

Fire Effects in Blue Oak Woodland¹

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Abstract: Mortality and resprouting of shrubs and trees were assessed in one recent fire and 11 older burns in blue oak woodland in the southern Sierra Nevada foothills. This poster reported results for blue oak. Survival following fire was high; with a 93 percent two year postfire survival rate after one intensively studied fire, despite a large number of trees with 100 percent crown scorch. Differences between sites accounted for most of the variability in mortality. Tree diameter was a minor component in mortality variability. Diameter was more important in resprouting, with most resprouting occurring in trees 20 cm DBH or less.

Blue oak (*Quercus douglasii* H.& A.) in the southern Sierra Nevada foothills exist in a highly flammable environment. Despite this fact, relatively little is known about the effects of fire on blue oak woodlands. Two recent studies (McClaran 1986, Mensing 1988) found strong relationships between known fire dates and establishment of new trees, as determined from fire scar histories and age/size relationships. Both studies suggested an important role for postfire resprouting of blue oak in maintaining blue oak in the stands. McClaran (1986) found a positive relationship between fire dates and new establishment on two Yuba County sites. Mensing (1988) reported that more than half of the trees on his Tehachapi Mountains study site established as sprouts in a single year.

This study looked at a recently burned stand and an adjacent control, and 11 other sites which had burned within the last ten years. All sites were within the Kaweah River watershed of the southern Sierra Nevada, Tulare County, California. Land ownership included Bureau of Land Management, National Park Service, and private properties. Most sites (eight) were within Sequoia National Park, where 60 percent or more of the blue oak woodland has burned within the last thirty years, much of that within the last ten years. Elevation of the sites ranged from 390 m to 951 m. Rainfall at the National Park Service Ash Mountain Headquarters, a National Oceanic and Atmospheric Administration weather station, averages 65 cm. A strong elevational gradient in rainfall exists in the Kaweah River drainage.

The fires which burned the sites ranged from low intensity prescribed burns to high intensity wildfires resulting from arson and accidental ignitions such as car fires or powerline

failures. Blue oak is found in open, nearly pure stands, in mixed woodlands with other trees, or with a significant brush component. These fuel characteristics influenced the severity of each fire, as did existing weather, ignition source and direction of fire spread.

METHODS

Following an arson ignited wildfire in Sequoia National Park, a sample of trees was selected by the point centered quarter method to be followed for two years. Variables measured shortly after burning were species and size of tree, live or dead, degree of crown scorch and bole char and such damage factors as presence of fire scars, mistletoe or insects. Subsequent visits in 1988 and 1989 recorded new mortality, sprouting and formation of new fire scars.

RESULTS AND DISCUSSION

Over a two year period blue oak had a 93 percent survival rate, despite a large number of trees with complete crown scorch (table 1). Interior live oak (*Quercus wislizenii*) had a 79 percent survival rate and a lower tolerance to complete crown scorch (table 2). However, 50 percent of the interior live oak individuals resprouted basally within the first year while only 15 percent of the blue oak resprouted in the first year.

Many blue oak developed crown sprouts within the first year (fig. 1) and crown sprouts were observed as soon as two weeks after the burn. New scars formed on a majority of the trees (fig. 2). Larger trees showed less scarring, but fire scar studies have shown intact trees can hide a number of old fire scars (McClaran 1988).

Table 1—Survival of crown scorched blue oak after Ash Mountain fire (no. of live trees).

Year	Percent Crown Scorched			
	<25	>25-50	>50-95	100
1987	39	20	22	36
1988	39	19	22	36
1989	39	19	21	30

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Table 2—Survival of crown scorched interior live oak (no. of live trees).

Year	Percent Crown Scorched			100
	<25	>25-50	>50-95	
1987	9	7	7	8
1988	9	7	7	2
1989	9	7	4	2

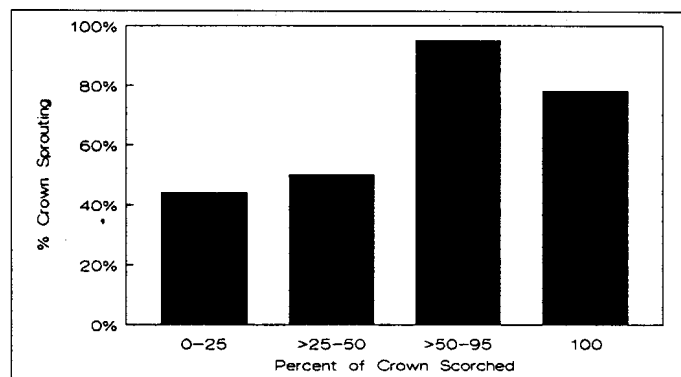


Figure 1—Crown sprouting in scorched blue oak, Ash Mountain fire.

A more extensive survey of 11 other sites which had burned within the ten years prior to the initiation of the study was also conducted (table 3). All sites were sampled by means of circular fixed area plots .05 ha in size. Tree and shrub species composition, size of trees, counts of shrubs and seedlings by species, and presence of resprouts, scars and native grasses were recorded

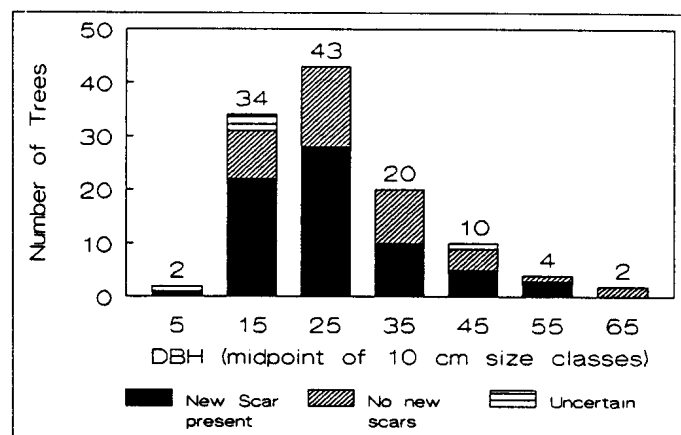


Figure 2—New scar formation on blue oak following Ash Mountain fire.

Table 3—Physical and vegetative characteristics of sites.

Number	1	2	3	4	5	6	7
Site	Ash Mtn	Control	Moore	Lagoon	Potwisha	Three Rivers	Stewart
Elevation (m)	579	585	390	523	732	488	829
Aspect	SW-SE-E	E-SE	N-NW	S	S	NE-NW	S-SE
Slope (pct)	45-80	40-60	30	16	45	45	43
Size (ha)	68	—	20	<2	52	238	46
Year Burned	1987	—	1980	1984	1981	1984	1984
Tree Density in numbers/ha (pct Blue Oak)							
Live	144(76)	212(82)	62(85)	248(98)	120(92)	67(100)	38(95)
Dead	95(5)	16(80)	82(71)	12(67)	158(75)	90(98)	40(60)
Number	8	9	10	11	12	13	
Site	Shepherd	Buckeye	Min. King	Yucca	Dinely	North Fork	
Elevation (m)	701	951	640	646	390	610	
Aspect	S-SE	S-SE	NE	W	SE	NW-SE	
Slope (pct)	50	50	40	25	48	20	
Size (ha)	50	1245	23	23	53	61	
Year Burned	1979	1988	1987	1979	1984	1979	
Tree Density in numbers/ha (pct Blue Oak)							
Live	78(78)	328(92)	148(57)	378(94)	58(76)	357(95)	
Dead	49(49)	190(84)	123(15)	8(100)	49(69)	33(85)	

for each plot as well as general site information. Observations were made on a total of 1481 trees, over 1200 of which were blue oak.

Mean mortality of blue oak was quite low, with the smallest (≤ 10 cm DBH) and larger (≥ 40.0 cm DBH) size classes experiencing greatest mortality (fig. 3). Topkill, defined as death of the bole with successful resprouting, generally did not occur in trees over 20 cm DBH (fig. 4). In trees 5 cm DBH or less topkill slightly exceeded mortality.

Preliminary data analysis by ANOVA found significant differences in blue oak mortality between sites ($p < .001$). In blue oak, site accounted for 98 percent of the variation in the mortality response, with 2 percent attributable to size. Further analysis will look at the site characteristics which resulted in variation in mortality and resprouting responses.

CONCLUSION

Despite an emphasis on blue oak, a community wide perspective to fire effects is the final goal of this study. An understanding of fire interactions in the foothill region will be important to the National Park Service in its efforts to 1) where possible, restore fire to a more natural role in the preservation, or restoration and maintenance, of the foothill woodland and chaparral communities, and 2) provide an adequate level of fire protection within developed areas and adjacent to land management boundaries while acknowledging the repercussions of fire suppression.

REFERENCES

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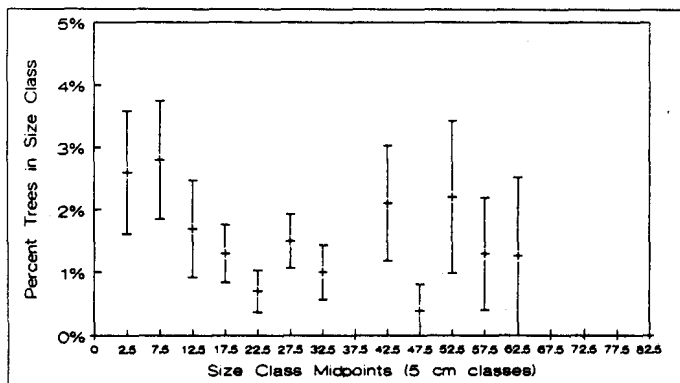


Figure 3—Mean and standard error of blue oak mortality by size class on burned sites.

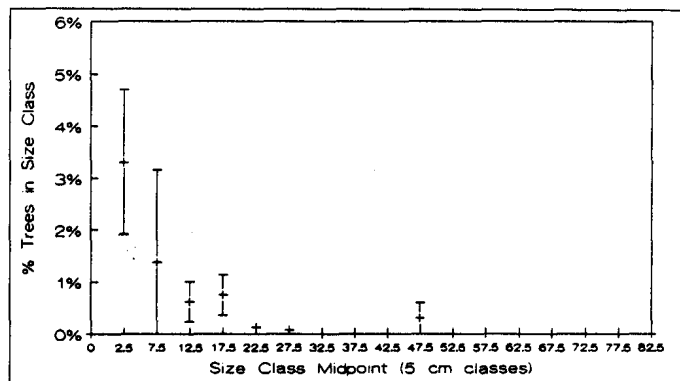


Figure 4—Mean and standard error of topkilled blue oak by size class on burned sites.