2000 Annual Fire Report
Research, Inventory, and Monitoring

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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.

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 2000 amounted to 33.2 ha (81.9 ac). Area burned during 2000 was limited by the burn moratorium decreed by the Secretary of the Interior following the Cerro Grande fire (originally ignited as a prescribed burn) in the Jemez Mountains of New Mexico which escaped control in Bandelier National Park and burned a large number of homes in the nearby community of Los Alamos.

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 the reports began to compile and describe work carried out from throughout the Parks, in addition to work relating to the ongoing MKRRP. During 2000 there were 14 ongoing projects related to fire underway within the Parks and several major new projects in the initiation stage.

1. Project Year Synopsis: Accomplishments for 2000 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

! **Fire History** - Fire history sampling during 2000 concentrated on collecting sites on north and south aspects in the Marble Fork of the Kaweah River and Cedar Grove area of Kings Canyon. The purpose of the sampling was to verify whether or not differences in fire regime as were found by aspect in the East Fork occurred. In the East Fork fire history samples have been obtained from most elevation, aspects, and vegetation types within the East Fork from 1995 to 1999. These samples are part of an effort to the 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).

! **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 Tar Gap prescribed Burn. They will provide long-term data 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 (fuels and tree mortality) of the two burned plots (#1 and #2) was largely completed in 2000.

- **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** - 2000 marked the second year 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.

- **Wildlife Monitoring** - Four permanent small mammal live-trapping plots have been established between 1995 and 2000 and all were 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. Over the last five year additional colonies of *Aplodontia*–a species originally of special concern within the parks–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 Middle Fork was discontinued during 2000 and analysis of the many years of sampling is being initiated. Work in the East Fork is continuing and being carried out by Andi Heard (graduate student) and John Stednick at Colorado State University. Analysis of post-fire hydrologic changes observed in the Giant Forest's Tharp's Creek–in the Middle Fork–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. Past work in the East Fork drainage includes studies on large woody debris, annual runoff coefficients for the study catchments, and annual volume-weighted mean (VWM) solute concentrations.

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

2.2 - Park Area Description

Sequoia and Kings Canyon National Parks are located in the south central Sierra Nevada (**Fig. 2.2-1**) 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. 2.2-2**). 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).

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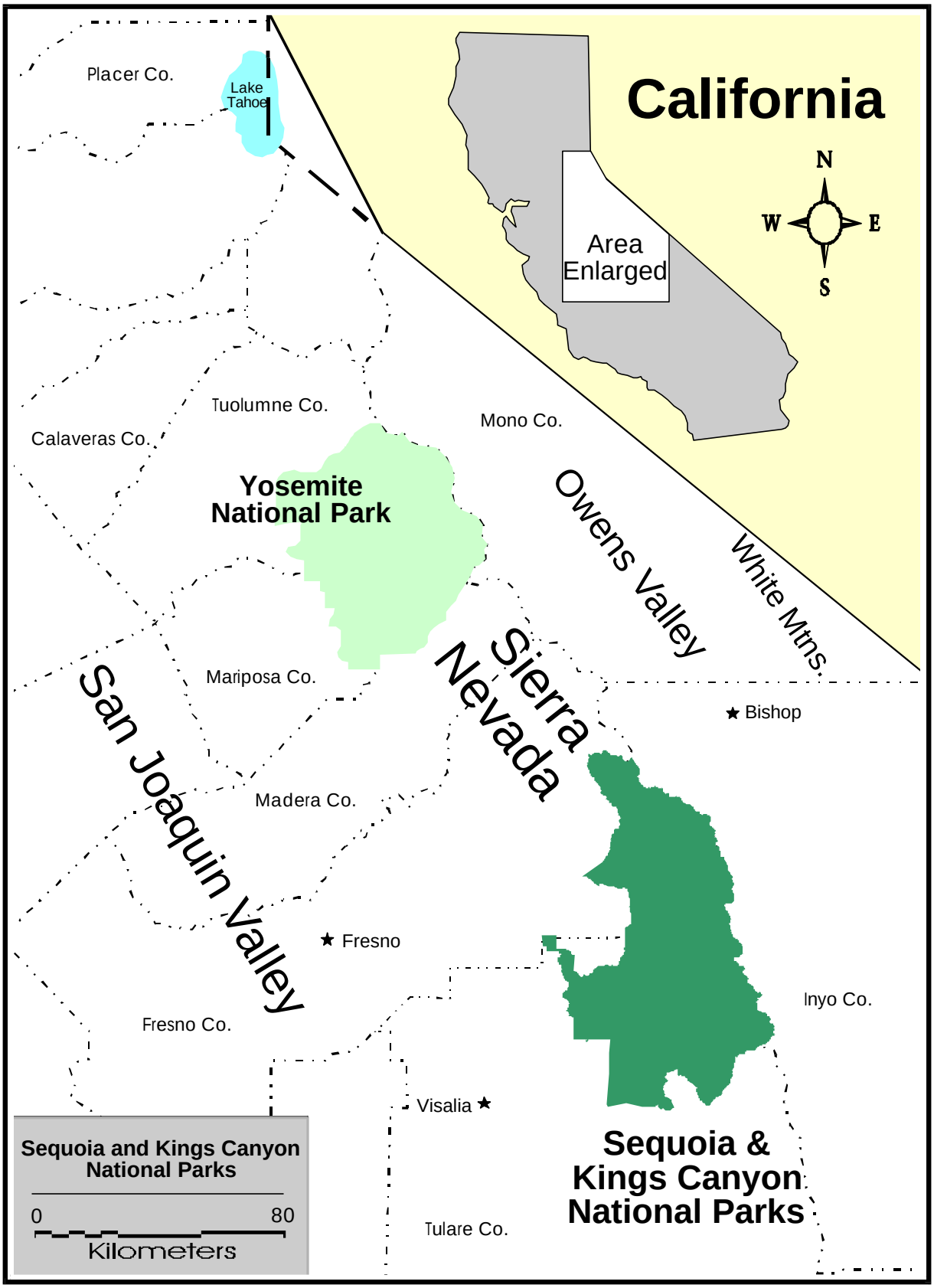

Figure 2.2-1. Location of Sequoia and Kings Canyon National Parks in the southern Sierra Nevada of california.

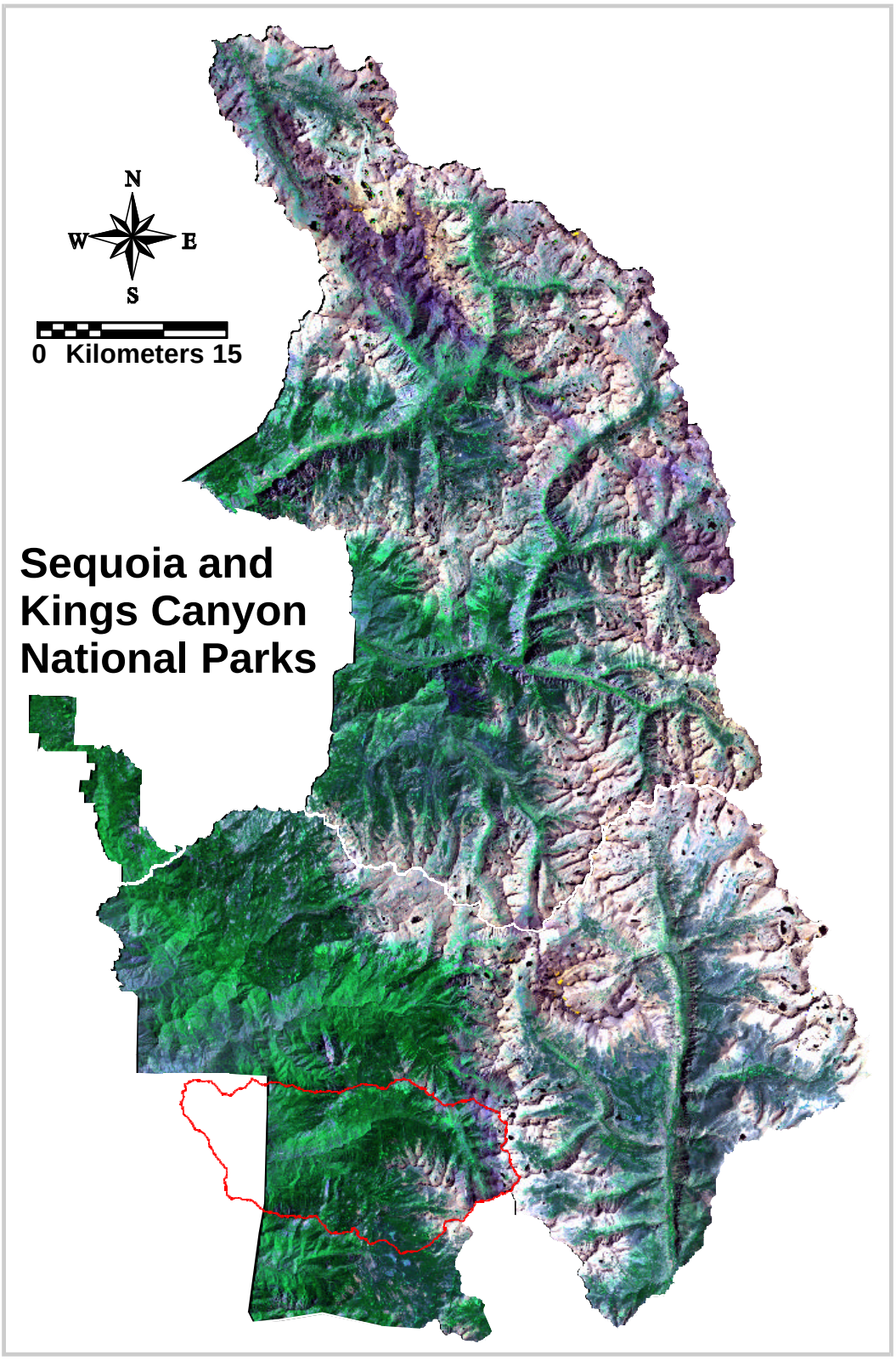

Figure 2.2-1. TM scene of Sequoia and Kings Canyon National Parks. Green areas are vegetated areas of the landscape. The East Fork drainage, where the Mineral King Risk Reduction Project is located, is outlined in red on the lower portion of the map.

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