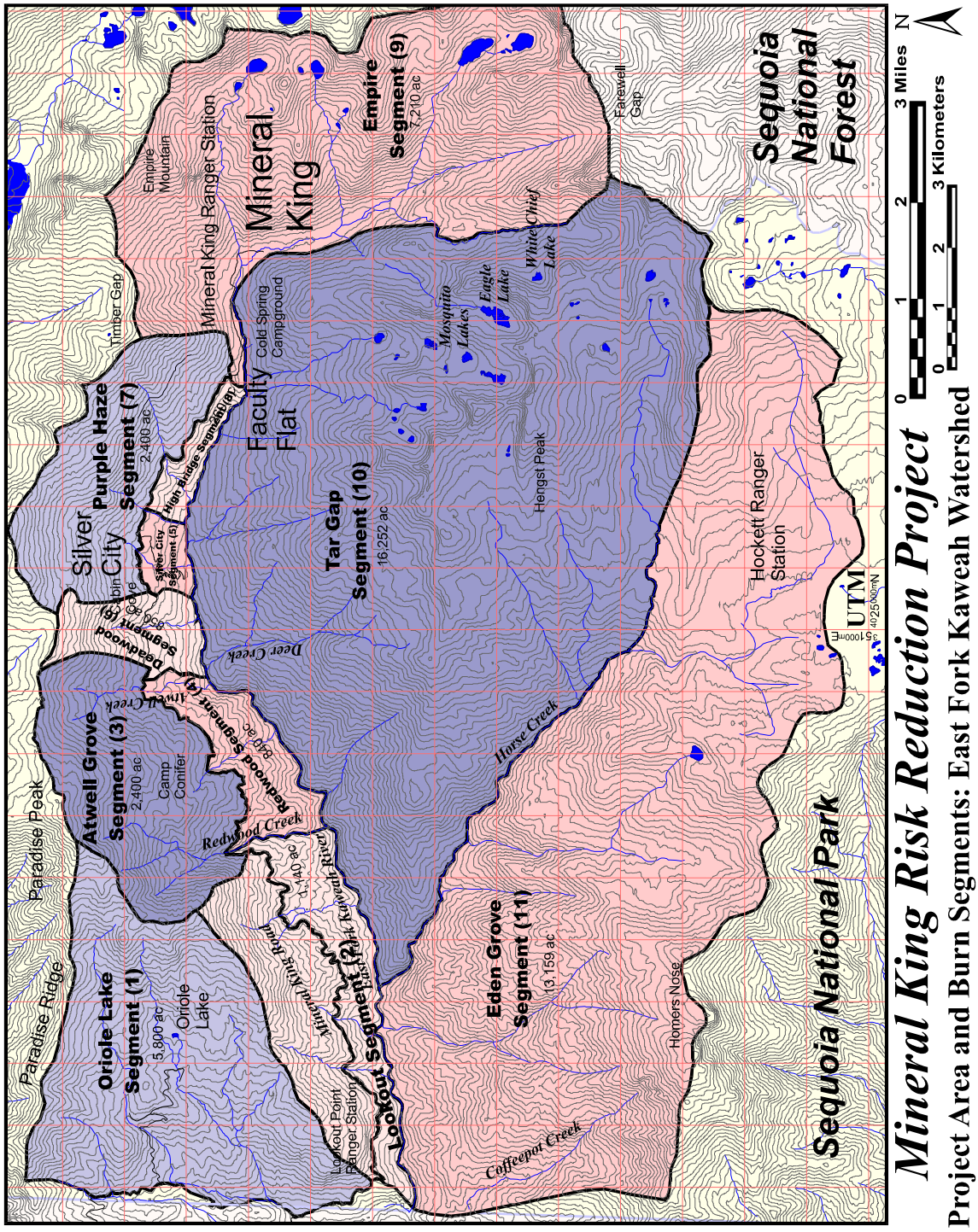

Figure 2.2-2. Mineral King Risk Reduction Project project area and segment boundaries. Not all area within the segments is burnable vegetation. Approximately 20% of the watershed within the Parks is barren rock.

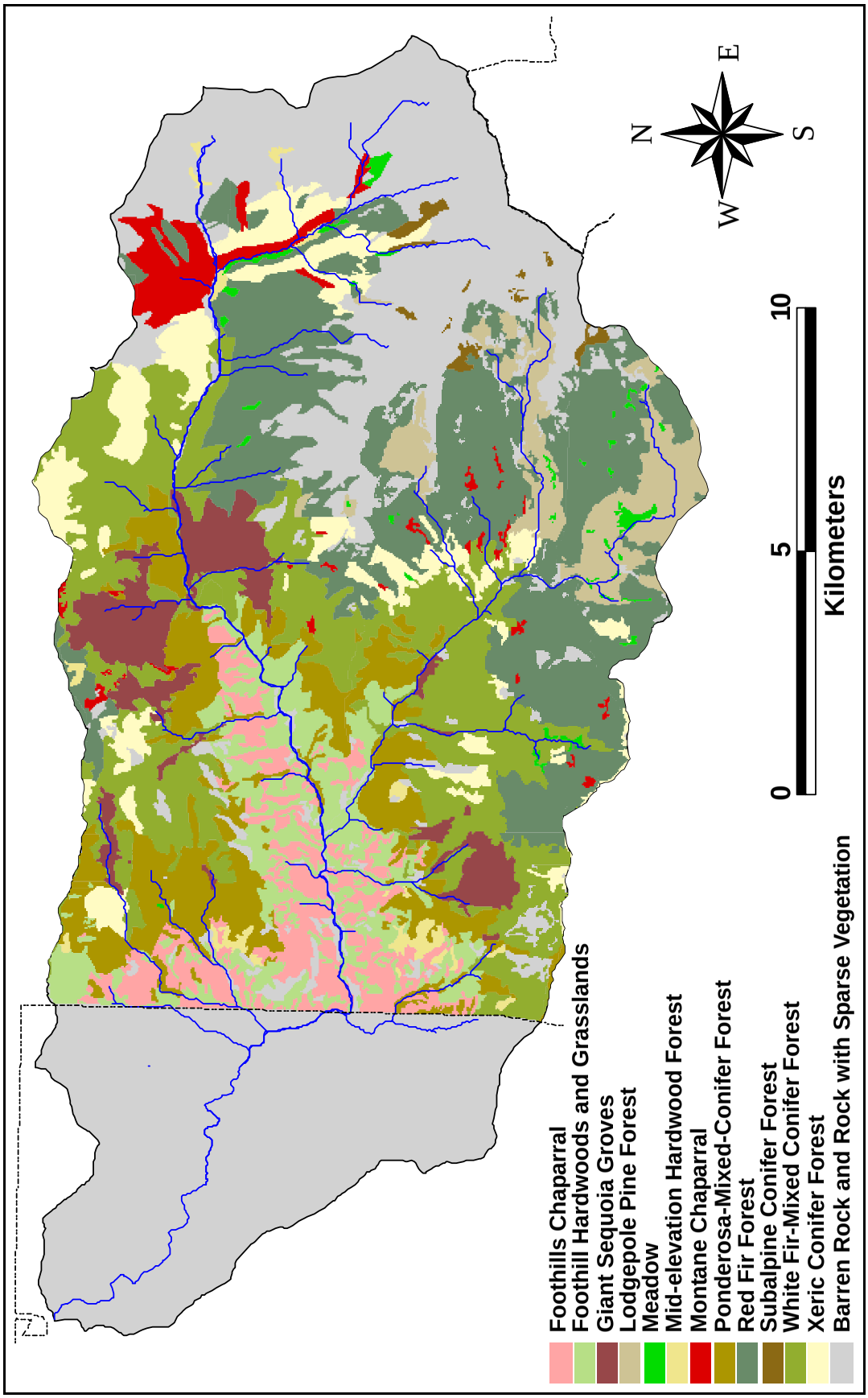

Figure 2.2-3. Major vegetation classes within the Park in the East Fork drainage

recreation use while lower elevations receive relatively little use. Developed or semi-developed areas within the watershed include Silver City, Oriole Lake (private lands), Cabin Cove, Mineral King, Faculty Flat (lease cabin sites), Lookout Point, and the Atwell Mill areas (administrative sites). NPS campgrounds exist at Atwell Mill and Mineral King.

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Figure 2.2-4 Main drainage of the East Fork of the Kaweah from Case Mountain. Photo does not show the Oriole Lake subdrainge (left of view). Photo by Linda Mutch.