Kilgore and Biswell. 1971. Seedling Germination Following Fire in a Giant Sequoia Forest.
Calif. Agri. Feb. 1971.

In this hot spot at Redwood Mountain, convection columns of heat rose high into the canopy, killed sequoia and fir needles, dried out sequoia cones, and apparently led to unusually heavy seed fall on an ideal seedbed. More than 40,000 seedlings per acre germinated on this site (photo by Harold Weaver).

Seedling germination following fire in a GIANT SEQUOIA FOREST

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NATURAL FIRE is recognized by the National Park Service as one of the ecological factors contributing to the perpetuation of plants and animals in a given habitat. As such, fires in national parks resulting from natural causes may be allowed to run their course under specified conditions. Prescribed fire may be used as a substitute for natural fire where this can achieve approved vegetation or wildlife management objectives. To provide the facts upon which to base such a program, researchers at Sequoia and Kings Canyon National Parks are studying the role of fire in various plant communities; of greatest interest at this time are forests of the giant sequoia- mixed conifer type.

Research has indicated that fire plays an important role in the germination and survival of the giant sequoia. Studies at Whitaker's Forest, on the western slope of Redwood Mountain, show that in the absence of fire, shrubs have become increasingly scarce during the past 90 years, thus reducing the value of these areas for deer and other wildlife. Many such shrubs have hard seed coats which prevent germination unless cracked by fire.

Unburned forest (left) along the Redwood Mountain trail, July, 1966. The same site in June, 1970 (right) after burning. Note unusual fire scar on lefthand sequoia (Harold Weaver photos).

The present study records the impact of prescribed burning on germination of seedlings of sequoia and various shrub species.

In the first major effort, some 100 acres of giant sequoia forest were burned under prescribed conditions in late summer or early fall of 1969 on the ridge of Redwood Mountain in Kings Canyon National Park. The management objective was to reduce the fire hazard along this western boundary of the largest grove of giant sequoias (3,100 acres) and to help begin to restore natural conditions to the adjacent National Park environment. Data on germination of sequoia and shrub seedlings were collected on three burn plots and an adjacent control plot in mid-summer of 1970, one year after burning.

Before ignition, the 100-acre unit was divided into 13 sectors and each sector was surrounded by small, hand-built fire lines. In the three study units, relatively intensive pre-burn preparations were made. White fir and incense-cedar less than 9 inches dbh (diameter breast high) were felled and left to be consumed by the fire. Snags except sequoias were felled. Two-foot hand lines were built around most sequoias. Fire hose was run to all sectors, and charged lines were available for use at any point along the sector perimeter being burned.

SEQUOIA AND DEERBRUSH SEEDLING RESPONSE TO 1969 BURNING AT REDWOOD MOUNTAIN

Plot No.	Size	Mature sequoia*		Seedling sequoia		Seedling deerbrush	
	acres	no. per plot	no. per acre	no. per transect	no. per acre	no. per transect	no. per acre
Burn #1	3.75	11	2.9	138	7,514	120	6,534
Burn #2	6.10	28	4.6	337	18,350	53	2,886
Burn #3	6.25	58	9.3	737	40,130	4	218
Burn plots totals	16.10	97		1,212		177	
Means			6.0		21,998		3,213
Control	5.30	31	5.8	...	.....	...	....

* Trees more than six feet diameter at a height of 4.5 ft.

In general, a prescription developed by Harry Schimke of the Forest Service Experiment Station in Berkeley was followed, with ignition taking place at the ridgetop at about noon. Occasionally strip burning was employed to speed up the process, but only short distances were found to be feasible without running risk of a hotter fire than desired.

Four transects were run through the study plots, three in burn plots and one in the control plot. A record was kept of the number of tree and shrub seed- lings found in 4 ft x 4 ft microplots at 25-ft intervals along each transect. There were 50 microplots in each transect.

The numbers of sequoia and deerbrush seedlings which germinated on the four plots are shown in the table. On plot 3, which burned hottest, more than 40,000 sequoia seedlings per acre were found, while on the lighter burned plot 1, some 7,500 seedlings per acre were recorded. On the other hand, more than 6,500 deerbrush seedlings per acre were re- corded on the lightly burned plot 1, with only 218 per acre on the heavy burned area. Not a single sequoia or shrub seed- ling was found on the control plot, while the three burn plots averaged nearly 22,000 sequoia seedlings per acre and more than 3,200 deerbrush seedlings per acre.

A possible relationship with seed source is clear from the table, which shows more than nine sequoia greater than 6 ft dbh per acre on burn plot 3, compared with fewer than 3 per acre for burn plot 1. Thus, the most productive burn plot had both the greatest numbers of large sequoias per acre and the hottest burning conditions. It appears that the rising convection column of heat, which dried out and killed sequoia needles more than 100 ft up m three trees on plot 3, may have also caused drying and opening of sequoia cones on several of these same trees and hence contributed to very heavy seed fall in the area of the hottest burn. The extremely large numbers of sequoia seedlings germinating in plot 3 were probably related to both ideal seedbed conditions and heavy seedfall. From 50 to more than 200 seedlings were counted in a number of the 4-ft-square microplots. The greater numbers of deerbrush seedlings on the lightly burned area is explained by the fact that heavy burning conditions destroy seeds, while lesser temperatures crack seed coats and allow germination.

In addition to deerbrush, smaller numbers of littleleaf ceanothus and greenleaf manzanita were also found on the burn plots. A few seedling white fir germinated in each burn area, thus confirming earlier findings that white fir also benefit by conditions following burning. For giant sequoia, however, such conditions are almost essential.

Dry weight samples of ground fuels from unburned sites adjacent to the burned plots indicated that more than 12 tons of flash fuels and 36 tons of duff are found per acre in this giant sequoia forest, prior to burning. This does not include logs more than 12 inches in diameter. After burning, samples from heavy and moderately

burned segments of the burn plots indicated about 2 tons of flash fuels per acre and 7% tons of duff per acre remained. This is an 80 per cent decrease in ground fuels, presumably resulting in a considerable de- crease in fire hazard in the area.

These results confirm the importance of fire in the early stages of establishment of giant sequoia and various brush species found in the mixed conifer forest in California. The Park Service policy of trying to restore natural environmental processes to natural areas of the national parks should (1) aid the re-establishment of shrubs as a significant part of the habitat of these montane forests, (2) insure a continual supply of young sequoias to replace the 2,000-year-old mature trees, and (3) decrease the unnaturally high fire hazard in these forests.

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The extreme density of sequoia seedlings which germinated in-certain areas after burning is shown in this photo of a l-sq-ft sampling frame. More than 50 seedlings are shown here.