Annual Report 1996

Research, Inventory, and Monitoring

Mineral King Risk Reduction Project

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1996 Annual Report - Research, Inventory, and Monitoring: Mineral King Risk Reduction Project

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Executive Summary

The Mineral King Risk Reduction Project (MKRRP) was 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. The local objectives of the project are to initiate the reduction of unnatural fuel accumulations (these accumulations can create hazardous conditions for visitors, developments, and natural resources) and begin restoration of ecosystem structure and function within the East Fork drainage of Sequoia and Kings Canyon National Parks. However, because the scale of the project is unprecedented, a number of integrated monitoring and research projects were also 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. These projects and their results are important in providing information about short- or long-term resource responses and impacts when burning at this scale, a relatively new management strategy, and whether the planned objectives for the MKRRP are being met. This information will feed back into management planning and permit modification and fine tuning of the burn program in addition to providing information to the public and policy makers.

Support for the monitoring and research projects is coming from a variety of sources. Projects funded directly out of the Mineral King Risk Reduction Project include fire effects monitoring, fuel and wildlife inventories, and a study on the relationship between fuel loads and fire impacts on giant sequoia fire scars. Other projects are using resources from within and the Sequoia and Kings Canyon Field Station (Biological Resources Division of the USGS). These include natural resource inventory, watershed hydrology, stream chemistry, resampling old vegetation plots, and fire history. Cooperative research projects are also underway using the dedication, energy, and support of graduate students from several universities (University of California, Davis; University of California, Berkeley [partially funded by the MKRRP and the Biological Resources Division of the USGS]; and the University of Virginia). New research projects being initiated during 1997 include a fire effects/remote sensing study of red fir forest (UC Berkeley) and a watershed sediment transport study (USGS).

Several noteworthy observations or findings were made by the monitoring/research projects during 1995/1996. The small mammal trapping project found that small mammal populations roughly doubled in the burned sequoia plot compared to preburn population densities. Fire effects plots showed overstory tree mortality varied by vegetation type: 0% red fir forest, 35% sequoia forest (no mortality of overstory sequoias was noted), and 82% in ponderosa pine forest. These plots also showed total fuel reductions of 67% (ponderosa pine forest) to 94% (red fir forest). A significant increase in giant sequoia seedlings was noted in the burned Atwell sequoia plots. Watershed sampling completed its first 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 Sierran watersheds.

No burning was carried out in the watershed in 1996 (2,100 ac were burned during 1995) due to the severity of the fire season (over 11,000 ac were burned in Sequoia and Kings Canyon National Parks and six millions acres in the western United states during 1996) and the scarcity of resources for carrying out the burning at this scale. Burn plans for 1996 will carry over into 1997.

The MKRRP area encompasses 21,202 ha (52,369 ac) within the East Fork watershed with elevations ranging from 874 m (2,884 ft) to 3,767 m (12,432 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). About 80% of the watershed is vegetated with most of the remainder being rock outcrops located on steep slopes and at high elevations

I) Project Year Synopsis

Accomplishments for 1996 projects.

- **Fire Effects Plots** - Fire effects plots are being established within the Mineral King Risk Reduction Project (MKRRP) area to allow park staff to monitor both the short- and long-term effects of the management ignited prescribed burns on park vegetation and fuels (primary emphasis is placed on fuel loads and tree density). These plots provide important feedback to park managers on how well they are meeting their management goals and will help refine the goals of future burn plans. A total of 16 fire effects plots have been set up in the East Fork since 1995. These include seven forest plots (five in segment #3, one in segment #10, and a control plot adjacent to segment #3) and nine brush plots (located on the north side of the East Fork). Five forest plots burned following the ignition of segment #3 during the fall of 1995 with postburn rechecks completed during 1996. The rechecks showed overstory tree mortality varied by vegetation type: 0% red fir forest, 35% sequoia-mixed conifer forest (no mortality of overstory sequoias was noted), and 82% in ponderosa pine forest. Total fuel reductions of 67% were found in ponderosa pine forest, 89% in sequoia-mixed conifer forest, and 94% in red fir forest. Additionally, giant sequoia seedlings increased from no seedlings preburn to 88,300 seedlings • ha^{-1} postburned in the Atwell sequoia plots.

- **Natural Resource Inventory** - The Natural Resource Inventory (NRI) staff of the Biological Resources Division of the USGS (formerly NBS) have been establishing permanent inventory plots within the drainage. The general purpose of the NRI plots is to provide a systematic, plot-based inventory for detecting and describing the distribution of vascular plants, vertebrate animals, and soils throughout the Sequoia and Kings Canyon National Parks. Within the East Fork, the plots document the preburn floristic composition and structure of vegetation. Since 1995, 18 plots have been established as part of the MKRRP. These supplement 32 plots that already existed in the watershed. Plots that burned during 1995 have been revisited during 1996 (seven of nine were relocated) to assess burn impacts and first year postburn vegetation responses. An effort was made to also sample locations falling within the little known, dense chaparral vegetation of the East Fork.

- **Wildlife Monitoring** - Three permanent small mammal live-trapping plots have been established and sampled during 1995 and 1996. 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), and in ponderosa pine/black oak transition forest (Camp Conifer). The mid-elevation sequoia plot, located in segment #3, burned during November 1995 and was resampled in 1996. Initial results indicate a doubling of small mammal biomass in the one year since the burn. Serendipity trapping (non-permanent trap locations) was also carried out at a number of locations in the Mineral King Valley and Oriole Lake watershed.

- **Watershed Sampling: Stream Chemistry and Hydrology** - Stream chemistry and hydrological information have been sampled by staff of the Biological Resource Division of the USGS at regular intervals (weekly) since May 1995. Three sites are being sampled in the East Fork (the East Fork itself and two tributary creeks, one in chaparral and one in mixed-conifer forest) which will provide data to help assess the effects of watershed scale prescribed fire on important chemical components and flow characteristics. Data will be compared to the "reference" unburned Log Creek watershed in Giant Forest, sampled as part of another long-term watershed study. Watershed sampling completed its first 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 Sierran watersheds.

! **Watershed Sampling: Benthic Macro-Invertebrate Survey** - Ian Chan (graduate student at UC Davis) is conducting a pre- and postburn survey of benthic macro-invertebrates in the East Fork. This study will assess the effects of prescribed fire on the structure of aquatic macro-invertebrate communities and provide baseline inventory of composition, abundance, and diversity. Six treatment streams (situated in areas that will be burned) and four non-treatment reference streams (which will remain unburned) have been located and sampled in the Middle Fork watershed. Benthic macro-invertebrates are collected through a combination of quantitative sampling and qualitative description in three habitat types: riffles, pools, and slickrock glides. In addition, several artificial substrates (unglazed clay tiles) were placed in slickrock area to help quantify colonization rates. The initial postfire sampling has been completed on the Redwood and Atwell Creek sites that burned during 1995.

! **Fire History** - Fire history samples were recovered from segments #2, #3, #4, and #10 during 1995 and 1996. 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, at this time almost no data exists 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.

! **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. No sequoia mortality resulted from the fire although small new fire scars were noted on some trees by the field crew doing the postburn sampling.

! **Fuel Inventory and Monitoring** - Fuel-load sampling was carried out during 1995 and early summer of 1996 to obtain field information on forest fuels (tons per acre) that are available to forest fires. This information will provide input into the FARSITE fire spread computer model which will be used to more accurately predict fire spread following an ignition. Most sampling has concentrated on the south aspect of the East Fork and in segment #10. To date over 580 plots have been sampled and two permanent "Miller" fuel plots established. In addition to estimating fuel loads at each plot, additional forest attribute measurements were obtained on tree height, basal area, height to lowest branches, and on litter and duff depths.

! **Resampling of the 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 are now being resampled prior to the burning of segment #10 (sampling of two plots is complete). Because of little long-term data from red fir forest these plots will provide important information to park managers on changes in forest structure and composition, and fuel loads over a 20 year period. Initial estimates indicate a 40% increase in fuel loads (tons per acre) 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 has 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. Initial field sampling was carried out this past summer in segment #4 and #10 (portions originally planned for burning during 1996). High resolution digital multispectral imagery was recently acquired by an overflight over the East Fork. The imagery will have high enough resolution (one meter) that individual tree crowns should be discernable, allowing detailed observations on tree health and species to be made.

- **Bark-Foraging Bird Species** - Todd Dennis' (graduate student University of Virginia) research focuses on understanding several possible mechanisms that may limit bird species distributions (his emphasis is on the bark-foraging guild - some 14 species of woodpeckers, nuthatches, etc. inhabit the west slope of the Sierra Nevada). Over 600 foraging behavior plots were sampled along with some 450 descriptive vegetation plots. Much of his field sampling was undertaken within the East Fork watershed and has included the examination of species within a number of recent burns in the drainage. He found a number of bark-foraging species to prefer these recent burned areas: northern flicker, white-headed woodpecker, hairy woodpecker, Williamson's sapsucker, and black-backed woodpecker. The latter species was only observed in recent burns which appear to be critical habitat for its presence. His data suggests that fire creates more habitat diversity, allowing better foraging opportunities and nesting locations. He plans to obtain additional funding to return to the area to extend his sampling and obtain more postburn observations as more areas are burned as part of the MKRRP.

- **Remote Sensing and Fuels** - Mitchell Brookins and William Miller (graduate student and professor at Arizona State University) are in the initial phases of developing a fuels inventory based on TM data with field verification. This project will develop a vegetation classification scheme for the watershed based on Landsat thematic mapped (TM) data and a fuel loading classification based on these vegetation classes that can be for fire management planning. There are three phases to this study: 1) initial image processing and remote vegetation classification, 2) ground verification of the initial classification scheme and the collection of forest stand data including fuel load, 3) the integration of the data from the first two phases into a procedure that accurately predicts vegetation and fuels. During 1996 phase one was completed and ground verification begun in the East Fork.

II) Overview of Project

Objectives

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 30,000 acres over a five year period (1995-2000) in the East Fork of the Kaweah River (**Fig. 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 consistant with the study objectives.

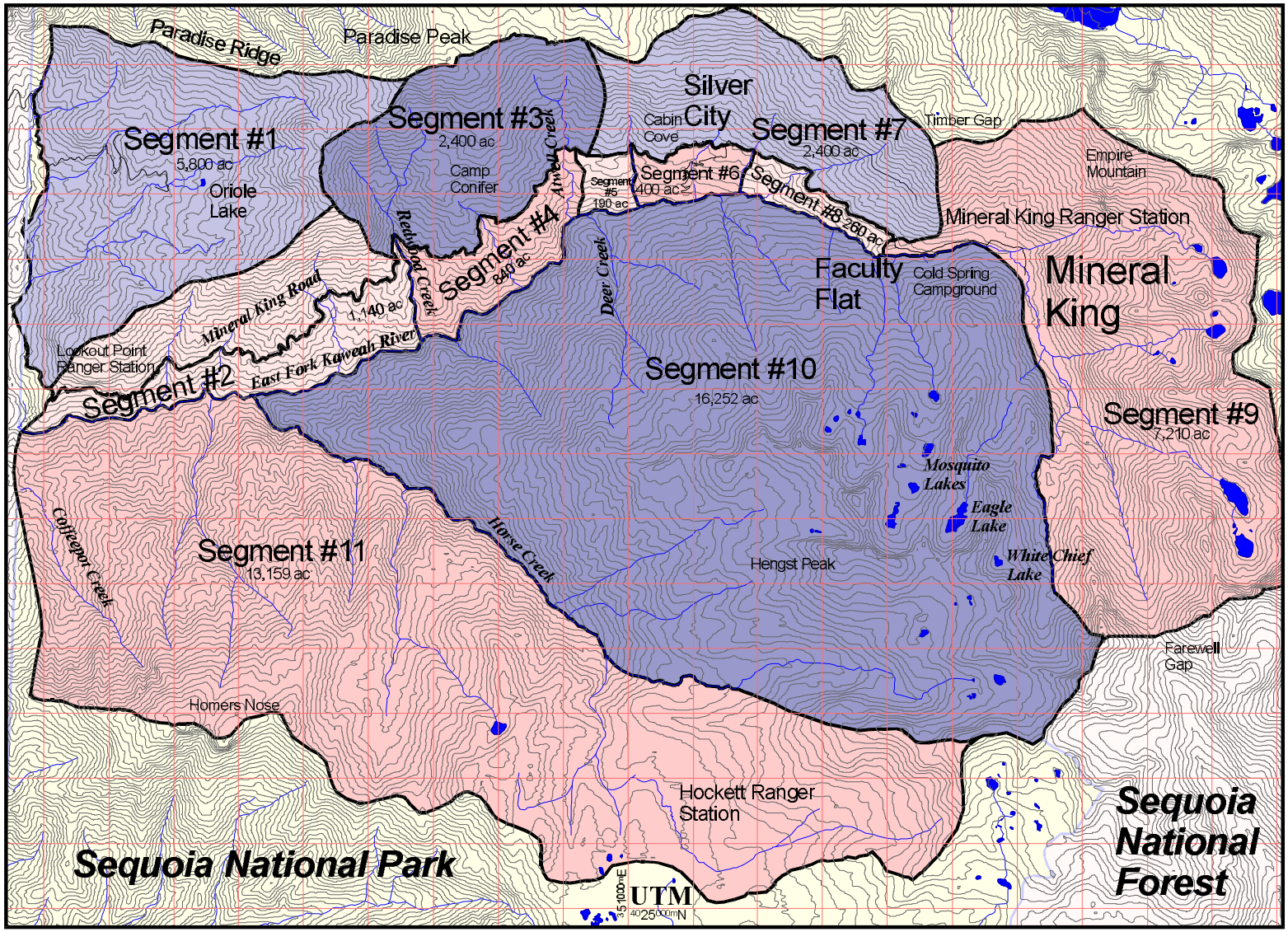

Figure 1.

Mineral King Risk Reduction Project

Project Area and Burn Segments: East Fork Kaweah Watershed

Description - East Fork Project Area

The East Fork watershed 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 Valley. Terrain in the watershed is rugged, elevations range from 874 m (2884 ft) to 3767 m (12,432 ft) within the project area. The watershed, 21202 ha (52369 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 1700 m elevation).

Eleven burn segments have been outlined within the watershed by fire management staff (**Table 1** and **Fig. 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.

Table 1. Segment number and area.

Segment	Hectares	(Acres)
1	2352	(5811)
2	439	(1084)
3	962	(2377)
4	289	(716)
5	121	(300)
6	135	(335)
7	989	(2445)
8	121	(299)
9	2917	(7210)
10	6577	(16252)
11	5325	(13159)

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. 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**). No endangered species are known from the watershed although several sensitive species have been located (**Fig. 2**) during surveys (Norris and Brennan 1982).

Vegetation Classification	Hectares	(Acres)
Foothills Chaparral	1119	(2764)
Foothills Hardwoods & Grassland	1433	(3538)
Ponderosa Pine Mixed Conifer	1968	(729)
White Fir Forest	4034	(9964)
Red Fir Forest	4206	(10388)
Xeric Conifer Forest	1244	(3074)
Montane Chaparral	484	(1195)
Mid-Elevation Hardwood Forest	170	(420)
Lodgepole Pine Forest	967	(2387)
Subalpine Forest	99	(266)
Meadow	133	(328)
Other (primarily water)	100	(247)
Barren Rock	4198	(10368)
Missing or No Data	1050	(2593)

Table 2. 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 recreation use while lower elevations receive relatively little use. Developed or semi-developed areas within the watershed include Silver City/Cabin Cove, Mineral King, Lookout Point, Oriole Lake, and the Atwell Mill areas. NPS campgrounds exist at Atwell Mill and Mineral King.

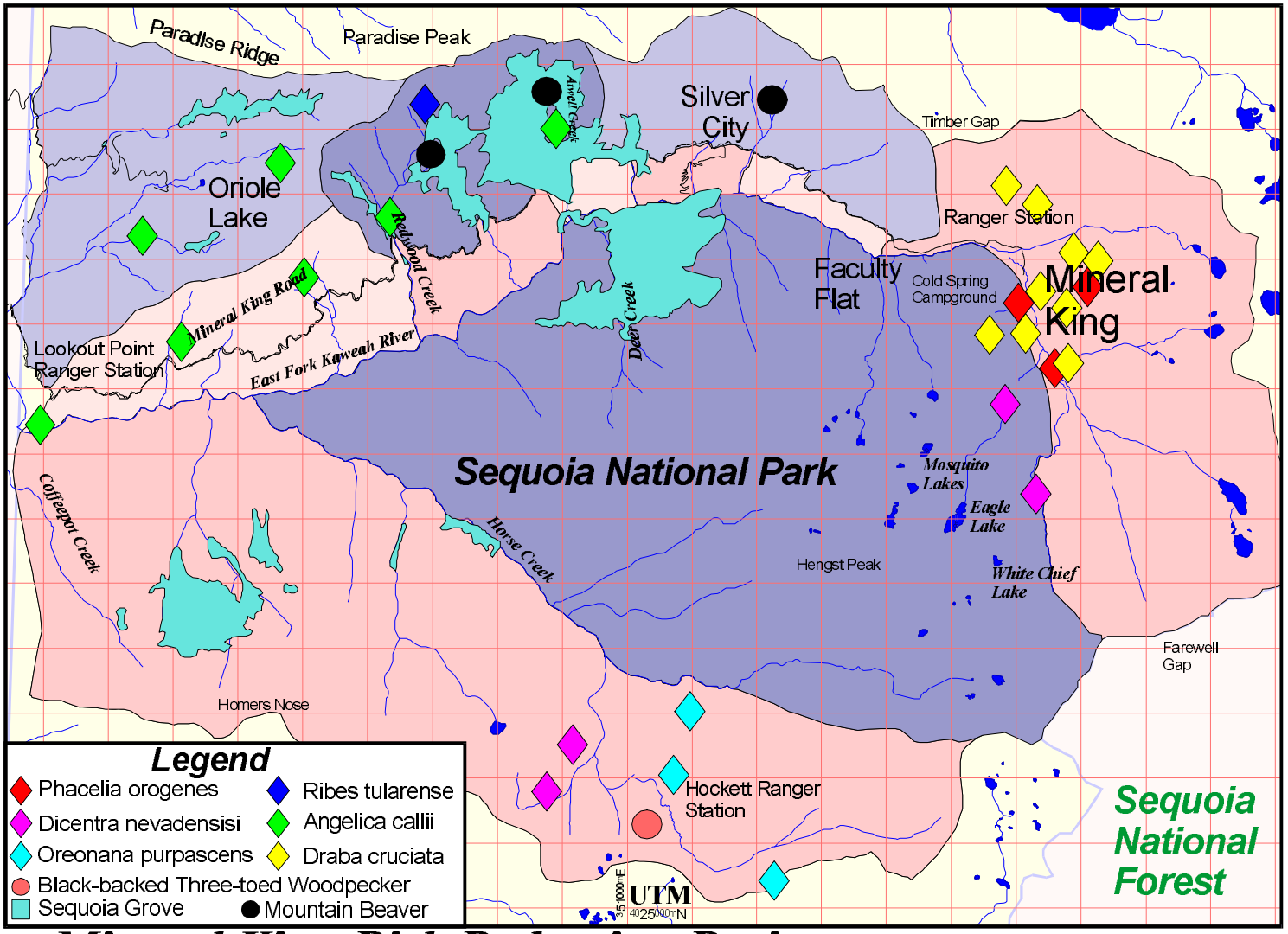

Figure 2.

Mineral King Risk Reduction Project

Sensitive Plant & Animal Species - Locations Approximate

Historic Fires (1920-1996) - East Fork Project Area: No large watershed-scale fires have occurred within the NPS administered portion of the East Fork drainage over at least the last 70 years (**Table 3 and Fig. 3**). The largest burns during this time period occurred in the lower elevation chaparral and evergreen-oak woodlands during the 1920s and 1930s (NPS SEKI fire records database). The largest burn in forested conifer areas (other than the burning of Segment #3 as part of the MKRRP) was the 292 ha (720 ac) Deer Creek Burn (prescribed natural fire) within the East Fork Grove in 1991.

Table 3. Updated table (expanded from the 1995 MKRRP Annual Report) on the major fires (≥1 acre) from about 1920 (early records are incomplete, 1927 missing) through 1996 that occurred wholly or partially within the East Fork watershed (three fires are off the map to the west {†}several fires named on the map are outside the East Fork {*}). Based on current information from SEKI fire records (NPS 1996) and SEKI GIS, a total of 69 fires (≥1 acre) and 17,131 hectares (42,313 acres) burned since 1920.

Fire Name	Year	Hectares	(Acres)
unknown	1922	141.7	(350)
unknown	1924	16.2	(40)
unknown	1925	149.8	(370)
unknown	1925	18.2	(45)
unknown	1926	24.3	(60)
unknown	1928	9,595.1	(23,700)
Red Hill †	1930	101.2	(250)
South Fork	1930	809.7	(2,000)
unknown	1933	6.1	(15)
Traugers #1	1934	24.3	(60)
Traugers #2	1934	97.2	(240)
Eden Grove	1934	3.2	(8)
Case Mountain	1934	809.7	(2,000)
South Fork	1934	161.9	(400)
Grunigen Creek #3	1935	0.4	(1)
Oriole #2	1935	1.2	(3)
unknown	1938	121.5	(300)
Lake Canyon	1939	16.2	(40)
Red Hill	1939	728.7	(1800)
Cain Flat	1939	226.7	(560)
unknown	1939	12.2	(30)
unknown	1939	16.2	(40)
Tar Gap Ridge	1942	1.6	(4)
Paradise Peak Lookout	1945	0.4	(1)
Paradise	1945	0.4	(1)
Atwell Mill	1946	43.3	(107)
Castle Grove*	1947	151.8	(375)
Hockett Ridge	1950	0.8	(2)
unknown	1951	14.2	(35)
Homer's Nose	1952	6.9	(17)
Mineral King	1952	18.2	(45)
Paradise	1952	0.8	(2)
Conifer Tract	1955	11.3	(28)
Paradise Peak #1	1957	0.4	(1)
unknown	1969	?	(?)
Homer's Nose	1969	5.3	(13)
Horse Creek	1969	0.8	(2)
Atwell Mill #2	1970	0.4	(1)
Lookout Point	1970	89.9	(222)

Fire Name	Year	Hectares	(Acres)
Atwell Mill	1971	1.6	(4)
Jet Plane	1971	1.2	(3)
Clough Cave*	1971	12.2	(30)
Horse Creek	1973	0.8	(2)
unknown	1974	13.8	(34)
Lookout	1974	16.2	(40)
Whitman Creek	1976	3.6	(9)
Whitman	1978	0.4	(1)
Eden Grove	1978	6.9	(17)
Eagle Lake	1979	0.4	(1)
Dome Fire	1980	202.4	(500)
Salt Creek †	1984	18.2	(45)
Garfield*	1985	113.4	(280)
Camp Creek*	1986	206.5	(510)
Coffeepot #1	1987	0.8	(2)
Coffeepot #2	1987	0.4	(1)
Coffee	1987	97.2	(240)
Silver	1987	0.8	(2)
Case	1987	2024.3	(5,000)
Kaweah †	1987	64.8	(160)
Lost	1987	0.8	(2)
Hockett	1988	8.1	(20)
Hockett	1988	20.2	(50)
Purple Haze	1988	0.4	(1)
Paradise	1988	2.8	(7)
Deer Creek	1988	5.7	(14)
Deer Creek	1991	291.5	(720)
Paradise	1994	30.4	(75)
Horse Creek	1994	0.8	(2)
Milk Ranch*	1994	20.2	(50)
Empire	1994	47.9	(118)
Hockett	1994	23.1	(57)
Spring	1994	1.2	(3)
Segment #3	1995	850.2	(2,100)
TOTALS	**68 fires**	**17,315 ha**	**42,768 ac**

* Outside the East Fork watershed but shown for reference purposes.

† Not shown on map (located in lower portion of the Eastr Fork drainage).

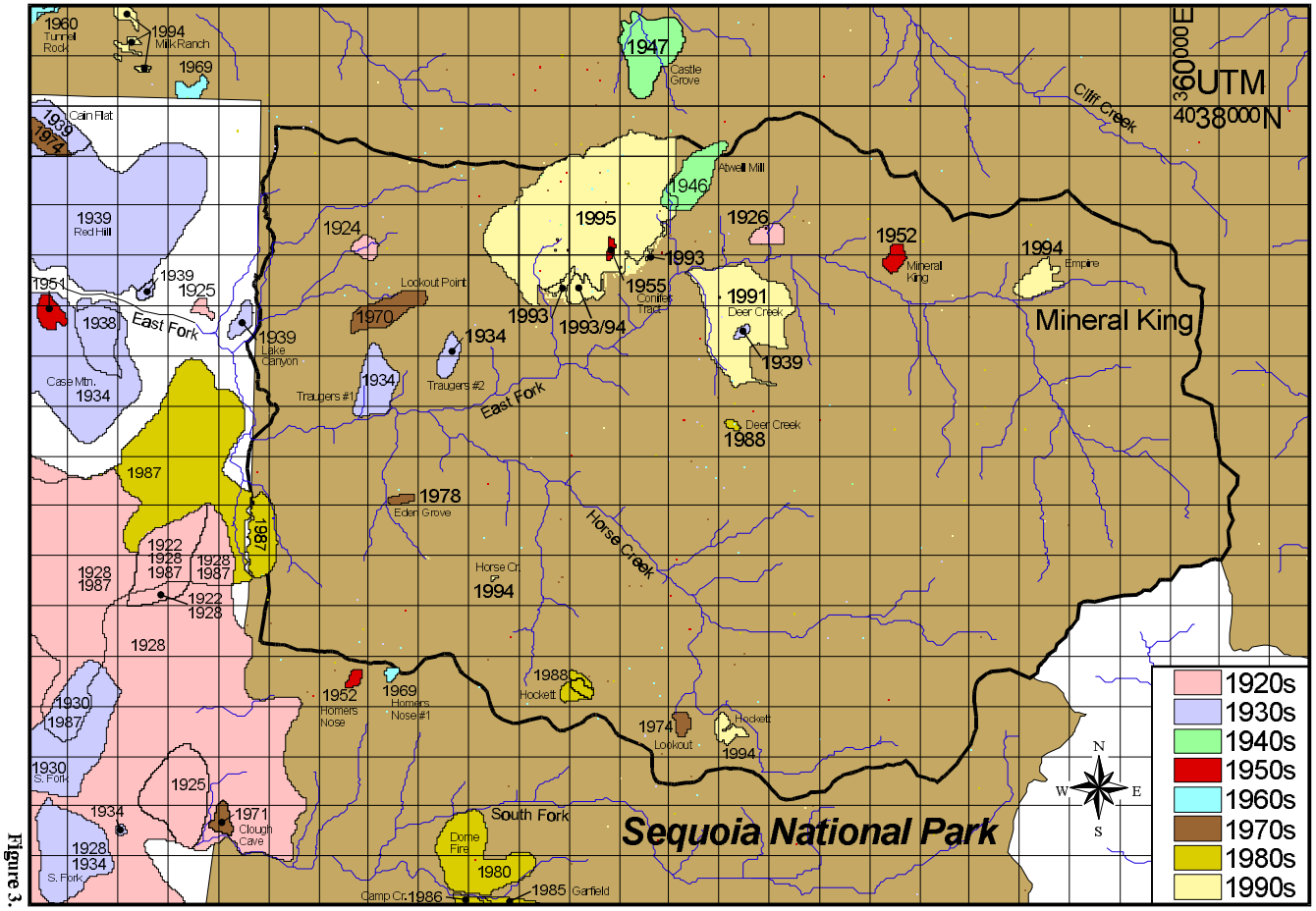

Figure 3.

Burns in the East Fork Drainage (1920-1995)*

Mineral King Risk Reduction Project area is shown by heavy outline. * Data is incomplete for some years.