

Photo Series for Quantifying Fuels and Assessing Fire Risk in Giant Sequoia Groves

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Introduction

The giant sequoia (*Sequoiadendron giganteum* Lindl. Buchholz.) of the Sierra Nevada is among the most highly valued tree species in North America. Approximately 75 giant sequoia groves exist throughout the natural range, a 420- by 24-km belt in central California. Groves occupy a combined area of 14,410 ha (Weatherspoon 1990). Fire is an important part of the giant sequoia/mixed conifer forest type. Fire is essential to the continued vigor of this type and plays many roles ranging from fuel reduction and nutrient cycling to seedbed preparation and serotinous cone opening (Barbour and others 1980). However, effective fire exclusion in this century has caused dead and live fuel loadings to increase in many groves. Fire-free intervals ranged from 5 to 18 years during the time period 1700 to 1875 for a 4,500-acre area in the giant sequoia-mixed conifer type (Kilgore and

Taylor 1979). Fuel reduction has been accomplished using prescribed fire and thinning (Benson 1986, Harrison 1986, Parsons and Nichols 1986, Rogers 1986). These treatments have resulted in a wide range of stand and fuel conditions that affect the fire hazard potential as well as the esthetics of the groves.

Fire hazard analysis requires an inventory of the combustible natural fuels present in each grove. This inventory can be costly and time consuming even though the total area occupied by the giant sequoia type is small compared to other forest cover types. Photo series are often used to quickly provide rough estimates of the amount of fuel in a stand (Maxwell and Ward 1976) by providing a series of photographs that can be used to estimate the loading of each fuel component separately. Thus a composite loading for the site could be derived by

summing the components from different photographs. Standard procedures to ensure compatibility of photo series have been developed (Maxwell and Ward 1980).

Photo series have been developed for a wide variety of forest cover types and fuels. Most photo series have been developed for western cover types; however, a small number have been developed for eastern forest types. Recent photo series have included stereo photographs (Ottmar and Hardy 1989, Ottmar and others 1990). The photo series developed by Blonski and Schramel (1981) and Maxwell and Ward (1979) illustrate fuels created by natural processes (natural fuels) and active management (activity fuels), respectively, and are applicable to the Sierra Nevada of California. Other photo series may also be applicable to California fuels.

Development of Photo Series

The photo series presented in this report was developed as an aid to determine fire hazard potential caused by natural and activity fuels in giant sequoia groves; it also illustrates the esthetic impacts of the various treatments used in the selected groves. Nineteen sites representing the range of fuel loading conditions generated by various management activities were identified by Sequoia National Forest staff in cooperation with Sequoia-Kings Canyon National Park and Mountain Home Demonstration State Forest staffs. Sites that were easily accessible and had been logged,

burned, logged and burned, or undisturbed were located in Sequoia National Forest, Sequoia-Kings Canyon National Parks, and Mountain Home Demonstration State Forest. Because multiple activities have occurred in many groves, a description of the activities that resulted in the present fuel condition accompanies each photo.

Photo points were located at each site and permanently identified with reinforcing bar. Locational information such as distance and bearing from a prominent landmark or latitude and longitude determined with a global positioning system was collected for each photo point. This information can be used to reestablish the photo point in the future to monitor the long-term changes associated with various management activities. A 6-foot (1.8-m) pole with 1-foot (0.30-m) increments was placed near the center of the field of view. The design of the inventory plot followed the guidelines developed by Maxwell and Ward (1980).

Five equally spaced lines 150 feet long (45.7 m) radiating from the photo point were established at each location. Dead and downed fuels were inventoried along each line at five sample points. At each sample point, dead and down woody material was sampled and classified along a 30-ft (horizontal distance) sample plane (Brown 1974). A 3-ft (0.91-m) sample plane was used for 0- to 0.25-inch (0 to 0.64-cm) material, 6-ft (1.83-m) for 0.25- to 1-inch (0.65- to 2.54-cm), 10-ft (3.05-m) for 1- to 3-inch (2.54- to 7.62-cm), and 30-ft (9.15-m) for greater than 3-inch (> 7.62-cm)

material. A 0.15-acre (0.06 ha) triangular plot was centered in the field of view. The apex of the equilateral triangular plot (150 ft on a side, 90 ft base) was located at the photo point. Diameter at breast height, total height, and crown height (height to crown base) were estimated for all trees and all snags greater than 8 inches dbh (20.3 cm). Trees less than 8 inches dbh were sampled in six 1/300th-acre (13.5 m²) circular plots, and shrub and grass data were collected using twelve 1/4,000th-acre (1-m²) circular plots. The small plots were located along the 150-ft lines (see Brown 1974 for exact plot configuration). Because of the nature of the sampling scheme, prominent fuels in the photo may or may not have been measured.

Organic material (litter, fermentation, and humus layers) that has accumulated for many years in the groves is quite deep and a significant percentage of the total fuel load. Research has shown that prescribed fires often remove most if not all accumulated organic material. The resulting temperature increase in the mineral soil below the organic layers has been found to be quite significant (Sackett and Haase 1988). Current photo series often list only the depth of the accumulated organic material—not the weight. To determine the actual forest floor loading (all organic material and woody material up to 1-inch diameter) for each photo, twenty-five 1-ft² (0.09-m²) forest floor samples were systematically located within each field of view. Mean forest floor loadings were determined and are included in the Other Measurements section of the

photo point data sheet (Haase and others 1996). Forest floor fuels accounted for as much as 80 percent of the total dead fuel loading at some of the photo points.

For 15 of the 19 photo points, a depth was measured in the center of each side for each undisturbed square-foot forest floor sample because Haase and others (1996) have shown a direct relationship between depth and loading for undisturbed forest floors in giant sequoia/mixed conifer stands. An equation to predict forest floor weight as a function of depth was successfully developed ($R^2 = 0.91$) (Haase and others 1996). The general equation to predict forest floor weights is

$$\text{Loading} = 12.3(\text{depth}) - 2.9,$$

where loading is in tons/acre and depth is in inches. This equation may be used to easily estimate forest floor loading in giant sequoia groves with undisturbed forest floors. The accuracy of this estimate depends on the total percentage of the area that has undisturbed forest floor material.

Information on overstory and understory was collected using various-sized plots. All stems greater than 2 inches were inventoried. Diameter at breast height, total height, and height to live crown (crown height) were measured. Because giant sequoia is a component of the Sierra Nevada mixed-conifer type (Society of American Foresters 1980), the stand description lists the major species for each photo point. No dominant species is assigned. A dominant brush and grass were determined

by selecting the brush type and grass type that occurred most frequently in the sample plots. Mean height and ground cover were calculated from data for all brush and grass species.

Using the Photo Series

Visual inventory of downed woody fuels using the photo series can be made as follows. Each fuel characteristic should be considered separately. It is possible that the composite fuel loading for the site will be derived from several different photos.

1. Observe each characteristic of the woody fuel on the ground, such as size, arrangement, and amount of decay, by walking the site.
2. Select a photo that nearly matches the observed characteristic or two photos that appear to bracket it.
3. Obtain the quantitative value for the characteristic being estimated from the data sheet accompanying the selected photo (or interpolate value between photos).

These steps are repeated for each characteristic desired. If the general area being inventoried has zones of obvious differences in woody fuel loading, consider stratifying the area, making separate determinations for each zone (strata) and calculating the loading for the whole area by weighting and summing the zone loadings.

Fuel characteristics not distinguishable in the photos are duff and litter depth. If values for these characteristics

are desired in an inventory, they must be derived from an independent sampling or observations. If forest floor loading is desired, use the equation developed to estimate forest floor loading for this photo series (Haase and others 1996), or develop an equation that follows procedures outlined in Haase and others (1996).

Fire Behavior Prediction

Fire behavior can be predicted using the fuels information in the photo series combined with appropriate weather and environmental variables. A table containing rate of spread and fireline intensity predictions for a single set of environmental conditions is included in the photo series (*table 1*). This table was developed using the BEHAVE fire behavior prediction system, the fuels information for each photo point, and three sets of weather data—the 10th, 50th, and 90th percentile conditions (Andrews 1986, Andrews and Chase 1989, Burgan and Rothermel 1984). Observations from three weather stations were used. An empirical frequency distribution was determined for each fire behavior input variable (1-, 10-, 100-hr timelag fuel moisture content, wind speed). The values at each station that corresponded to the 10th, 50th, and 90th percentiles for 1-hr, 10-hr, 100-hr timelag fuel moistures and wind speed were selected and used to describe the 10th, 50th, and 90th percentile environmental conditions. Fire behavior predictions were made using the DIRECT

module of the BURN subsystem of the BEHAVE system (Andrews 1986). The 10-m wind speed was adjusted to midflame wind speed by multiplying the wind adjustment factor by the wind speed. The wind adjustment factor presented in this photo series is based on open exposed fuels. The weather station, the photo points assigned to the weather station, and the observed values for fuel moisture and wind speed were also tabulated (*table 2*). Only fuel loadings by size class (1 hr, 10 hr, 100 hr) were used to create the fuel models. The forest floor and 1,000-hr fuel loadings were not used to predict rate of spread, fireline intensity, or flame length. A constant surface-area-to-volume ratio (σ) of 2,000 ft⁻¹ and heat content of 8,000 Btu/lb were assumed for the 1-hour timelag fuel size class. Rate of spread and flame length for the 90th percentile conditions are listed with the fuel and stand information.

This photo series can also be used to illustrate the long-term visual consequences of the various management activities that occur within groves. In addition to the fuels information provided with each photo, a brief narrative description of the disturbance history is included. These disturbances include timber harvest, wildfire, prescribed fire, and recreational use. The photos are arranged by total fuel weight in increasing order.

Plant Species Cited

Common Name	Species Code	Scientific Name
Giant sequoia	SEGI	<i>Sequoiadendron giganteum</i>
Incense-cedar	LIDE	<i>Libocedrus decurrens</i>
White fir	ABCO	<i>Abies concolor</i>
Red fir	ABMA	<i>Abies magnifica</i>
Ponderosa pine	PIPO	<i>Pinus ponderosa</i>
Sugar pine	PILA	<i>Pinus lambertiana</i>
Willow	SASP	<i>Salix</i> sp.
Gooseberry	RISP	<i>Ribes</i> sp.
White thorn	CELE	<i>Ceanothus cordulatus</i>
Bear clover	CHFO	<i>Chamaebatia foliolosa</i>
Dogwood	COSP	<i>Cornus</i> sp.

Metric Equivalentents

1 acre	=	0.4047 hectare
2.471 acres	=	1 hectare
1 foot	=	0.3048 meter
3.281 feet	=	1 meter
1 inch	=	2.54 centimeters
0.3937 inch	=	1 centimeter
1 ton	=	907 kilograms
1 ton/acre	=	2,241 kilograms/hectare

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Table 1—Fire behavior predictions for 10th, 50th, and 90th percentile weather conditions for each giant sequoia/mixed conifer fuel complex for 0, 30, and 60 percent slope.**Slope = 0 pct**

Location	10th percentile			50th percentile			90th percentile		
	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)
Alder Creek 1	2	2	25	5	3	65	9	4	140
Alder Creek 2	1	1	6	3	2	18	6	3	42
Bearskin 1	1	1	3	3	2	21	5	2	40
Bearskin 2	0	0	0	2	1	8	5	2	17
Converse Mtn. 1	1	1	4	2	2	14	4	2	29
Converse Mtn. 2	1	1	4	2	1	11	3	2	24
General Grant 1	0	0	1	1	1	3	2	1	6
General Grant 2	0	0	0	0	0	0	0	0	0
Redwood Mtn. 1	0	0	0	0	0	0	0	0	0
Redwood Mtn. 2	0	0	0	0	0	0	0	0	0
Black Mtn. 1	0	0	0	0	0	1	1	1	1
Black Mtn. 2	1	1	4	2	1	11	3	2	27
Black Mtn. 3	0	0	0	1	1	4	4	2	14
Black Mtn. 4	0	0	0	2	2	18	6	3	61
Black Mtn. 5	0	0	0	1	1	3	3	1	11
Mtn. Home 1	0	0	0	0	1	1	1	1	4
Mtn. Home 2	0	0	1	1	1	3	2	1	11
Mtn. Home 3	0	0	0	2	1	8	5	2	32
Long Meadow	2	1	3	5	1	12	10	2	30

Continued

Table 1, continued

Slope = 30 pct

Location	10th percentile			50th percentile			90th percentile		
	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)
Alder Creek 1	3	2	35	6	3	79	11	5	159
Alder Creek 2	2	1	10	4	2	23	7	3	49
Bearskin 1	1	1	4	4	2	26	6	3	46
Bearskin 2	0	0	0	3	1	10	6	2	20
Converse Mtn. 1	1	1	6	2	2	18	4	2	35
Converse Mtn. 2	1	1	6	2	2	15	4	2	28
General Grant 1	0	1	1	1	1	4	2	1	7
General Grant 2	0	0	0	0	0	0	0	0	0
Redwood Mtn. 1	0	0	0	0	0	0	0	0	0
Redwood Mtn. 2	0	0	0	0	0	0	0	0	0
Black Mtn. 1	0	0	0	0	0	1	1	1	2
Black Mtn. 2	1	1	6	2	2	15	4	2	33
Black Mtn. 3	0	0	0	2	1	5	5	2	16
Black Mtn. 4	0	0	0	3	2	24	7	3	70
Black Mtn. 5	0	0	0	1	1	4	4	1	12
Mtn. Home 1	0	0	1	1	1	2	1	1	5
Mtn. Home 2	1	1	2	1	1	4	3	1	12
Mtn. Home 3	0	0	0	2	1	11	6	2	37
Long Meadow	3	1	6	7	2	17	13	2	37

Continued

Table 1, continued

Slope = 60 pct									
Location	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)	Rate of spread (ch/hr)	Flame length (ft)	Fireline intensity (Btu/ft/sec)
Alder Creek 1	5	3	63	9	4	121	15	5	217
Alder Creek 2	4	2	20	6	2	39	10	3	72
Bearskin 1	2	1	8	6	3	42	9	3	66
Bearskin 2	1	0	1	5	2	18	8	2	28
Converse Mtn. 1	2	2	14	4	2	31	6	3	51
Converse Mtn. 2	2	1	11	3	2	25	5	3	41
General Grant 1	1	1	3	2	1	6	3	1	10
General Grant 2	0	0	0	0	0	0	0	0	0
Redwood Mtn. 1	0	0	0	0	0	0	0	0	0
Redwood Mtn. 2	0	0	0	0	0	0	0	0	0
Black Mtn. 1	0	0	1	1	1	1	1	1	2
Black Mtn. 2	2	2	14	4	2	26	6	3	49
Black Mtn. 3	0	0	0	3	1	9	7	2	22
Black Mtn. 4	0	0	0	5	3	40	10	4	98
Black Mtn. 5	0	0	0	2	1	7	5	2	17
Mtn. Home 1	1	1	2	1	1	4	2	1	8
Mtn. Home 2	1	1	2	2	1	7	4	2	18
Mtn. Home 3	0	0	0	4	2	19	8	3	52
Long Meadow	7	2	15	13	2	33	20	3	59

Table 2—Weather station, photo points assigned to weather stations, and observed 10th, 50th, and 90th percentile values of various fire behavior model inputs for giant sequoia fuel model fire behavior predictions.

Weather station	Photo point	10th percentile				50th percentile				90th percentile			
		1 hr ¹	10 hr	100 hr	Wind ²	1 hr	10 hr	100 hr	Wind	1 hr	10 hr	100 hr	Wind
Park Ridge	Gen. Grant 1, 2 Redwood 1, 2 Converse 1, 2 Bearskin 1, 2	16.0	14.5	16.0	3.5	6.5	8.0	12.0	7.0	5.0	5.0	8.0	11.0
Peppermint	Alder 1, 2 Long Meadow Black Mtn. 1, 2	9.0	11.5	14.5	3.0	4.5	6.0	9.0	6.0	2.5	4.0	5.5	10.0
UHL	Black Mtn. 3, 4, 5 Mtn. Home 1, 2, 3	16.0	27.0	22.0	3.0	7.0	7.0	13.0	6.0	3.0	3.0	8.0	12.0

¹ Moisture content (pct) for 1-hour, 10-hour, and 100-hour timelag fuels.

² Wind speed measured at 20 feet above vegetation. This wind speed is reduced by a wind adjustment factor to estimate the within-stand wind speed (miles / hour).



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	5.6
0 – 0.25	0.1	3 – 6	0.3	0.1	Avg. forest floor depth (in.)	
0.26 – 1	0.5	6 – 10	0.3	0.1	Avg. residue depth (in.)	0.7
1.1 – 3	0.2	10 – 20			Sound residue > 3 in. (pct)	70
3+ sound	0.7	20+			Avg. duff depth (in.)	1.3
3+ rotten	0.2				Avg. sound diam. (in.)	4.2
					Avg. rotten diam. (in.)	4.7
					Avg. diam. (S&R) (in.)	4.3
Total	1.7	Total	0.6	0.2		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior			
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	0		
	Trees per acre	7	7		68	Dominant species	_____	Spread rate (ch/hr)	0		
	Avg. d.b.h. (inches)	21	23		14	Avg. height (in.)	_____	Wind adjustment	0.3		
	Avg. height (ft)	120	110		48	Avg. crown height (in.)	_____				
	Avg. crown height (ft)	70	65			Ground space (pct)	_____				
8 to 20 inches					<i>User notes</i>	Grass and forbs		Remarks Prescribe burned in 1992.			
Trees per acre		74				Dominant species	Unknown forb				
Avg. d.b.h. (inches)		15				Avg. height (in.)	2				
Avg. height (ft)		76				Ground space (pct)	5				
Avg. crown height (ft)		50									
< 8 inches											
Trees per acre			7								
Avg. d.b.h. (inches)			2								
Avg. height (ft)			8								
Avg. crown height (ft)			6								



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	33.1
0 – 0.25	0.3	3 – 6			Avg. forest floor depth (in.)	3.4
0.26 – 1	2.4	6 – 10			Avg. residue depth (in.)	2.9
1.1 – 3	0.3	10 – 20			Sound residue > 3 in. (pct)	0
3+ sound		20+			Avg. duff depth (in.)	3.9
3+ rotten					Avg. sound diam. (in.)	
					Avg. rotten diam. (in.)	
					Avg. diam. (S&R) (in.)	
Total	3.0	Total				

Stand Information

Brush, Shrub, and Grass Information

Fire Behavior

CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	<i>Brush</i>		Fire Behavior	
	Trees per acre	183				20	Dominant species	_____	Flame length (ft)
Avg. d.b.h. (inches)	31				13	Avg. height (in.)	_____	Spread rate (ch/hr)	5
Avg. height (ft)	136				43	Avg. crown height (in.)	_____	Wind adjustment	0.4
Avg. crown height (ft)	65					Ground space (pct)	_____		
8 to 20 inches					<i>User notes</i>	<i>Grass and forbs</i>		<i>Remarks</i>	
Trees per acre	155					Dominant species	Fern	No logging or fires since 1900. This is a control plot.	
Avg. d.b.h. (inches)	12					Avg. height (in.)	5		
Avg. height (ft)	73					Ground space (pct)	10		
Avg. crown height (ft)	28								
< 8 inches									
Trees per acre		27							
Avg. d.b.h. (inches)		3							
Avg. height (ft)		15							
Avg. crown height (ft)		7							



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading(T/ac)	20.6
0 - 0.25	0.4	3 - 6	0.2	0.1	Avg. forest floor depth (in.)	2.0
0.26 - 1	2.5	6 - 10			Avg. residue depth (in.)	2.1
1.1 - 3	0.8	10 - 20			Sound residue > 3 in. (pct)	58
3+ sound	0.2	20+			Avg. duff depth (in.)	1.2
3+ rotten	0.1				Avg. sound diam. (in.)	3.7
					Avg. rotten diam. (in.)	4.5
					Avg. diam. (S&R) (in.)	4.0
Total	4.0	Total	0.2	0.1		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft) <u>1</u> Spread rate (ch/hr) <u>2</u> Wind adjustment <u>0.4</u>	
	Trees per acre	7				Dominant species	White thorn		
	Avg. d.b.h. (inches)	183				Avg. height (in.)	20		
	Avg. height (ft)	208				Avg. crown height (in.)	5		
	Avg. crown height (ft)	120				Ground space (pct)	50		
8 to 20 inches	Trees per acre				<i>User notes</i>	Grass and forbs		Remarks Fire occurred in 1980s, logged prior to 1900. Area was a campground in 1940s.	
	Avg. d.b.h. (inches)					Dominant species	Unknown forb		
	Avg. height (ft)					Avg. height (in.)	7		
	Avg. crown height (ft)					Ground space (pct)	10		
< 8 inches	Trees per acre								
	Avg. d.b.h. (inches)								
	Avg. height (ft)								
	Avg. crown height (ft)								



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	34.0
0 - 0.25	0.2	3 - 6	0.4	0.4	Avg. forest floor depth (in.)	3.0
0.26 - 1	1.3	6 - 10		0.3	Avg. residue depth (in.)	2.4
1.1 - 3	0.6	10 - 20		2.0	Sound residue > 3 in. (pct)	8
3+ sound	0.4	20+		2.1	Avg. duff depth (in.)	2.7
3+ rotten	4.8				Avg. sound diam. (in.)	3.3
					Avg. rotten diam. (in.)	8.3
					Avg. diam. (S&R) (in.)	6.3
Total	7.3	Total	0.4	4.8		

Stand Information					Brush, Shrub, and Grass Information		Fire Behavior		
CHARACTERISTIC > 20 inches d.b.h. Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)	Giant sequoia	White fir	Sugar pine	Dogwood	Snags > 8 inches d.b.h.	Brush		Flame length (ft) 1 Spread rate (ch/hr) 3 Wind adjustment 0.4	
	7	20				Dominant species	Azalea		
	112	31				Avg. height (in.)	18		
	165	113				Avg. crown height (in.)	8		
	105	67				Ground space (pct)	2		
8 to 20 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)					<i>User notes</i>	Grass and forbs		Remarks Fire occurred in 1929, area logged in 1954.	
		88				Dominant species	Unknown forb		
		14				Avg. height (in.)	1		
		64				Ground space (pct)	1		
< 8 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)									
		13		20					
		3		1					
		13		14					
		9		6					



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	41.1
0 – 0.25	0.2	3 – 6	0.5	0.2	Avg. forest floor depth (in.)	4.8
0.26 – 1	1.2	6 – 10	2.3	1.0	Avg. residue depth (in.)	2.8
1.1 – 3	1.1	10 – 20	0.5	1.1	Sound residue > 3 in. (pct)	60
3+ sound	3.3	20+			Avg. duff depth (in.)	2.7
3+ rotten	2.3				Avg. sound diam. (in.)	6.1
					Avg. rotten diam. (in.)	7.9
					Avg. diam. (S&R) (in.)	6.7
Total	8.1	Total	3.3	2.3		

Stand Information

Brush, Shrub, and Grass Information

Fire Behavior

CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Incense cedar	Snags > 8 inches d.b.h.	<i>Brush</i>		Flame length (ft) <u>2</u> Spread rate (ch/hr) <u>4</u> Wind adjustment <u>0.4</u>	
	Trees per acre	7	27				Dominant species		Bear clover
Avg. d.b.h. (inches)	147	28			Avg. height (in.)	9			
Avg. height (ft)	240	104			Avg. crown height (in.)	3			
Avg. crown height (ft)	100	14			Ground space (pct)	5			
8 to 20 inches					<i>User notes</i>	<i>Grass and forbs</i>		<i>Remarks</i> Fire occurred prior to 1915. Area logged in 1950. Recent cattle grazing.	
Trees per acre		20		7		Dominant species	Unknown forb		
Avg. d.b.h. (inches)		12		8		Avg. height (in.)	3		
Avg. height (ft)		67		30		Ground space (pct)	5		
Avg. crown height (ft)		22		5					
< 8 inches									
Trees per acre		7							
Avg. d.b.h. (inches)		5							
Avg. height (ft)		30							
Avg. crown height (ft)		28							



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	18.2
0 – 0.25	1.0	3 – 6	0.1		Avg. forest floor depth (in.)	2.5
0.26 – 1	4.7	6 – 10			Avg. residue depth (in.)	2.4
1.1 – 3	1.9	10 – 20	0.8		Sound residue > 3 in. (pct)	100
3+ sound	0.9	20+			Avg. duff depth (in.)	1.1
3+ rotten					Avg. sound diam. (in.)	6.3
					Avg. rotten diam. (in.)	0.0
					Avg. diam. (S&R) (in.)	6.3
Total	8.5	Total	0.9			

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Willow	Snags > 8 inches d.b.h.	Brush		Flame length (ft) <u>2</u> Spread rate (ch/hr) <u>4</u> Wind adjustment <u>0.4</u>	
	Trees per acre					Dominant species	Whitethorn		
	Avg. d.b.h. (inches)					Avg. height (in.)	28		
	Avg. height (ft)					Avg. crown height (in.)	16		
	Avg. crown height (ft)					Ground space (pct)	75		
8 to 20 inches	Trees per acre	41	7		<i>User notes</i>	Grass and forbs		Remarks Burned in 1960, logged in 1987, salvage sale in progress, small fires < 10 acres.	
	Avg. d.b.h. (inches)	8	8			Dominant species			
	Avg. height (ft)	29	30			Avg. height (in.)			
	Avg. crown height (ft)	13	10			Ground space (pct)			
< 8 inches	Trees per acre	88	47	7					
	Avg. d.b.h. (inches)	4	4	1					
	Avg. height (ft)	15	13	8					
	Avg. crown height (ft)	8	3	2					



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	17.1
0 – 0.25	0.5	3 – 6	0.4	0.3	Avg. forest floor depth (in.)	1.8
0.26 – 1	1.4	6 – 10	0.9	0.2	Avg. residue depth (in.)	1.4
1.1 – 3	1.4	10 – 20	2.8	1.2	Sound residue > 3 in. (pct)	71
3+ sound	4.1	20+			Avg. duff depth (in.)	1.0
3+ rotten	1.7				Avg. sound diam. (in.)	6.7
					Avg. rotten diam. (in.)	6.7
					Avg. diam. (S&R) (in.)	6.7
Total	9.1	Total	4.1	1.7		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h. Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft) 2 Spread rate (ch/hr) 5 Wind adjustment 0.4	
	7					Dominant species	Whitethorn		
	45					Avg. height (in.)	58		
	170					Avg. crown height (in.)	17		
	70					Ground space (pct)	70		
8 to 20 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)					<i>User notes</i>	Grass and forbs		Remarks Prescribe burned and logged in 1985.	
						Dominant species	Fern		
						Avg. height (in.)	27		
						Ground space (pct)	10		
< 8 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)									



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	7.4
0 – 0.25	0.3	3 – 6	2.0	0.2	Avg. forest floor depth (in.)	
0.26 – 1	1.4	6 – 10	2.6	0.1	Avg. residue depth (in.)	1.7
1.1 – 3	1.3	10 – 20	2.1		Sound residue > 3 in. (pct)	95
3+ sound	6.7	20+			Avg. duff depth (in.)	1.2
3+ rotten	0.3				Avg. sound diam. (in.)	5.2
					Avg. rotten diam. (in.)	4.5
					Avg. diam. (S&R) (in.)	5.1
Total	10.0	Total	6.7	0.3		

Stand Information					Brush, Shrub, and Grass Information		Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft) <u>1</u> Spread rate (ch/hr) <u>2</u> Wind adjustment <u>0.4</u>
	Trees per acre	13	20		41	Dominant species	Giant sequoia	
	Avg. d.b.h. (inches)	98	25		21	Avg. height (in.)	1	
	Avg. height (ft)	245	102		88	Avg. crown height (in.)	1	
	Avg. crown height (ft)	150	82			Ground space (pct)	5	
8 to 20 inches					<i>User notes</i>	Grass and forbs		Remarks Recreational use area. Prescribe burned in 1992. Logged prior to 1940.
	Trees per acre		7			Dominant species	Unknown forb	
	Avg. d.b.h. (inches)		19			Avg. height (in.)	3	
	Avg. height (ft)		90			Ground space (pct)	5	
< 8 inches								
	Trees per acre		13	13				
	Avg. d.b.h. (inches)		5	4				
	Avg. height (ft)		12	10				
			0	3				



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	42.7
0 – 0.25	0.3	3 – 6	1.0	0.6	Avg. forest floor depth (in.)	4.2
0.26 – 1	1.3	6 – 10	0.7	0.2	Avg. residue depth (in.)	2.5
1.1 – 3	1.6	10 – 20			Sound residue > 3 in. (pct)	65
3+ sound	4.7	20+	2.9	1.7	Avg. duff depth (in.)	1.7
3+ rotten	2.5				Avg. sound diam. (in.)	5.4
					Avg. rotten diam. (in.)	5.5
					Avg. diam. (S&R) (in.)	
Total	10.4	Total	4.6	2.5		

Stand Information

Brush, Shrub, and Grass Information

Fire Behavior

CHARACTERISTIC	Stand Information				Snags > 8 inches d.b.h.	Brush		Fire Behavior	
	Giant sequoia	White fir	Ponderosa pine	Incense cedar		Dominant species	Bear clover	Flame length (ft)	
> 20 inches d.b.h.									
Trees per acre	7	7			20	Avg. height (in.)	10	Spread rate (ch/hr)	10
Avg. d.b.h. (inches)	161	51			33	Avg. crown height (in.)	5	Wind adjustment	0.3
Avg. height (ft)	230	155			33	Ground space (pct)	1		
Avg. crown height (ft)	110	25							
8 to 20 inches					<i>User notes</i>	Grass and forbs		Remarks	
Trees per acre			20	13		Dominant species	Fern	Lightning fires < 10 acres in 1970s. Logged prior to 1900.	
Avg. d.b.h. (inches)			15	11		Avg. height (in.)	13		
Avg. height (ft)			57	45		Ground space (pct)	15		
Avg. crown height (ft)			12	10					
< 8 inches									
Trees per acre									
Avg. d.b.h. (inches)									
Avg. height (ft)									
Avg. crown height (ft)									



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	46.5
0 - 0.25	0.2	3 - 6	0.9	0.7	Avg. forest floor depth (in.)	4.7
0.26 - 1	1.7	6 - 10	0.4	1.8	Avg. residue depth (in.)	3.9
1.1 - 3	2.8	10 - 20	1.1	1.2	Sound residue > 3 in. (pct)	38
3+ sound	2.4	20+			Avg. duff depth (in.)	3.7
3+ rotten	3.7				Avg. sound diam. (in.)	5.1
					Avg. rotten diam. (in.)	5.9
					Avg. diam. (S&R) (in.)	5.6
Total	10.8	Total	2.4	3.7		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	3
	Trees per acre	13	20		13	Dominant species	Ribes	Spread rate (ch/hr)	6
	Avg. d.b.h. (inches)	136	27		55	Avg. height (in.)	14	Wind adjustment	0.4
	Avg. height (ft)	238	112		29	Avg. crown height (in.)	1		
	Avg. crown height (ft)	175	57			Ground space (pct)	10		
8 to 20 inches					<i>User notes</i>	Grass and forbs		Remarks Fire occurred in 1910, area logged in 1954.	
	Trees per acre		47	13		Dominant species	Unknown forb		
	Avg. d.b.h. (inches)		14	15		Avg. height (in.)	4.2		
	Avg. height (ft)		71	62		Ground space (pct)	10		
< 8 inches									
	Trees per acre		7						
	Avg. d.b.h. (inches)		2						
	Avg. height (ft)		7						



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	50.8
0 – 0.25	0.4	3 – 6	3.2	0.1	Avg. forest floor depth (in.)	4.8
0.26 – 1	3.2	6 – 10	2.2	0.2	Avg. residue depth (in.)	3.9
1.1 – 3	3.2	10 – 20	3.2		Sound residue > 3 in. (pct) ⁷	78
3+ sound	8.6	20+		2.0	Avg. duff depth (in.)	2.2
3+ rotten	2.3				Avg. sound diam. (in.)	4.9
					Avg. rotten diam. (in.)	9.3
					Avg. diam. (S&R) (in.)	5.2
Total	17.7	Total	8.6	2.3		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h. Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	2
	13	34			7	Dominant species		Spread rate (ch/hr)	3
	122	23			14	Avg. height (in.)		Wind adjustment	0.4
	225	120			70	Avg. crown height (in.)			
	95	58				Ground space (pct)			
8 to 20 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)		20			<i>User notes</i>	Grass and forbs		Remarks	
		16				Dominant species	Unknown forb	Lightning fires < 0.25 acre since 1910. All trees except giant sequoias cut in 1960. Sequoia seedlings planted in 1980s. Slash fuels.	
		83				Avg. height (in.)	3		
		53				Ground space (pct)			
< 8 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)									



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	14.9
0 – 0.25	0.2	3 – 6	2.2	0.4	Avg. forest floor depth (in.)	2.8
0.26 – 1	2.2	6 – 10	4.5	0.2	Avg. residue depth (in.)	2.1
1.1 – 3	2.0	10 – 20	3.0	1.6	Sound residue > 3 in. (pct)	84
3+ sound	11.8	20+	2.1		Avg. duff depth (in.)	1.1
3+ rotten	2.2				Avg. sound diam. (in.)	6.0
					Avg. rotten diam. (in.)	7.1
					Avg. diam. (S&R) (in.)	6.2
Total 18.4	Total	11.8	2.2			

Stand Information

Brush, Shrub, and Grass Information

Fire Behavior

CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	<i>Brush</i>		Flame length (ft) 2 Spread rate (ch/hr) 5 Wind adjustment 0.4	
						Dominant species	Whitethorn		
Trees per acre	7				7	Avg. height (in.)	59		
Avg. d.b.h. (inches)	160				31	Avg. crown height (in.)	17		
Avg. height (ft)	190				90	Ground space (pct)	70		
Avg. crown height (ft)	110								
8 to 20 inches					<i>User notes</i>	<i>Grass and forbs</i>			<i>Remarks</i> Prescribe burned and logged in 1985.
Trees per acre		7	7			Dominant species	Unknown forb		
Avg. d.b.h. (inches)		14	9			Avg. height (in.)	12		
Avg. height (ft)		95	65			Ground space (pct)	5		
Avg. crown height (ft)		15	10						
< 8 inches									
Trees per acre			7						
Avg. d.b.h. (inches)			1						
Avg. height (ft)			8						
Avg. crown height (ft)			0						



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	55.4
0 - 0.25	0.2	3 - 6	2.7	0.5	Avg. forest floor depth (in.)	5.5
0.26 - 1	2.4	6 - 10	5.5	0.2	Avg. residue depth (in.)	2.8
1.1 - 3	2.7	10 - 20	1.5	0.9	Sound residue > 3 in. (pct)	90
3+ sound	13.8	20+	4.1		Avg. duff depth (in.)	1.3
3+ rotten	1.6				Avg. sound diam. (in.)	5.8
					Avg. rotten diam. (in.)	5.3
					Avg. diam. (S&R) (in.)	5.7
Total	20.7	Total	13.8	1.6		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h. Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)	Giant sequoia	White fir	Sugar pine	Incense cedar	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	3
					0.8	Dominant species	Ribes	Spread rate (ch/hr)	6
					10	Avg. height (in.)	13	Wind adjustment	0.4
					63	Avg. crown height (in.)	5		
						Ground space (pct)	20		
8 to 20 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)					<i>User notes</i>	Grass and forbs		Remarks	
		54				Dominant species	Unknown forb	Fire occurred in 1929, group selection cut in 1950s. Slash piles are abundant.	
		10				Avg. height (in.)	4		
		73				Ground space (pct)	10		
	38								
< 8 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)	7			13					
	2			2					
	9			10					
	1			2					



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	13.0
0 – 0.25	0.4	3 – 6	3.4	0.3	Avg. forest floor depth (in.)	
0.26 – 1	1.7	6 – 10	4.9		Avg. residue depth (in.)	1.6
1.1 – 3	3.8	10 – 20	8.4		Sound residue > 3 in. (pct)	98
3+ sound	16.7	20+			Avg. duff depth (in.)	1.2
3+ rotten	0.3				Avg. sound diam. (in.)	6.1
					Avg. rotten diam. (in.)	3.6
					Avg. diam. (S&R) (in.)	6.0
Total	22.9	Total	16.7	0.3		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h. Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)	Giant sequoia	White fir	Bigleaf maple	Incense cedar	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	0
	20				61	Dominant species	Incense cedar/Ribes	Spread rate (ch/hr)	0
	59				11	Avg. height (in.)	23	Wind adjustment	0.2
	202				32	Avg. crown height (in.)	6		
	110					Ground space (pct)	50		
8 to 20 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)					<i>User notes</i>	Grass and forbs		Remarks	
			7	13		Dominant species	Unknown forb	Burned in 1987. Salvage logging currently occurring.	
			18	16		Avg. height (in.)	6		
			35	60		Ground space (pct)	10		
< 8 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)			20	38					
	7								
	1								
	8								
1									



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	20.5
0 – 0.25	0.4	3 – 6	6.4	0.2	Avg. forest floor depth (in.)	2.5
0.26 – 1	2.8	6 – 10	1.6	1.4	Avg. residue depth (in.)	2.3
1.1 – 3	4.6	10 – 20		0.5	Sound residue > 3 in. (pct)	87
3+ sound	13.6	20+	5.6		Avg. duff depth (in.)	1.1
3+ rotten	2.1				Avg. sound diam. (in.)	4.4
					Avg. rotten diam. (in.)	6.5
					Avg. diam. (S&R) (in.)	4.7
Total	23.5	Total	13.6	2.1		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Red Fir	Snags > 8 inches d.b.h.	Brush		Flame length (ft) 2 Spread rate (ch/hr) 3 Wind adjustment 0.4	
	Trees per acre	7				Dominant species	Whitethorn		
	Avg. d.b.h. (inches)	39				Avg. height (in.)	8		
	Avg. height (ft)	110				Avg. crown height (in.)	1		
	Avg. crown height (ft)	55				Ground space (pct)	40		
8 to 20 inches	Trees per acre	34			<i>User notes</i>	Grass and forbs		Remarks Area burned in 1960, salvage sale in progress.	
	Avg. d.b.h. (inches)	9				Dominant species	Unknown grass		
	Avg. height (ft)	37				Avg. height (in.)	6		
	Avg. crown height (ft)	12				Ground space (pct)	5		
< 8 inches	Trees per acre	20		101					
	Avg. d.b.h. (inches)	2		2					
	Avg. height (ft)	8		9					
	Avg. crown height (ft)	3		3					



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	42.8
0 – 0.25	0.1	3 – 6	4.6	1.4	Avg. forest floor depth (in.)	4.6
0.26 – 1	1.7	6 – 10	3.6	1.9	Avg. residue depth (in.)	3.5
1.1 – 3	3.8	10 – 20	12.0	7.7	Sound residue > 3 in. (pct)	56
3+ sound	23.1	20+	2.9	7.1	Avg. duff depth (in.)	4.7
3+ rotten	18.1				Avg. sound diam. (in.)	6.2
					Avg. rotten diam. (in.)	8.4
					Avg. diam. (S&R) (in.)	7.0
Total	46.8	Total	23.1	18.1		

Stand Information					Brush, Shrub, and Grass Information		Fire Behavior		
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Incense cedar	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	4
	Trees per acre	7	7		27	Dominant species	Ribes	Spread rate (ch/hr)	9
	Avg. d.b.h. (inches)	124	32		22	Avg. height (in.)	17	Wind adjustment	0.5
	Avg. height (ft)	220	145		58	Avg. crown height (in.)	7		
	Avg. crown height (ft)	80	55			Ground space (pct)	30		
8 to 20 inches					<i>User notes</i>	Grass and forbs		Remarks	
	Trees per acre	47	13			Dominant species	Unknown forb	Fire occurred in 1910, area logged in 1954.	
	Avg. d.b.h. (inches)	9	13			Avg. height (in.)	3.5	Several fires < 10 acres since 1910.	
	Avg. height (ft)	45	67			Ground space (pct)	40		
< 8 inches									
	Trees per acre	20		7					
	Avg. d.b.h. (inches)	4		5					
	Avg. height (ft)	18		20					



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	25.1
0 – 0.25	0.4	3 – 6	4.0	0.7	Avg. forest floor depth (in.)	2.5
0.26 – 1	2.8	6 – 10	3.8	1.1	Avg. residue depth (in.)	2.2
1.1 – 3	1.9	10 – 20	4.9	0.8	Sound residue > 3 in. (pct)	94
3+ sound	40.4	20+	27.7		Avg. duff depth (in.)	1.6
3+ rotten	2.6				Avg. sound diam. (in.)	6.8
					Avg. rotten diam. (in.)	5.8
					Avg. diam. (S&R) (in.)	6.6
Total	48.1	Total	40.4	2.6		

Stand Information					Brush, Shrub, and Grass Information			Fire Behavior	
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	0
	Trees per acre	20	7		34	Dominant species	_____	Spread rate (ch/hr)	0
	Avg. d.b.h. (inches)	28	27		37	Avg. height (in.)	_____	Wind adjustment	0.3
	Avg. height (ft)	133	145		82	Avg. crown height (in.)	_____		
	Avg. crown height (ft)	80	80			Ground space (pct)	_____		
8 to 20 inches	Trees per acre	183	13		<i>User notes</i>	Grass and forbs		Remarks	
	Avg. d.b.h. (inches)	11	12			Dominant species	_____	Burned in 1987. Area used for recreation. Logged prior to 1915 causing a pure giant sequoia stand.	
	Avg. height (ft)	62	60			Avg. height (in.)	_____		
	Avg. crown height (ft)	40	37			Ground space (pct)	_____		
< 8 inches	Trees per acre	7							
	Avg. d.b.h. (inches)	3							
	Avg. height (ft)	12							
	Avg. crown height (ft)	0							



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	10.6
0 – 0.25	0.1	3 – 6	0.7	0.1	Avg. forest floor depth (in.)	
0.26 – 1	0.9	6 – 10	1.2		Avg. residue depth (in.)	1.0
1.1 – 3	0.9	10 – 20	2.2	0.5	Sound residue > 3 in. (pct)	99
3+ sound	54.2	20+	50.0		Avg. duff depth (in.)	1.6
3+ rotten	0.6				Avg. sound diam. (in.)	12.1
					Avg. rotten diam. (in.)	8.0
					Avg. diam. (S&R) (in.)	11.7
Total	56.7	Total	54.2	0.6		

Stand Information					Brush, Shrub, and Grass Information		Fire Behavior		
CHARACTERISTIC > 20 inches d.b.h. Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)	Giant sequoia	White fir	Sugar pine	Other	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	1
	7					Dominant species	Giant sequoia	Spread rate (ch/hr)	1
	48					Avg. height (in.)	11	Wind adjustment	0.3
	180					Avg. crown height (in.)	2		
	80					Ground space (pct)	30		
8 to 20 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)					<i>User notes</i>	Grass and forbs		Remarks	
						Dominant species	Unknown forb	Lightning fires < 0.25 acre since 1910. All trees except giant sequoias cut in 1960. Sequoia seedlings planted in 1980s.	
						Avg. height (in.)	6		
				Ground space (pct)	5				
< 8 inches Trees per acre Avg. d.b.h. (inches) Avg. height (ft) Avg. crown height (ft)									



Woody Fuel Loadings					Other Measurements	
SIZE CLASS (inches)	Loading (tons/acre)	SIZE CLASS (inches)	Sound Wood (tons/acre)	Rotten Wood (tons/acre)	Avg. forest floor loading (T/ac)	34.0
0 - 0.25	0.6	3 - 6	7.9	1.0	Avg. forest floor depth (in.)	4.1
0.26 - 1	4.2	6 - 10	13.9	1.5	Avg. residue depth (in.)	3.7
1.1 - 3	8.4	10 - 20	16.2	6.0	Sound residue > 3 in. (pct)	75
3+ sound	44.2	20+	6.2	6.5	Avg. duff depth (in.)	1.3
3+ rotten	15.0				Avg. sound diam. (in.)	6.0
0					Avg. rotten diam. (in.)	8.9
					Avg. diam. (S&R) (in.)	6.5
Total	72.4	Total	44.2	15.0		

Stand Information					Brush, Shrub, and Grass Information		Fire Behavior		
CHARACTERISTIC > 20 inches d.b.h.	Giant sequoia	White fir	Black oak	Incense cedar	Snags > 8 inches d.b.h.	Brush		Flame length (ft)	1
	Trees per acre	7		7	34	Dominant species	Giant sequoia	Spread rate (ch/hr)	1
	Avg. d.b.h. (inches)	109		22	10	Avg. height (in.)	8	Wind adjustment	0.3
	Avg. height (ft)	245		95	19	Avg. crown height (in.)	1		
	Avg. crown height (ft)	100		50		Ground space (pct)	10		
8 to 20 inches					<i>User notes</i>	Grass and forbs		Remarks	
	Trees per acre	27	13	7		Dominant species	Unknown forb	No recorded fire history, selectively logged in 1992, lopping for slash treatment.	
	Avg. d.b.h. (inches)	14	15	8		Avg. height (in.)	11		
	Avg. height (ft)	79	55	35		Ground space (pct)	10		
Avg. crown height (ft)	50	45	20						
< 8 inches	Trees per acre			7					
	Avg. d.b.h. (inches)			7					
	Avg. height (ft)			25					
	Avg. crown height (ft)			23					



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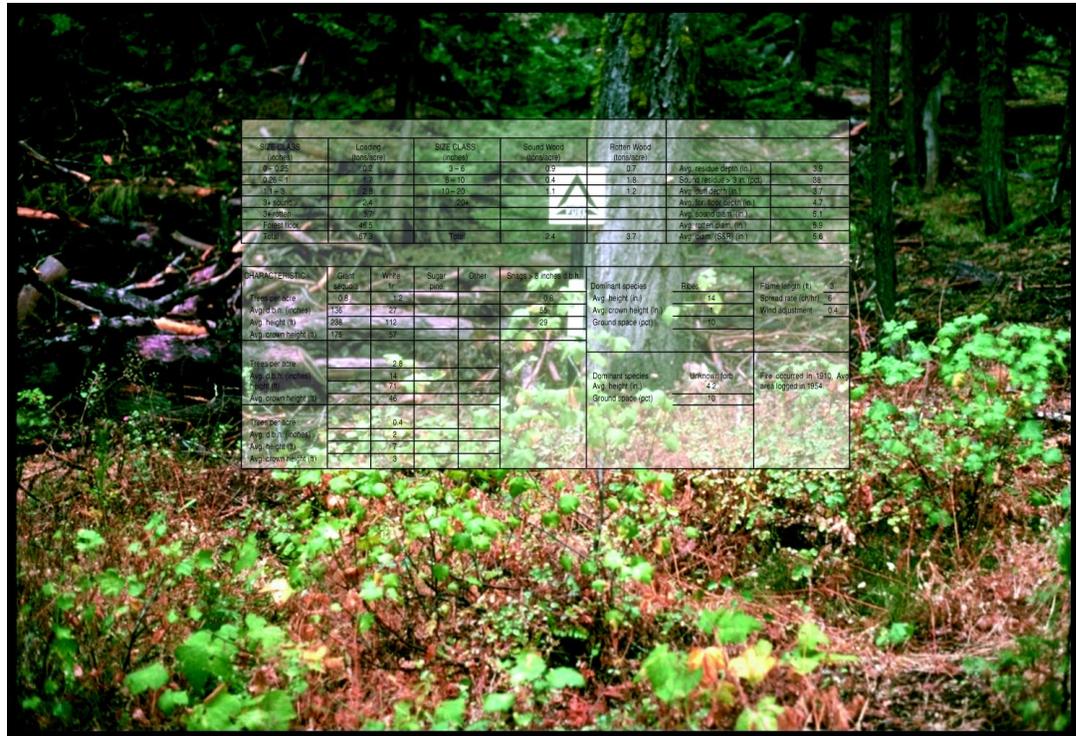
Photo Series for Quantifying Fuels and Assessing Fire Risk in Giant Sequoia Groves

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Abstract

Weise, David R.; Gelobter, Aaron; Haase, Sally M.; Sackett, Stephen S. 1997. **Photo series for quantifying fuels and assessing fire risk in giant sequoia groves.** Gen. Tech. Rep. PSW-GTR-163. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 49 p.

Fuels and stand inventory data are presented for giant sequoia by using 18 different photos located in giant sequoia/mixed conifer stands in the Sierra Nevada of California. Total fuel loading ranges from 7 to 72 tons/acre. The stands have been subjected to a variety of disturbances including timber harvesting, wildfire, prescribed fire, and recreational use. Fire behavior predictions were made by using 10th, 50th, and 90th percentile weather conditions and the inventoried fuels information. The long-term visual impacts of the various management activities can also be partially assessed with this photo series.

Retrieval Terms: mixed-conifer, prescribed fire, wildfire, thinning, recreation, Sierra Nevada

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Photo Series for Quantifying Fuels and Assessing Fire Risk in Giant Sequoia Groves

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USDA Forest Service
General Technical Report
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