3.13) Fire Effects Monitoring

- MaryBeth Keifer, Science and Natural Resources Management, SEKI

Lead: M. Keifer; field crew supervisor: G. Dempsey; field crew: M. Cox, D. Haskamp, G. Indindoli, K. Williams

INTRODUCTION

Fuels and vegetation monitoring has been part of the parks' fire management program for the last two decades. The fire effects monitoring information is used to assess if the program as a whole, is meeting intended objectives. The Mineral King Risk Reduction Project (MKRRP) represents a large step in the parks move toward increased prescribed fire on a landscape scale. Vegetation and fuels monitoring in the project area is critical to: 1) evaluate the achievement of fuel reduction objectives; 2) examine changes in vegetation structure and composition; 3) detect any unexpected or undesirable changes in vegetation that may be a result of the project; 4) provide the above information to fire managers, other park staff, and the public.

Fire effects monitoring work in various vegetation types within the MKRRP area is based on the relative need for information. Past research and monitoring efforts in other areas of the park have concentrated on the mid-elevation forests, especially the giant sequoia-mixed conifer type. Information about the effects of fire is least known in the lower and upper elevation vegetation types, and therefore, the MKRRP fire effects monitoring efforts are focused on these lesser understood areas.

Historically, the lower elevation vegetation type fire regimes consisted of generally more frequent and/or higher intensity fire than at higher elevations. A disruption in this fire regime, such as fire exclusion attempts, may have had a great effect on vegetation structure and function in these lower elevation types. With few studies on lower elevation vegetation fire effects, we need more information about the potential effects. Of the lower elevation types, chamise chaparral has been more thoroughly studied than other foothill vegetation communities (Rundel and Parsons 1979; Rundel 1982). Consequently, the MKRRP vegetation monitoring efforts focus on the lower elevation vegetation types of oak woodland and mixed evergreen chaparral.

In contrast to lower elevations, high elevation vegetation types in the Sierra generally have longer fire-return intervals. Consequently, hazardous fuel accumulation found at lower elevations due to fire exclusion over the last century is not as common in higher elevation vegetation types. The effects of changes in fire regime, and subsequent increased risk, are not as critical at higher elevations. Although both ecological and life and property risk is lower, limited information is available for upper elevation vegetation types, therefore, moderate efforts to monitor vegetation change in these types is warranted in the project area.

Although the mixed conifer forest has been monitored relatively intensively in the past, fire effects information for all vegetation types in the project area are needed for public information distribution. Accordingly, the mixed conifer forest vegetation types are monitored at a minimal level in the MKRRP area. Within the mixed conifer forest types, monitoring information is least available in the xeric, low elevation, therefore, mixed conifer monitoring efforts will be increased in this type if time allows.

METHODS

The National Park Service's Western Region Fire Monitoring Handbook (1992) standardized methods are used for monitoring fire effects on vegetation where appropriate. Monitoring plots in burn units are located randomly on a 100 x 100 m grid within each of the vegetation types designated for monitoring. Criteria for grid point exclusion include proximity to roads/trails, riparian areas, anomalous physical or biological characteristics, and inaccessibility (both safety and time constraints). Location of plots by burn segment, monitoring (vegetation) type (with corresponding dominant species), and UTM coordinates are presented in **Table 3.13-1** and shown in **Fig. 3.12-1**.

Plots are installed in chronological order according to segments scheduled to burn. Monitoring occurs according to the following schedule: pre-burn, immediately post-burn (within two months), and one, two, five, and 10 years post-burn. Data from these monitoring plots are summarized for the project after each step of the monitoring schedule and results are promptly distributed to park staff and the public. The data may also be included in monitoring type summaries for the parks.

Unburned monitoring plots in other areas of the parks may be used to compare with burn project results. Additional plots may be established in areas that are not currently scheduled for prescribed burning adjacent to the project area if existing unburned plots will not suffice.

Changes in MKRRP Monitoring Program since 1996

Due to highly variable species composition, the ponderosa pine-mixed conifer forest monitoring type was split into two different types for the parks' fire effects monitoring program, the ponderosa pine forest and the low elevation-mixed conifer forest types. This change (in name only) affects one MKRRP fire effects plot in the Atwell Segment (segment #3), which is now identified as FCADE1T08094; this change does not affect the data collected or reported in past years.

A change that affects the fuel load data is that new species-specific bulk density constants are now used in the calculation of duff load. These new constants are a result of long-term research by Jan van

Table 3.13-1. Plot locations (an asterisk in the UTME column indicates the plot was geo-referenced using a global positioning system with an accuracy of ± 3-30 meters). See Fig. 2.1-1 for segment locations. Filled rows are plots added during 1997.

PLOT ID	MONITORING TYPE	DOMINANT SPECIES	BURN SEGMENT	UTME	UTMN
CADE 094	Low elevation-mixed conifer	incense cedar	Atwell	347570	4035590
SEGI 093	Giant sequoia-mixed conifer	white fir	Atwell	348280	4036200
SEGI 095	Giant sequoia-mixed conifer	white fir	Atwell	349513*	4037639
ABMA 096	Red fir forest	red fir	Atwell	349100	4038310
ABMA 097	Red fir forest	red fir	Atwell	348428*	4037631
ABMA 098	Red fir forest	red fir	unburned	348602*	4038256
ABMA 100	Red fir forest	red fir	Tar Gap	352809*	4030052
ABMA 101	Red fir forest	red fir	Tar Gap	353059*	4034063
ABMA 102	Red fir forest	red fir	Tar Gap	354987*	4034922
ADFA 012	Chamise chaparral	chamise	Lookout	342251*	4032915
ADFA 013	Chamise chaparral	chamise	Lookout	342214*	4032867
ADFA 014	Chamise chaparral	chamise	Lookout	342233*	4032845
ARME 007	Mixed chaparral	manzanita	Lookout	347391*	4034592
ARME 008	Mixed chaparral	manzanita	Lookout	346596*	4034345
ARME 009	Mixed chaparral	manzanita	Lookout	346568*	4034144
ARME 015	Mixed chaparral	manzanita	Lookout	344635*	4033573
ARME 010	Mixed chaparral	manzanita	Redwood	348001*	4035021
ARME 011	Mixed chaparral	manzanita	Redwood	348112*	4034811

Wagtendonk to further refine fuels information for Sierran mixed conifer forests. The change in these constants has resulted in higher fuel load estimates for duff in all forest monitoring types. The new constants have been applied to previously collected data to obtain new estimates for fuel reduction and accumulation.

Work Completed in 1997

During the 1997 field season, five forest plots that burned in the Atwell Segment (segment #3) of the Mineral King burn unit and one forest plot located outside the segment (unburned) were remeasured two-years postfire (**Fig. 3.12-1**). Two new plots were installed in the Tar Gap Segment (segment #10) in the red fir forest monitoring type.

RESULTS TO DATE

Results are presented for plots that burned in the Atwell Segment (segment #3) in three forest monitoring types. The results include dead and down fuel reduction and accumulation, live overstory tree (>1.37 m in height) density changes by species (species composition) and diameter class (stand structure), and tree seedling (<1.37 m in height) density. Where more than one plot is included in the analysis, results are presented as mean values ± one standard error. Results related directly to quantitative fire management objectives are indicated in bold typeface. Note that results may not be representative of the entire monitoring type and only apply to the plot areas measured due to the small sample sizes (at most, two plots per monitoring type).

Low Elevation-mixed Conifer Forest (CADE)

Fuel Reduction and Accumulation: In one CADE plot, **72% of the total fuel load was consumed** by the fire, from 117.6 tons/acre (26.37 kg/m^2) prefire to 33.0 tons/acre (7.39 kg/m^2) immediately postfire (**Fig. 3.13-1**). The duff was completely consumed (100%) and woody fuels were reduced by 51%. Woody fuels increased by 67% over immediate postfire levels within one-year, indicating that branch and tree mortality was already contributing to the downed woody fuel layer (**Fig. 3.13-2**). A small decrease in fuel load from one- to two-years postfire is likely due to slight differences in fuel transect locations repeated from one year to the next (error associated with the sampling technique).

Overstory Tree Density (Species Composition and Stand Structure): Total overstory tree density was 1270 trees/ha prefire and 30 trees/ha two-years postfire, indicating 98% overstory mortality in the plot two years following fire (**Fig. 3.13-3**). Prefire composition was dominated by incense cedar (68% of all trees; **Fig. 3.13-3**), most of which were less than 50 cm in diameter at breast height (dbh) (**Fig. 3.13-**

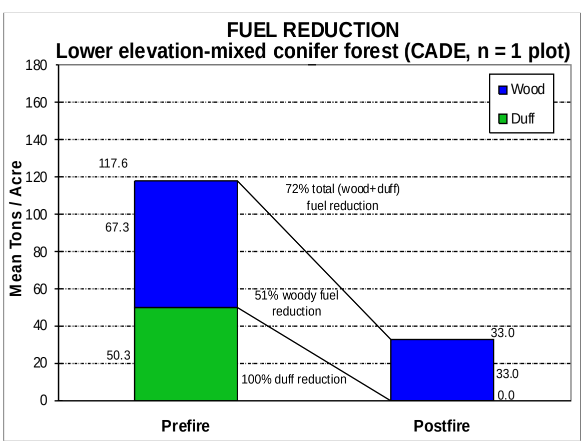

Figure 3.13-1.

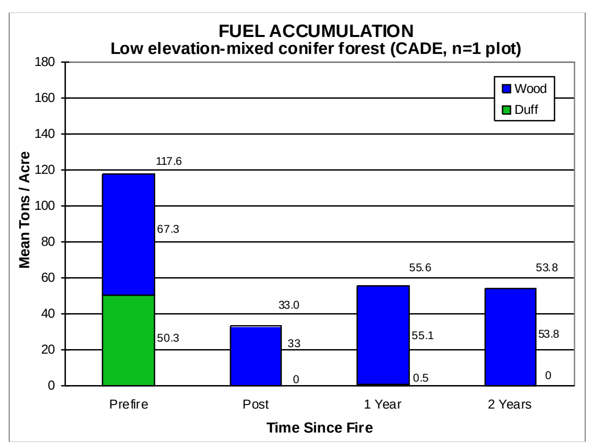

Figure 3.13-2.

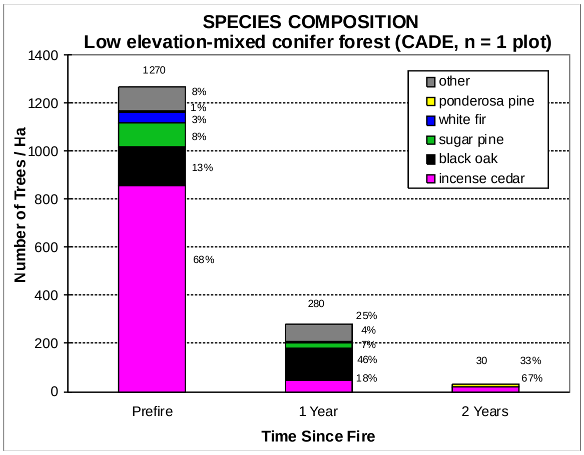

Figure 3.13-3.

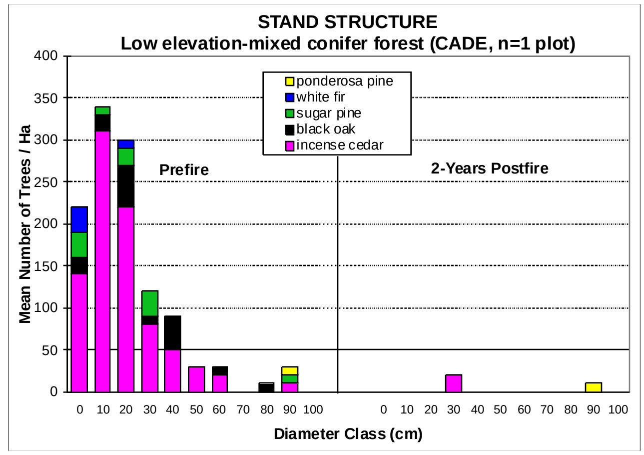

Figure 3.13-4.

4). Incense cedar was reduced from 860 trees/ha prefire to 20 trees/ha two-years postfire (98% mortality) while its relative species composition remained unchanged from prefire condition to two-years postfire (68-67%; **Fig. 3.13-3**). Black oak, sugar pine, and white fir overstory tree densities were reduced to zero, while the only ponderosa pine tree in the plot survived the fire, and therefore, ponderosa pine relative density increased from 1% to 33% (**Fig. 3.13-3**).

Tree Seedling Density: Total tree seedling density increased by 62% from 3,280 seedlings/ha prefire to 5,320 seedlings/ha two-year postfire.

Giant Sequoia-mixed Conifer Forest (SEGI)

Fuel Reduction and Accumulation: **Total fuel load was reduced by 89%** in one SEGI plot, from 161.7 tons/acre (36.24 kg/m^2) prefire to 17.7 tons/acre (3.96 kg/m^2) immediately postfire (**Fig. 3.13-5**). The duff was reduced by 92%, while 88% of the woody fuels were consumed. Due to the late season burn, the second SEGI plot was not remeasured immediately postfire and, therefore, was not included in the fuel reduction estimate. Woody fuel increased greatly one-year postfire, surpassing the prefire woody fuel load (**Fig. 3.13-6a**). Note that the error bars (± one standard error) are large, indicating high variability in total fuel load between the two plots for all visits (**Fig. 3.13-6**). The large postfire increase occurred in only one of the plots and is a result of a large fallen white fir that intercepted three of the four fuel transects. The arrangement of this downed tree gives the plot a very high fuel load which is not representative of the plot area in general and not typical

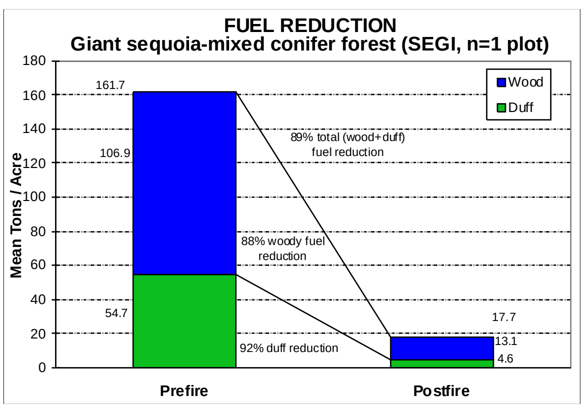

Figure 3.13-5.

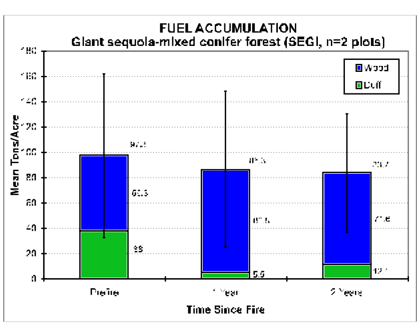

Figure 3.13-6a.

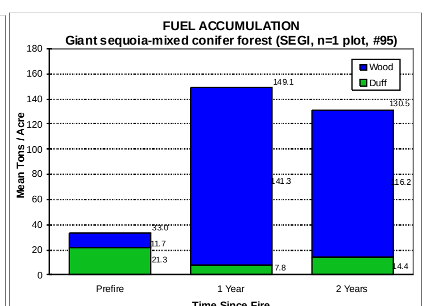

Figure 3.13-6b.

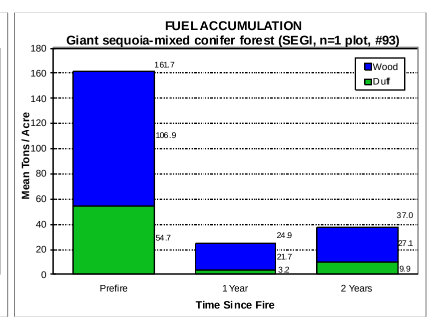

Figure 3.13-6c.

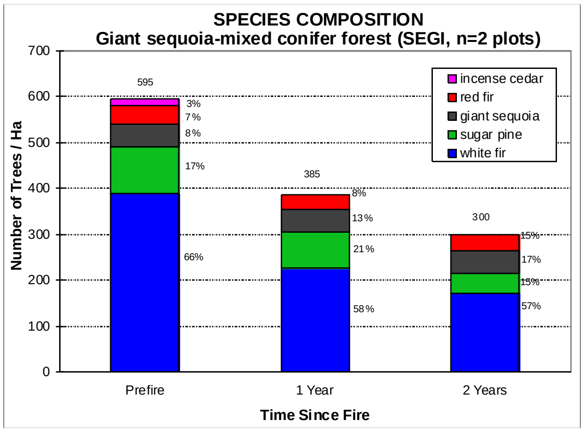

Figure 3.13-7.

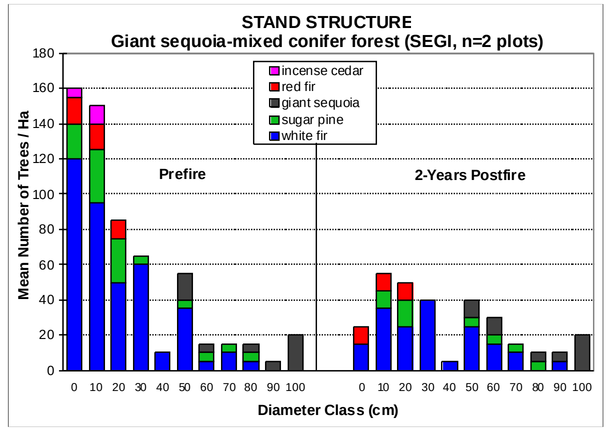

Figure 3.13-8.

of other plots throughout the parks in this monitoring type (**Fig. 3.13-6b**). Results from the second plot is much more representative of the postfire fuel accumulation pattern seen in the giant sequoia-mixed conifer forest type in the park (**Fig. 3.13-6c**).

***Overstory Tree Density (Species Composition and Stand Structure)*:** In two SEGI plots, mean total overstory tree density was reduced by 50%, from 595 ± 215 trees/ha prefire to 300 ± 50 trees/ha two-years postfire (Fig. 3.13-7). White fir dominated prefire (66%) and most mortality occurred in the smaller diameter white fir (less than 30 cm; Fig. 3.13-8). Relative density changed from prefire condition to two-years postfire. Incense cedar, white fir, and sugar pine decreased (from 3% to 0%, from 66% to 57%, and from 17% to 15% respectively) and relative increases occurred in red fir (from 7% to 15%) and giant sequoia (from 8% to 17%; Fig. 3.13-8). No mortality of any giant sequoia trees occurred in either plot.

Tree Seedling Density: Mean total seedling density for two SEGI plots was 3,520 ± 2,080 seedlings/ha prefire and increased by 86% to 6,560 ± 5,880 seedlings/ha two-years postfire. This increase was due to the postfire establishment of giant sequoia seedlings (from zero prefire to a mean of 5,800 seedlings/ha two-years postfire); for all other species, seedling density decreased by two-years postfire. This result corroborates previous studies that show that fire greatly increases the establishment of giant sequoia seedlings. Seedling density is, however, highly variable between plots (evidenced by the high standard error values) and indicates that seedling establishment varies greatly at this spatial scale.

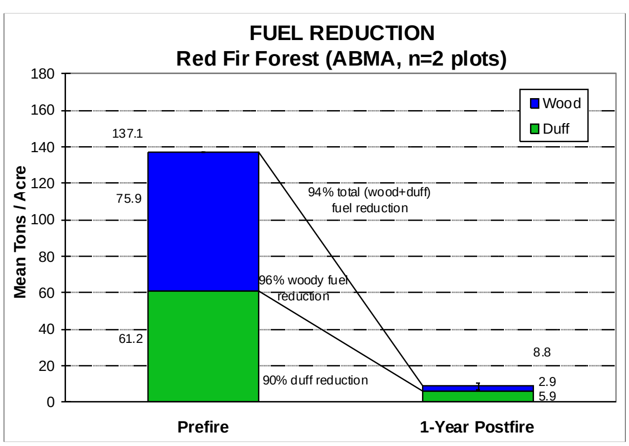

Figure 3.13-9.

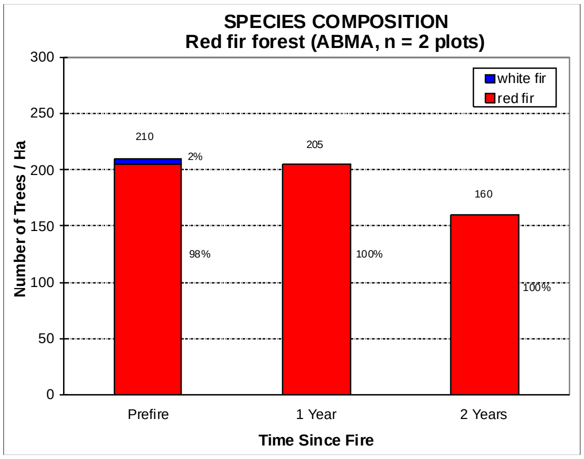

Figure 3.13-11.

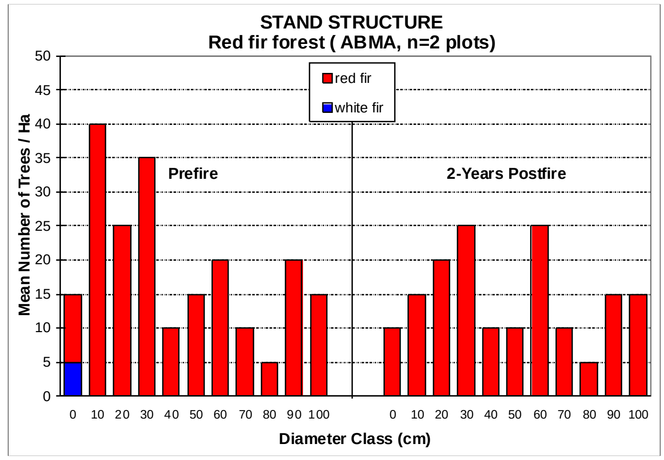

Figure 3.13-12.

Red Fir Forest (ABMA)

Fuel Reduction and Accumulation: In two ABMA plots, the mean total fuel load was 137.1 ± 0.2 tons/acre (30.74 ± 0.04 kg/m^2) prefire and 8.8 ± 1.7 tons/acre (1.98 ± 0.39 kg/m^2) 1-year postfire, which indicates **94% total fuel reduction** (**Fig. 3.13-9**). The plots were not revisited immediately postfire due to the late season burn. Some fuel may have accumulated from the time the plots burned until they were remeasured the following summer, therefore, the fuel reduction results may be conservative. The duff was reduced by 90% and 96% of the woody fuels were consumed. Woody fuel and duff accumulated slightly between the one- and two-years postfire (**Fig. 3.13-10**).

Overstory Tree Density (Species Composition and Stand Structure): Mean red fir overstory tree density for two plots was 205 ± 95.0 trees/ha prefire and 160 ± 50 trees/ha two-years postfire (**Fig. 3.13-11**). While no overstory red fir mortality was detected in either of the ABMA plots during the first year following the fire, 22% mortality occurred within two years after the fire. Most of this mortality occurred in the smaller diameter red firs (**Fig. 3.13-12**).

Tree Seedling Density: Mean red fir seedling density for two plots was reduced by 99%, from 17,380 ± 3,900 seedlings/ha prefire to 100 ± 100 seedlings/ha two-years postfire.

PLANS FOR 1998

According to burn perimeter maps, three of the Mixed chaparral plots burned last year, therefore,

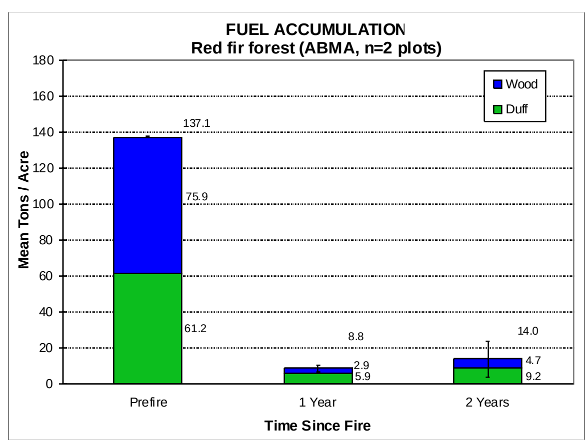

Figure 3.13-10.

they will each be revisited for the one-year postfire check in 1998. Three new plots are also scheduled to be installed in the Tar Gap Segment (segment #10), including one plot in the Red fir forest type and two plots in the Low elevation-mixed conifer forest type.