4.13) Fire Effects Monitoring

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INTRODUCTION

Fuels and vegetation monitoring has been part of Sequoia and Kings Canyon National Parks' fire management program for the last two decades. The Parks' fire effects monitoring program staff began installing permanent plots in 1982 in areas where prescribed burning was planned. The Parks' program was used to help develop standardized protocols for the National Park Service's Fire Monitoring Handbook (FMH), the service-wide program that began in 1989. In past years, two separate reports were written, one for the fire effects work done in the Mineral King Risk Reduction Project (MKRRP) area and one for the Parks' larger, overall fire effects program. Because significant progress has been made burning in the MKRRP project area, this year all work is fully integrated into one annual report presented here for the entire program. If specific results for the MKRRP area (or other areas of the Parks) are needed, they can be easily obtained from the fire effects monitoring database.

PROGRAM OBJECTIVES

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.

SUMMARY OF METHODS

The National Park Service's Western Region Fire Monitoring Handbook (1992) standardized methods are used for monitoring fire effects on vegetation and fuels. Monitoring plots in burn units are located randomly on a 100 x 100 meter 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). Specific location of individual plots (most geo-referenced) can be obtained from the Parks' plot location database (see **Fig. 4.12-1** for map).

Table 4.13-1. Number of fire effects monitoring plots by monitoring type.

Monitoring Type	Dominant Species	Number Of Plots Installed	Number of Plots Burned
Red fir forest	red fir	6	3
Giant sequoia-mixed conifer forest	white fir	29	29
White fir-mixed conifer forest	white fir	11	10
Low elevation-mixed conifer forest	incense cedar	5	5
Ponderosa pine-dominated forest	ponderosa pine	4	4
Chamise chaparral	chamise	3	3
Mixed chaparral	manzanita	6	2
Montane chaparral	manzanita	5	5

Plots are installed in a sequence according to segments scheduled to burn. Monitoring occurs according to the following schedule: preburn, immediately postburn (within 2 months of burning), and 1, 2, 5, and 10 years postburn. Data from these monitoring plots are summarized after each step of the monitoring schedule and results are promptly distributed to park staff and the public.

Unburned monitoring plots in other areas of the parks may be used to compare with burn program results. If existing unburned plots are not available, additional plots may be established adjacent to the project area in areas that are not currently scheduled for prescribed burning.

WORK ACCOMPLISHED IN 1999

Twenty plot remeasurements and 5 immediate postburn visits were accomplished in 1999. An additional 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.

PRELIMINARY FINDINGS AND PERTINENT DISCUSSION

Results to date are summarized below by monitoring type. All analyses consist of data collected through and including the 1999 field season. Mean values ± an 80% confidence interval are reported. The 80% confidence interval means that there is an 80% probability that the true population mean falls within the range of the sample mean plus or minus the confidence interval width. For example, if the mean total fuel load is 10.0 ± 2.2 kg/m^2, then this means that there is an 80% probability that the true population mean total fuel load value is between 7.8 and 12.2 kg/m^2. The confidence interval is based on the standard error and the students' t-distribution for the sample size used (number of plots).

Giant sequoia-mixed conifer forest

Fuel load

Mean total dead and down fuel load in the Giant sequoia-mixed conifer forest type was 20.9 ± 2.0 kg/m^2 preburn (93.3 ± 9.0 tons/acre) and 4.9 ± 1.0 kg/m^2 immediately postburn (21.8 ± 4.7 tons/acre) (n=28 plots; **Figure 4.13-1**). The mean total fuel load was therefore reduced by 77% immediately postburn, meeting the parks' fire management objective of 60-80% total fuel reduction. Woody fuel was reduced by 56%, while a greater proportion of litter and duff was consumed (83% and 93%, respectively) by the fires. By five years postburn, total fuel load accumulated to 48% of preburn levels (n=26 plots). Woody fuel reached 71% of preburn levels five years postburn, while duff accumulated at a slower rate, reaching only 26% of preburn levels. By ten years postburn, mean total fuel load was 59% of preburn levels, with wood, litter, and duff reaching 81%, 64%, and 37% of preburn levels, respectively, in this monitoring type (n=12 plots; **Figure 4.13-2**).

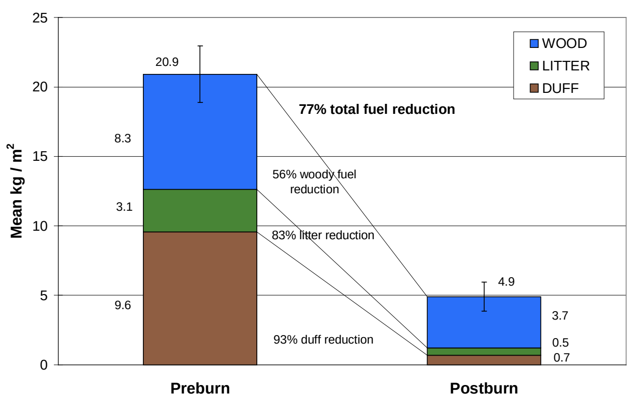

Figure 4.13-1. Fuel reduction in the Giant sequoia-mixed conifer forest type (n=29 plots).

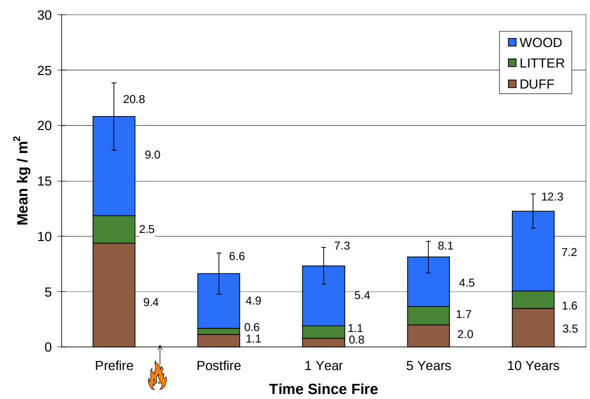

Figure 4.13-2. Fuel accumulation in the Giant sequoia-mixed conifer forest type (n=12 plots).

Four burn units containing 9 plots have been reburned in the Giant sequoia-mixed conifer forest type: one in 1996 (2 plots) that had originally burned in 1982; one in 1997 (1 plot) that first burned in 1989; one in 1998 that first burned in 1987 (2 plots); and one in 1999 that first burned in 1982 (4 plots). The 2 plots that burned in 1998 exceeded the prescription parameter for relative humidity, and, therefore, data from these plots were not included.

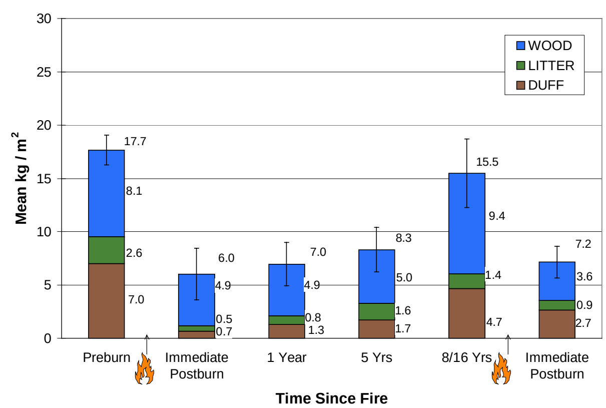

Figure 4.13-3. Fuel load in the Giant sequoia-mixed conifer forest type reburns (n=7 plots).

Mean total fuel load for the 7 plots had reached 88% of the initial preburn level 8-16 years after the initial burn (**Figure 4.13-3**). Woody fuels were a much larger component (116% of initial preburn level) than duff (67% of initial preburn level). As a result of the repeat burns, total fuel load was reduced by 54%, with a 62% reduction in woody fuel, 36% litter consumption, and a 43% reduction in duff (**Figure 4.13-3**). A greater proportion of woody fuel was consumed in the repeat burns than in the initial prescribed fires in these 7 plots (62% and 40%, respectively). Conversely, a much smaller proportion of duff was consumed in the repeat burns than in the initial prescribed fires (43% and 90%, respectively).

Stand structure and composition

Mean total tree density in the Giant sequoia-mixed conifer forest type was reduced by 49%, from 461 ± 63 trees/ha preburn to 234 ± 25 trees/ha ten-years postburn (n=12 plots; **Figure 4.13-4**). Species composition changed slightly over this time period, with white fir (*Abies concolor*), sugar pine (*Pinus lambertiana*), and red fir (*Abies magnifica*) relative density all decreasing by 3-4% while the relative density of giant sequoia (*Sequoiadendron giganteum*) tripled from 5% preburn to 16% ten-years postburn (**Figure 4.13-4**). This increase was due to the successful recruitment of postburn sequoia regeneration (seedlings) into the smallest diameter class of trees (0-10 cm). Tree diameter distribution changed following fire, with the ten-year postburn mean density of the smaller diameter classes much reduced from preburn densities. The preburn mean densities in the four smallest diameter classes were reduced by 41-74% ten years postburn (n=12 plots; **Figure 4.13-5**). This change includes mortality as well as live tree growth into larger size classes over time. The reduction in density was generally less as size class increased, with a 19% increase in mean density for trees >100 cm (**Figure 4.13-5**).

In the 7 plots that were reburned, total tree density was further reduced from 266 ± 32 trees/hectare 8-16 years after the initial burn down to 210 ± 37 trees/hectare immediately after the repeat burn (n= 7 plots; **Figure 4.13-6**). Even further reduction may occur in the next few years as tree mortality is often delayed following fire. Species composition had changed dramatically in these plots after the initial burn (54% white fir, 23% giant sequoia), primarily as a result of a patch of giant sequoia post-burn regeneration in one of the plots. Following the repeat burn, species composition shifted back again, however, giant sequoia relative density was still twice that present prior to the initial burn (4% prior to initial burn, 9% after two burns) (n=7 plots; **Figure 4.13-6**). A single patch of small giant sequoia trees located in one of the plots was completely scorched in the reburn. Observations from throughout the areas reburned reveal that patches of small giant sequoia trees had widely varying levels of scorch and mortality, including

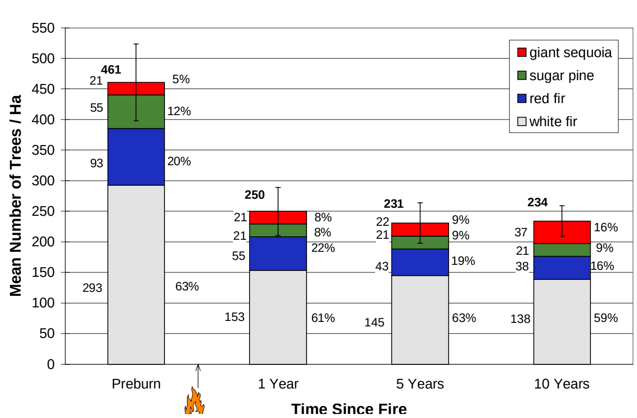

Figure 4.13-4. Stand density by species composition in the Giant sequoia-mixed conifer forest type (n=12 plots).

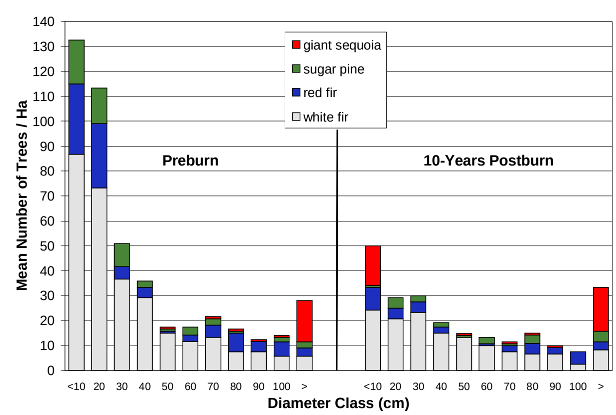

Figure 4.13-5. Stand density by diameter class in the Giant sequoia-mixed conifer forest (n=12 plots).

some patches that were not scorched at all in which all trees survived. A study monitoring giant sequoia regeneration in reburned areas corroborates these observations, and complete mortality in the 0-10 cm diameter class is not expected in all areas reburned.

Management implications of results

The objective of 60-80% total fuel reduction is met in the Giant sequoia-mixed conifer forest for initial prescribed burns. Ten-years postburn, fuel load had reached 59% of preburn levels indicating reburns for fuel reduction should be considered approximately 10 years following the initial burns to avoid a return to heavy preburn fuel load conditions. Reburn results show that total fuel reduction was lower in the reburn than in the initial burn (54% and 77% respectively), and the reduction by fuel component was quite different. The fuel complex prior to the repeat burns was made up of a larger proportion of woody fuel (61%) than that prior to the initial burns (46%) and a larger proportion of the woody fuel was consumed in the reburns than in the initial burns. Fuel reduction objectives for repeat burns may need to reflect the difference in fuel complex following initial burning. This change in fuel complex may also be important for predicting reduced smoke emissions in successive burns over time.

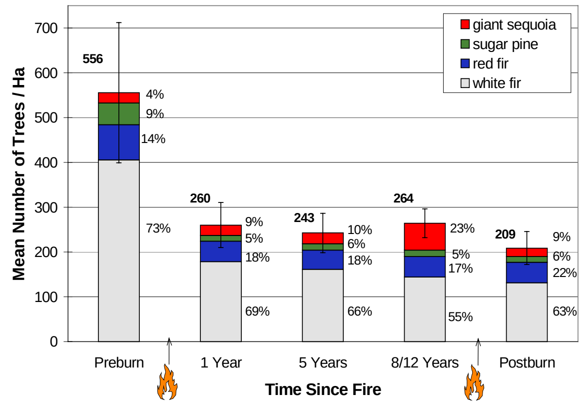

Figure 4.13-6. Stand density by species composition in the Giant sequoia forest reburns (n=7 plots).

Newly developed preliminary targets for total stand density in the mixed conifer forest types are as follows: 50-250 trees/hectare <80 cm DBH, and 10-75 trees/hectare >80 cm DBH. For 27 plots in the Giant sequoia-mixed conifer forest type, preburn mean density for trees <80 cm DBH was 625 ± 114 trees/ha, which is two and a half times the maximum target value (**Figure 4.13-7**). The preburn mean density of trees >80 cm DBH was 46 ± 7 trees/ha, well within the target range of 10-75 trees/ha. While reduced from the preburn value by 54%, the one-year postburn mean density of trees <80 cm DBH was still higher than the target maximum of 250 trees/ha (292 ± trees/ha; **Figure 4.13-7**). By five years postburn, however, the mean density of trees <80 cm DBH was further reduced to 222 trees/ha, which falls within the target range (**Figure 4.13-7**). The larger trees are only slightly reduced to 42 ± 7 trees/ha by five years postburn and remain within the target range of 10-75 trees/hectare. Most of the density reduction occurred in the smaller trees, indicating that prescribed fire may reduce the potential for spread of crown fire in these forests by thinning smaller trees and ladder fuels, while minimizing effects on larger trees (8% reduction in density from preburn to five-years postburn). No mortality of large giant sequoia trees occurred within the monitoring plots following prescribed burning. In addition, some recruitment of post-burn giant sequoia regeneration into the

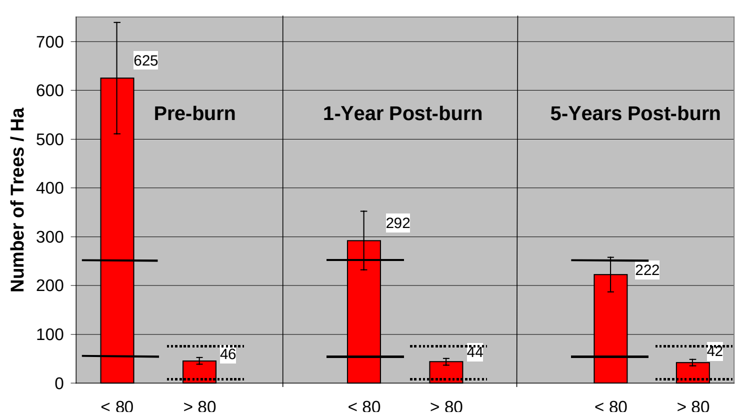

Figure 4.13-7. Stand density by diameter class in the Giant sequoia-mixed conifer forest type (n=27 plots).

smallest diameter class indicates an increase in the relative density of giant sequoia. These results will be useful to evaluate progress towards meeting the structural objectives (Keifer and others, in press).

White fir-mixed conifer forest

Fuel load

In the White fir-mixed conifer forest type, mean total fuel load was 16.1 ± 3.79 kg/m^2 preburn (71.8 ± 16.9 tons/acre) and 3.4 ± 1.5 kg/m^2 immediately postburn (14.9 ± 6.8 tons/acre) (n=10 plots). The mean total fuel load was therefore reduced by 79% immediately postburn, meeting the parks' fire management objective of 60-80% total fuel reduction. Woody fuel was reduced by 63%, while a greater proportion of litter and duff was consumed (82% and 89%, respectively) in the fires. By ten-years postburn in this monitoring type, mean total fuel load was 71% of preburn levels, with wood, litter, and duff reaching 127%, 77%, and 37% of preburn levels respectively (n=6 plots; **Figure 4.13-8**).

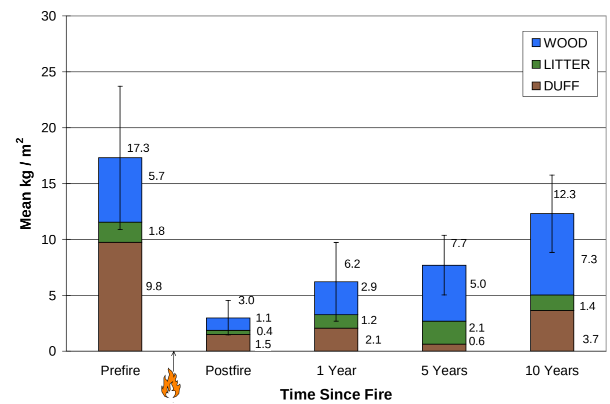

Figure 4.13-8. Fuel accumulation in the White fir-mixed conifer forest type (n=6 plots).

Stand structure and composition

Mean total tree density in the White fir-mixed conifer forest type was reduced by 63%, from 765 ± 280 trees/ha preburn to 345 ± 55 trees/ha ten-years postburn (n=6 plots; **Figure 4.13-9**). Species composition changed very little over this time period, with only 1-2% increases or decreases in species' relative density. Tree diameter distribution changed following fire, with the ten-year postburn mean density of the smaller diameter classes much reduced from preburn densities. The preburn mean densities of the four smallest diameter classes were reduced by 22-84% ten years postburn (n=6 plots). This reduction includes mortality, as well as live tree growth into larger size classes over time. The density reduction was generally smaller as size class increased, with a 14% increase in mean density for trees >100 cm.

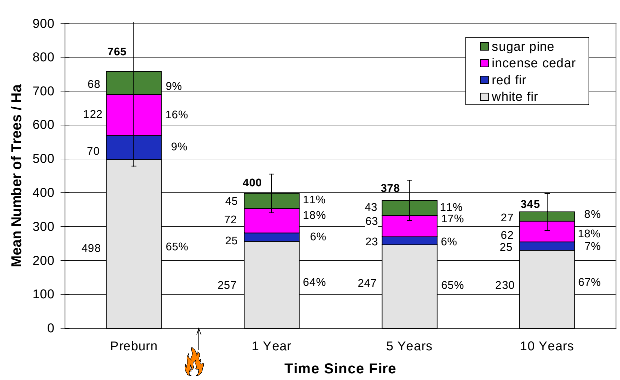

Figure 4.13-9. Stand density by species composition in the White fir-mixed conifer forest type (n=6 plots).

Management implications of results

The total fuel reduction objective of 60-80% is met in the White fir-mixed conifer forest. The mean tree density for trees <80 cm DBH is 316 ± 43 trees/hectare five years postburn (n=10 plots), still well above the target range maximum of 250 trees/hectare. Another burn will likely be needed to further reduce the small tree density to within the target range.

Low elevation-mixed conifer forest

Fuel load

In the Low elevation-mixed conifer forest type, mean total fuel load was 19.5 ± 5.3 kg/m^2 preburn (87.1 ± 23.4 tons/acre) and 3.1 ± 1.9 kg/m^2 immediately postburn (13.6 ± 8.3 tons/acre) (n=5 plots; **Figure 4.13-10**). The mean total fuel load was, therefore, reduced by 84% immediately postburn, exceeding the parks' fire management objective of 60-80% total fuel reduction. Woody fuel was reduced by 65%, while a greater proportion of litter and duff (93% and 95%, respectively) was consumed in the fires. Two years postburn, total fuel load accumulated to 31% of preburn levels (n=5 plots; **Figure 4.13-10**). By two years postburn, litter and wood reached 41% and 59% of preburn levels, respectively, while duff accumulated at a slower rate, reaching only 7% of preburn levels.

Stand structure and composition

Mean total tree density in the Low elevation-mixed conifer forest type was reduced by 66%, from 1236 ± 218 trees/ha preburn to 416 ± 193 trees/ha two-years postburn (n=5 plots; **Figure 4.13-11**). Relative species composition changed only slightly over this time period, with white fir and canyon live oak relative density decreasing by 2-5%, and sugar pine, black oak, incense cedar, and ponderosa pine increasing by 1-4% two-years postburn (**Figure 4.13-11**). Tree diameter distribution changed greatly following fire, with the two-year postburn mean density of the smaller diameter classes dramatically reduced from preburn densities. The preburn mean densities of the four smallest diameter classes were reduced by 27-86% two years postburn (n=5 plots; **Figure 4.13-12**). Some larger tree density reduction occurred in this type. Density reduction in the six largest diameter classes ranged from 0 to 56% (**Figure 4.13-12**).

Management implications of results

The fuel reduction objective was exceeded in these plots and fuel accumulated faster than in other forest types, especially for woody fuels (59% of preburn woody fuel level by two years postburn). This fuel accumulation is due to the high amount of postburn tree mortality (66%) that occurred in the plots. The mean tree density for trees <80 cm DBH is 396 ± 193 trees/hectare two years postburn (n=5 plots), still well above the target range maximum of 250 trees/hectare. Perhaps further mortality will occur by the five-year postburn visit and/or another burn may be needed to further reduce the small tree density to within the target range. While longer-term data does not yet exist for these plots, and the sample

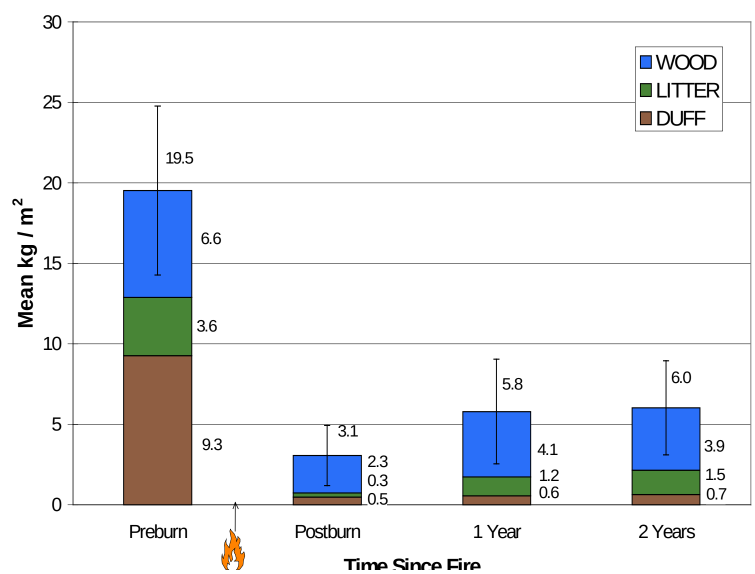

Figure 4.13-10. Fuel accumulation in the Low elevation-mixed conifer forest (n=5 plots).

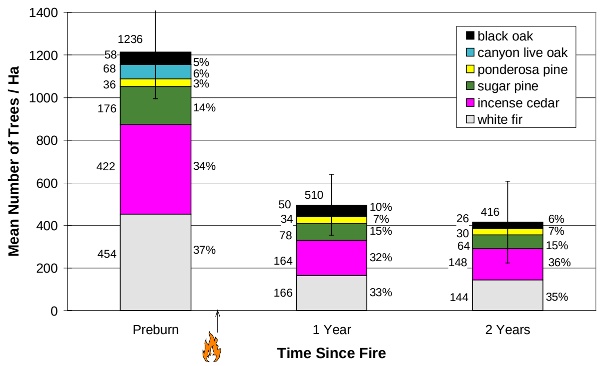

Figure 4.13-11. Stand density by species composition in the Low elevation-mixed conifer forest (n=5 plots).

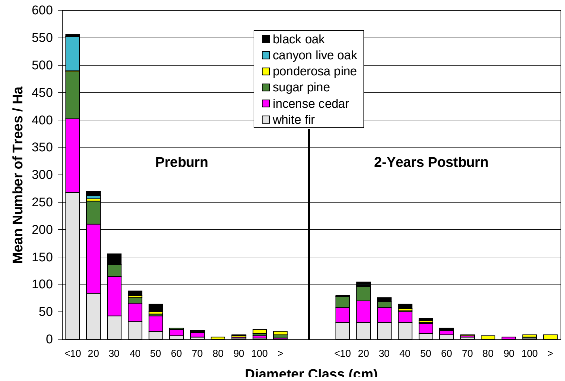

Figure 4.13-12. Stand density by diameter class in the Low elev.-mixed conifer forest (n=5 plots).

size is small, data from these two-year postburn plots indicate that reburning may be warranted sooner than in other forest types to prevent fuels from accumulating to preburn levels.

Ponderosa pine-dominated forest

Fuel load

Mean total fuel load in the Ponderosa pine-dominated forest type was 16.6 ± 4.2 kg/m^2 preburn (74.0 ± 18.7 tons/acre) and 0.4 ± 0.4 kg/m^2 immediately postburn (1.9 ± 1.8 ton/acre) (n=4 plots; **Figure 4.13-13**). The mean total fuel load was therefore reduced by 97% immediately postburn, exceeding the parks' fire management objective of 60-80% total fuel reduction. Woody fuel was reduced by 98%, while litter was reduced by 92% and the duff was completely consumed (100%) in the fires. Five years postburn, total fuel load accumulated to 22% of preburn levels (n=4 plots; **Figure 4.13-13**). Woody fuel reached 13% of preburn levels five-years postburn, while litter and duff accumulated proportionally more quickly, reaching 37% and 45% of preburn levels respectively, in this monitoring type.

Stand structure and composition

Mean total tree density in the Ponderosa pine-dominated forest type was reduced by 63%, from 420 ± 197 trees/ha preburn to 143 ± 22 trees/ha five-years postburn (n=4 plots; **Figure 4.13-14**). Species composition changed slightly over this time period. The relative density of incense cedar (*Calocedrus decurrens*) and black oak (*Quercus kellogii*) increased by 5% each, while the relative density of canyon live oak (*Quercus chrysolepis*) decreased by 2% and ponderosa pine (*Pinus ponderosa*) decreased by 7% five-years postburn (**Figure 4.13-14**). Tree diameter distribution changed following fire, with the five-year postburn mean density of the smaller diameter classes much reduced from preburn densities. The preburn mean densities of the four smallest diameter classes were reduced by 55-97% five years postburn (n=4 plots; **Figure 4.13-15**). Unlike the other forest monitoring types, reduction in tree density is relatively high in some of the larger size classes of trees in this type. Density reduction in the six largest diameter classes ranged from 18 to 100% (**Figure 4.13-15**).

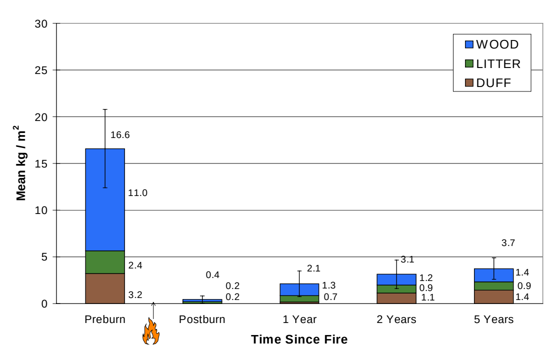

Figure 4.13-13. Fuel reduction and accumulation in the Ponderosa pine-dominated forest type (n=4 plots).

Nearly all of these larger trees are ponderosa pines; however, where 100% reduction occurred in a diameter class, the sample included only 1 tree.

Management implications of results

Fuel accumulation occurred somewhat more slowly in the Ponderosa pine-dominated plots than in the mixed conifer forest types. The mortality of larger ponderosa pines following prescribed fire in this type prompted a separate study to determine the ages of the large pines killed. Data from this study has not been completely analyzed yet, but we hope to determine whether trees killed had been established before or after Euro-American settlement and resulting changes in the historic fire regime. We may also initiate a study in this forest type to determine whether removing some of the litter and duff at the base of the large tree boles reduces the amount mortality.

During the 1998 season, a dramatic increase in the abundance and vigor of cheatgrass (*Bromus tectorum*) was observed on the valley floor of Kings Canyon (comprised primarily of Ponderosa pine-dominated forest). Cheatgrass is a highly invasive, exotic species, which has impacted many areas of the west and until now, was present only in relatively small numbers within the parks. Burning in areas of dense cheatgrass has been suspended until an action plan can be developed to assess the effects that prescribed burning may have on the spread of this non-native species. One small area was burned in 1998 and additional data was collected by the parks' Plant Ecologist to get a preliminary assessment of cheatgrass response to burning. One fire effects plot was located in the area reburned and results indicate that cheatgrass percent cover was 28% prior to the reburn, reduced to 3% immediately postburn, and then increased to 32% one-year following the reburn. Since these results are from a single plot, no conclusions can be drawn from this information at this time, however, the additional data collected by the Plant Ecologist will be examined to see if the same trend occurred.

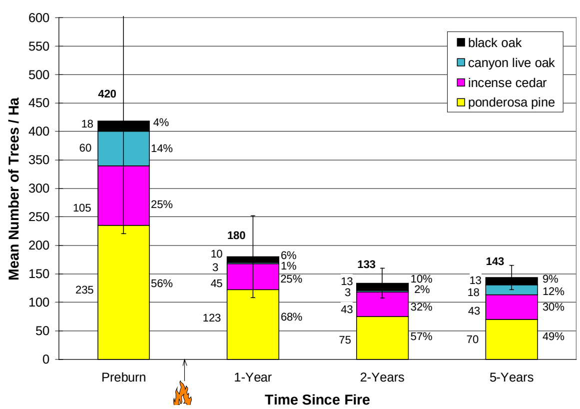

Figure 4.13-14. Stand density by species composition in the Ponderosa pine-dominated forest (n=4 plots).

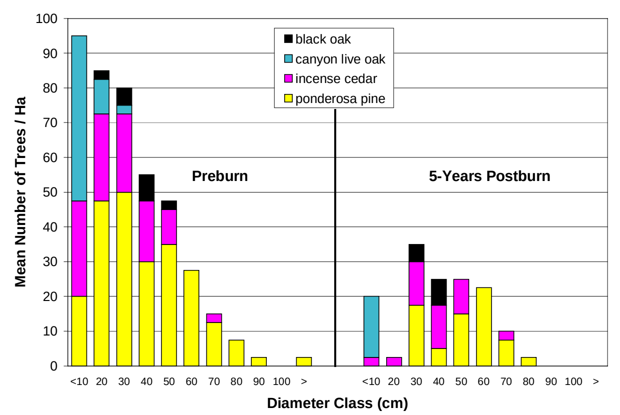

Figure 4.13-15. Stand density by diameter class in the Ponderosa pine-dominated forest (n=4 plots).

Red fir forest

Fuel load

In the Red fir forest type, preburn mean total fuel load was 27.6 ± 10.9 kg/m^2 (123.1 ± 48.6 tons/acre) and 5.0 ± 4.0 kg/m^2 one-year postburn (22.3 ± 17.8 tons/acre) (n=3 plots; **Figure 4.13-16**). The mean total fuel load was therefore reduced by 82% 1-yr postburn, slightly exceeding the parks' fire management objective of 60-80% total fuel reduction. Woody fuel was reduced by 92%, while 75% of duff was consumed in the fire. By two years postburn, in two of the plots, little fuel accumulation had occurred (14% of preburn total fuel load). Wood and duff reached 6% and 15% of preburn levels respectively, while 58% of preburn litter accumulated by two-years postburn (**Figure 4.13-17**). Note that the preburn mean total fuel load is much higher in this type than any other monitoring type (27.6 kg/m^2). When including 3 other Red fir forest plots that have not yet burned, the preburn mean is only 18.56 ± 7.33 kg/m^2. Apparently, two of the plots that have burned, both located on south-facing slopes, have much higher fuel loads when compared to plots located on north-facing slopes in this monitoring type.

Stand structure and composition

Mean total tree density in the Red fir forest type was reduced by 24%, from 210 ± 189 trees/ha preburn to 160 ± 94 trees/ha two-years postburn (n=2 plots; **Figure 4.13-18**). Species composition changed little since this type is composed of nearly pure red fir. Tree diameter distribution changed somewhat following fire. The preburn mean densities of the four smallest diameter classes were reduced by 0-62% two years postburn (n=2 plots; **Figure 4.13-19**). Note that the third red fir plot that burned this year is not included in the tree density results as tree mortality is not often not detectable immediately postburn.

Management implications of results

The sample size is too small to make any general statements about implications for management at this time.

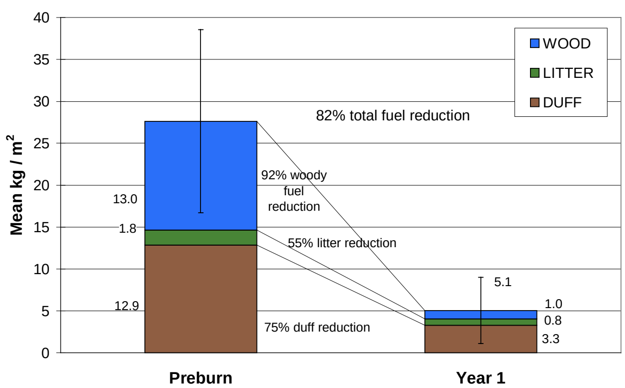

Figure 4.13-16. Fuel reduction in the Red fir forest type (n=3 plots).

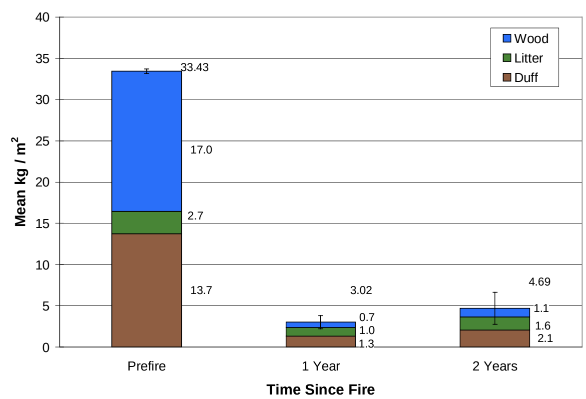

Figure 4.13-17. Fuel accumulation in the Red fir forest type (n=2 plots).

Mixed chaparral

Postburn conditions

The burn severity rating mean was 4.5 (unburned to scorched) for organic substrate and 4.0 (scorched) for vegetation indicating very low severity fire burned through these two plots.

Cover by lifeform

Mean percent cover changed only slightly for live shrubs (all shrub species combined), from 88.6 ± 20.0% preburn to 82.5 ± 4.6% one-year postburn to 86.0 ± 3.1 two-years postburn (**Figure 4.13-20**). Live tree (all tree species combined) and substrate mean percent cover also decreased slightly, while mean percent cover for grasses (all grass species combined) was slightly reduced one-year postburn but then returned to the preburn value two-years postburn. Substrate includes organic material (leaf litter or wood) as well as mineral soil, ash, or rock. Mean percent cover for forbs (all forb species combined) increased from 2.0 ± 6.2% preburn to 8.5 ± 23.1% one-year postburn and then a large increase to 41.5 ± 103.1% two-years postburn (**Figure 4.13-20**). Note that percent cover can total more than 100% as

more than one lifeform (or species) can occur at a sampling point. These results indicate that the only major change in cover of vegetative lifeform categories was a large increase in forbs, however, with such a small sample size (2 plots), broad conclusions cannot be drawn from these data alone.

Cover by species

Mean percent cover for live *Arctostaphylos mewukka*, the dominant species, changed very little between preburn (70.2%) and one-year postburn (69.0%) visits, but decreased by about 20% by two-years postburn (**Figure 4.13-21**). Black oak (*Quercus kellogii)* and bear clover (*Chamaebatia foliolosa*) decreased somewhat in mean percent cover. Flannelbush (*Fremontodendron californicum*) mean percent cover decreased one-year postburn but then increased two-years postburn (**Figure 4.13-21**). Mountain mahogany (*Cercocarpus betuloides*) mean percent cover increased from 16.5 ± 13.9% preburn to 28.5 ± 38.5% one-year postburn. The large increase in forbs can be attributed primarily to one species, miner's

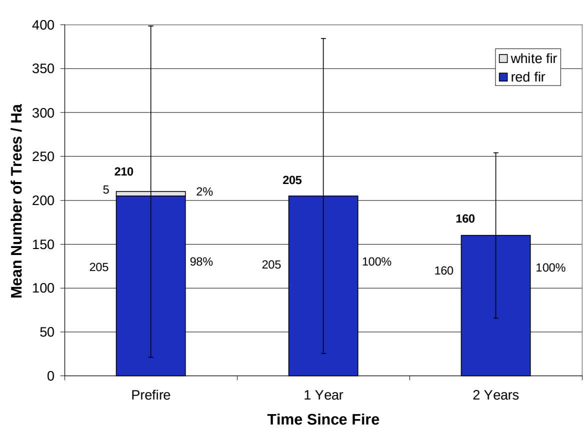

Figure 4.13-18. Stand density by species composition in the Red fir forest type (n=2 plots).

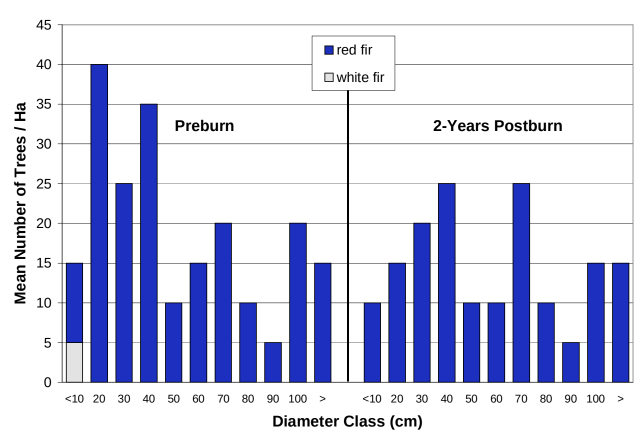

Figure 4.13-19. Stand density by diameter class in the Red fir forest type (n=2 plots).

lettuce (*Claytonia perfoliata*) which was not detected preburn but had a mean percent cover of 37.0 ± 95.4% five years after the fire. Cheatgrass (*Bromus tectorum*), a highly invasive exotic grass, was found within these plots before burning. The mean percent cover of cheatgrass decreased slightly, from 2.5 ± 1.5% preburn to 1.5 ± 4.6% one-year postburn but then increased to 4.5 ± 4.6 two-years postburn. The sample size is too small to make any conclusions about changes observed in cheatgrass cover following burning.

Management implications of results

Newly developed target conditions for brush monitoring types are stated in terms of the amount of landscape within a certain range of shrub cover. These targets have not yet been translated into specific objectives for a monitoring type. Although the sample size is small (2 plots), little change in shrub cover was observed in the two plots as a result of the low severity of the burn. If a reduction in shrub cover is desired, the fire severity will need to be higher in this brush type.

Chamise chaparral

Postburn conditions

The burn severity rating mean for both organic substrate and vegetation was 1.9, indicating that the estimate of severity ranged from moderately to heavily burned.

Cover by lifeform

Mean percent cover for live shrubs (all species combined) decreased by 84% from 93.0 ± 6.6% preburn to 15.0 ± 28.3% postburn. An increase to 26.0 ± 25.6% one-year postburn indicates that postburn resprouting occurred (**Figure 4.13-22**). A corresponding increase in mean percent cover of substrate occurred, from 7.0 ± 3.5% preburn to 74.0 ± 16.1% postburn indicating that much of the vegetative cover was consumed during the burn.

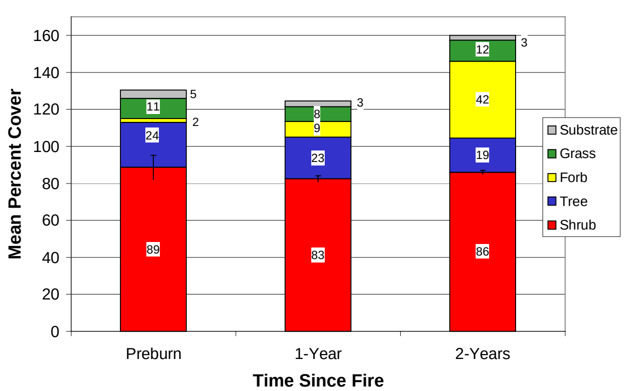

Figure 4.13-20. Percent cover by lifeform in the Mixed chaparral type (n=2 plots).

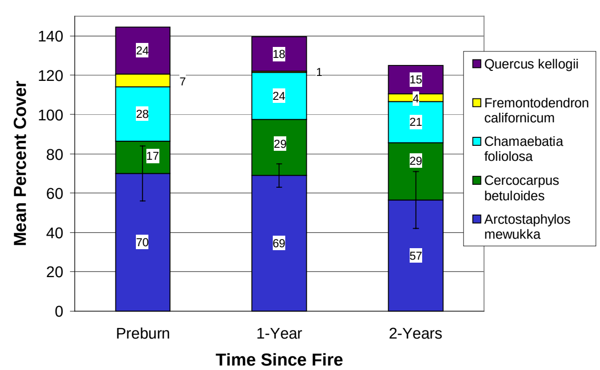

Figure 4.13-21. Percent cover by species in the Mixed chaparral type (n=2 plots).

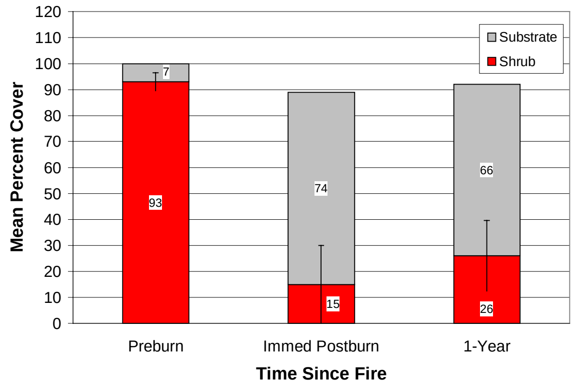

Figure 4.13-22. Percent cover by lifeform in the Chamise chaparral type (n=3 plots).

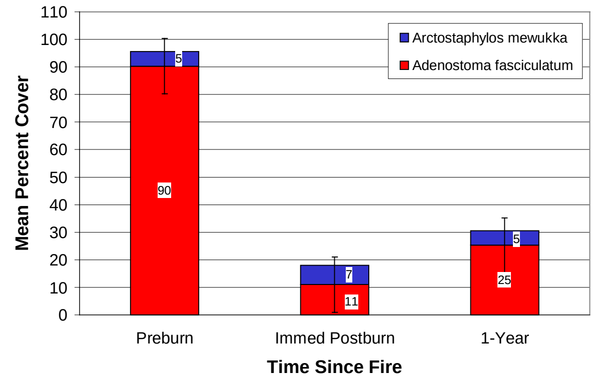

Figure 4.13-23. Percent cover by species in the Chamise chaparral type (n=3 plots).

Cover by species

Mean percent cover for live chamise, the dominant species, was reduced by 88% from 90.3 ± 11.6% preburn to 11.0 ± 20.7% postburn (**Figure 4.13-23**). Mean percent cover increased to 25.3 ± 16.4% one-year postburn, indicating resprouting occurred. *Arctostaphylos mewukka* mean cover increased slightly, between the preburn and immediate postburn measurements, likely due to slight differences in transect location from one visit to the next (an artifact of sampling).

Management implications of results

Newly developed target conditions for brush monitoring types are stated in terms of the amount of landscape within a certain range of shrub cover. These targets have not yet been translated into specific objectives for a monitoring type. The park staff recognizes the need for burning in chaparral to reduce fuel hazard and to restore fire to vegetation communities where fire has historically been an important component. Shrub cover in the Chamise chaparral type was greatly reduced immediately postburn and with continued monitoring over time, the subsequent increase in shrub cover will be measured.

Montane chaparral

Brush cover

ve shrub cover (all species combined) was reduced from 68.3 ± 10.6% preburn to 0.5 ± 0.5% one-year postburn, increased to 2.3 ± 1.4% two-years postburn followed by a large increase to 18.0 ± 6.0% by five-years postburn (n=4 plots; **Figure 4.13-24**). Forb and grass cover increased steadily from 0.2 to 24.8% and from 9.0 to 52.0%, respectively, from preburn to fives years following fire. Species that decreased in percent cover include greenleaf manzanita (*Arctostaphylos patula*) and sagebrush (*Artemesia tridenta*). While mountain whitethorn (*Ceanothus cordulatus*) decreased slightly in the first years following fire, a large increase occurred by five years postburn. Western needlegrass (*Achnatherum occidentalis*), blue wildrye (*Elymus glaucus*), and broad-leaved lotus (*Lotus crassifolius*) all increased in relative cover.

One plot could not be relocated this year and therefore is not included in the analysis. These plots were all opportunistically located within one prescribed natural fire, therefore, results do not apply to other areas that may fit the monitoring type description. Specific objectives do not exist for Montane chaparral because it is not a monitoring type where prescribed burning generally occurs.

PLANS FOR 2000

The number of plot visits will increase to 26 remeasurements and the potential for at least 9 immediate postburn plots next year. In addition, up to 15 new plots may be installed depending on the units that will actually burn in 2000.

Figure 4.13-24. Percent cover by lifeform in the Montane chaparral type (n=4 plots).

REFERENCES

Keifer, M., N. Stephenson, and J. Manley. In press. Prescribed fire as the minimum tool for wilderness fire regime restoration: a case study from the Sierra Nevada, California. In: Cole, David N.; McCool, Stephen F. 2000. Proceedings: Wilderness Science in a Time of Change. Proc. RMRS-P-000. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.Wilderness Science in a Time of Change. Missoula, MT, May 23-27, 1999.

Western Region Prescribed and Natural Fire Monitoring Task Force. 1992. Western Region Fire Monitoring Handbook. USDI National Park Service, Western Region, San Francisco, CA. 134 pp.