Final Report

Fire Regimes of Forests in the Peninsular and Transverse Ranges of Southern California

Joint Fire Science Program
Project 01B-3-3-18

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The goal of this project was to provide fire regime reference data for conifer forests to assist in the development of fire management and forest plans soon to be developed or revised for the four national forests in southern California. The science of dendrochronology has been used in many areas of the United States to reconstruct historical patterns of fire frequency, fire season, and fire extent. Some areas of California (southern Sierra Nevada, Lake Tahoe Basin) have been extensively sampled for fire history but similar research has been lacking for the southern California mountains. Here we provide fire history information for conifer stands from the four national forests (Angeles, Cleveland, Los Padres, and San Bernardino) and one state park (Cuyamaca Rancho State Park) in the Peninsular and Transverse ranges of southern California.

SUMMARY OF FINDINGS TO DATE:

Fire History of Peninsular and Transverse Ranges of Southern California

- Fire history was developed for 16 sites in the Angeles (ANF, 3 sites), Cleveland (CNF, 2 sites), Los Padres (LPF, 3 sites), and San Bernardino (SBF, 8 sites) National Forests, and one site from the Cuyamuca Rancho State Park.
- All mixed conifer forests in the Transverse and Peninsular Ranges of southern California appear to have had fire regimes characterized by frequent fires prior to the 20th Century. Some sites continued to experience frequent fires through the 20th Century in spite of organized fire suppression.
- Fire return intervals for fires scarring ≥ 10% of sampled trees on a site ranged from 2 to 36.8 years.
- Intra-ring locations of fire scars in mixed conifer forests in the Transverse and Peninsular ranges are predominantly latewood or ring boundary (dormant) scars, suggesting mid-summer to fall fires.
- The Los Padres NF had predominantly dormant wood fires (82.6%), suggesting primarily very late-summer and fall fires.
- The Angeles NF had 65.7% dormant wood, and 22.1% latewood, indicative of late summer to fall fires.
- The San Bernardino Mountains in the San Bernardino NF had 57.6% dormant wood and 32.6% latewood scars, suggesting mid summer through autumn fires but generally earlier than Angeles or Los Padres NFs.
- The San Jacinto Mountains of the San Bernardino NF had 60.8% ring boundary and 29.4% latewood scars.
- The Cleveland NF had 62.7% dormant wood scars. However, there was a notable increase in early earlywood (14.7%) scars. This indicates a significant component of spring-early summer fires. Thus, the interpretation of dormant wood fires here can be problematic since at least some of those fires are likely to have been spring fires.
- Early-wood and mid-season intra-ring locations of scars generally increase from northwest locations (LPF and ANF) to the southernmost locations., Thus, a transition from a strongly Californian montane fire regime, similar to Sierra Nevada, to more like that of the Sierra San Pedro Martir of Mexico takes place along our transect from northwest to south.

- Though many 20^{th} and 21^{st} Century fires were recorded on some sites, the fire scar record would indicate there was a reduction in fire activity over the period of fire-suppression across the region. Many fires are recorded in the records of various agencies for the sites that were sampled that were not detected in the fire scar record. Thus, it appears that the fire scar record, at least for the 20^{th} Century, is a conservative picture of fire activity.Many sites had indications that fire-scar evidence (e.g., cat-faced trees, old stumps with scars) was once available. However, much of this evidence has been destroyed in recent years by fires that have burned out the scar record of the cat-faced trees or burned up the record in old stumps.
- The Santa Rosa Mountains, south and east of the San Jacinto Mountains, appears to have a good fire-scar record. However, we did not have time to make collections there due to the interruptions caused by the fires of 2003 and the necessity to re-collect in several other sites.

DELIVERABLES

Proposed	***Accomplished/Status***
Annual progress reports	Annual progress reports completed.
Location and establishment of research sites will begin in the summer of 2002 and completed in summer of 2003	This work was completed in the summer of 2005 using the 1yr no-cost extension. The fires of 2003 interrupted the collection of material as well as destroyed many samples that had been cached in the field near roads awaiting removal to the lab.
Sample and data analysis will begin in winter of 2002-3 and be completed in winter of 2003-4	This work was actually completed in the spring of 2006 because of the above-mentioned delays.
Manuscript for publication will be completed in 2004-05.	We plan to complete this during the spring of 2007.
Workshop and demonstration field trips will be conducted in 2004-05	This awaits finishing the above. It is planned for 2007.
Project web site will be created in 2004 depicting sample site locations and summaries of findings.	The web site was begun in 2004. It will be updated as the remainder of the information comes available. It can be found at http://cnr.berkeley.edu/stephens-lab/research.htm#socal
Presentations	Fire in the Sierra Nevada and southern California Mountains, similarities and differences. Presentation at the University of California, Bears Lair, Pinecrest, CA. July 2005 Fire regimes and forest structure in the mountains of northwestern Mexico and Southern California. American Geophysical Union annual meeting, San Francisco, CA. December 2005

INTRODUCTION

Though fires are a significant component of ecosystems in southern California, the mixed conifer forests of the southern California mountain ranges have yet to have their historic fire regimes characterized using fire-scar dendrochronology (FSD). The USFS recently released the Southern California Mountains and Foothill Assessment for the Cleveland, San Bernardino, Angeles, and Los Padres National Forests. This assessment identified fire management as one of its important goals. Yet, only one published fire history study is available to assist in plan development (McBride and Laven 1976). The single fire history study did not use cross-dating and had a very limited spatial extent. Information on past fire season was not obtained. The lack of comprehensive information makes it extremely difficult to understand past fire dynamics in this large, diverse area.

Planning for appropriate fire use in these mountain ranges is often difficult since very limited information about past, long-term fire regimes and their relationship to stand conditions is available. The development of fuels management and prescribed fire programs is currently problematic since it is unknown as to the appropriate seasonality and frequency of fire use.

The mountain ranges that are the focus of this study are located between the Sierra Nevada, California and the Sierra San Pedro Martir, Baja California. The past fire regimes of these two areas are quite different in terms of fire frequency, fire season, and influence of fire suppression (Swetnam and Baisan 2003, Stephens et al. 2003). With virtually no information available for the mountains of southern California, there is no way to know if the fire regimes would be intermediate in character or tend to be more like one area or the other. The information from this study, by clarifying fire regime parameters, can assist in development of plans that must be prepared in response to the recent Southern California Mountains and Foothills Assessment (Stephenson and Calcarone 1999).

The objective of this project is to collect, cross-date, and analyze fire history information relevant to the montane forests of the Cleveland, San Bernardino, Angeles, and Los Padres National Forests in southern California.. The science of dendrochronology has been used in many areas of the United States to quantify past fire regimes. When cross-dating techniques are used to interpret fire scars in tree ring, an accurate and precise reconstruction of fire frequency and fire season can be created (Agee 1993, Kipfmueller and Swetnam 2001, Van Horne and Fulé 2006). A tree-ring based study of fire regimes will help managers design fire management plans that consider the appropriate long-term fire regime. It can help to answer questions such as: Were fires relatively infrequent (25-40 years), moderate-high severity fires or of frequent (5-15 years), low-moderate intensity fires? For what season should prescribed fires be planned?

STUDY AREAS

Fire history was examined for the mixed conifer forests of the Transverse and Peninsular mountain ranges of southern California. These ranges extend from northwest of Ventura to the Mexican border, forming an arc surrounding the Los Angeles and San Diego metropolitan areas. These mountains are fault-block ranges, created by uplift from the San Andreas and associated faults. These blocks are composed primarily of Cenozoic sedimentary, marine sedimentary, volcanic rock, as well as Mesozoic Plutonic intrusions, a mix of Mesozoic sedimentary, volcanic and metamorphic rocks, Paleozoic rock, and some older (1.1 billion years) Precambrian rock (Schoenherr 1992). With few exceptions, mixed conifer sample areas were generally on soils derived from granitic type rock. Sampling occurred in the mixed conifer zone between 1500 and 2500m elevation. Sampling took place within the Los Padres, Angeles, San Bernardino, and Cleveland National Forests, as well as in the Cuyamaca Rancho State Park (Figure 1, Table 1)

The forests of southern California are floristically similar to forests in the southern Sierra Nevada, and to those in the Sierra San Pedro Martir (Minnich and Franco-Vizcaíno 1998, Stephens and Fry 2005, Taylor 2004). Mixed-conifer forest covers over 400,000 ha of the Transverse and Peninsular Ranges (Stephenson and Calcarone 1999), with dominant species *Pinus jeffreyi* (Grev. and Balf.), *P. ponderosa* (Laws.), *Abies concolor* (Lindley), *Pinus lambertiana* (Doug.), and *Quercus chrysolepsis* (Lieb.). Canopy co-dominants in the include *Calocedrus decurrens* (Florin) and *Quercus kelloggii* (Newb.) (Barbour and Minnich 2000, Minnich and Everett 2001). Nomenclature follows that of Hickman (1993).

Climate is montane Mediterranean with cold wet winters and hot dry summers, with an annual precipitation ranging from 22cm per year to 100cm per year, generally as winter rain or snow (Table 1) (Teale Data Center 1999). Winter snowpacks at these elevations persist into March, and later on north-facing slopes. Summer thunderstorms account for less than 15% of the annual precipitation (U.S. Department of Commerce 1999). Mean monthly temperatures range from 0^{o}C in January to 18^{o}C in July (U.S. Department of Commerce 1999).

MATERIALS AND METHODS

Collections were made after an extensive field reconnaissance throughout the study area. Dead, downed, and remnant material suitable for crossdating were located within areas suitable for collection and where it was permissible to obtain necessary collection permits. Each potential site was located and georeferenced with a Global Positioning System (GPS). The GPS data, along with field data, were incorporated into a database, which was then used to determine overall coverage and potential suitability of sample areas. Actual sampling involved returning to the previously located sites, collecting and processing fire-scarred materials.

All field plots were digitally photographed and permanent marker tags identifying plot number, investigator, and date were installed. Fire-scarred specimen trees were permanently tagged. The distance and bearing from the marker tag to the nearest fire-scarred tree was recorded. Specimens containing rot, active wildlife, or were otherwise considered unsuitable for fire scar records were not used in sampling. Additional plot information that was recorded included plot location, percent slope, slope aspect (degrees), elevation (m), and geology (after Taylor 2000). Both field data and plot location data were incorporated into statistical and GIS databases for statistical analysis.

In the Black Mountain vicinity, San Jacinto Mountains of the San Bernardino NF, two systematic 250 m by 250 m grids extending over 250 ha sample areas were emplaced using Geographical Information System (GIS) coverages derived from United States Geological Service digital elevation data of the area (Everett 2003). A point of origin was randomly established with GIS using the 1000 m tick marks from the Universal Transverse Mercator Projection system, Zone 11 (California), and a 250m by 250m grid based off the random origin, providing uniform coverage over the sample area. Using a GPS receiver, each plot was located in the field and assessed as to suitability for representing the mixed-conifer vegetation series (Sawyer and Keeler-Wolf 1995). See Everett (2003) for details on grid based sampling.

Full and partial fire-scarred cross sections were removed by saw from remnant materials such as downed logs, snags, and standing trees (Arno and Sneck 1977, Stokes and Dietrich 1980) from each sample plot. Using relatively complete cross-sections allows a complete survey of scars from a sampled tree and is preferable over partial wedge or increment coring (Sheppard et al. 1988, Baisan and Swetnam 1997). Therefore, dead material was preferred. Live materials were sampled only when no suitable remnant materials were available. Serial sections were performed on dead specimens to assess the maximum number of scars available in the individual sample. Once a representative sample was selected, a circular or pie-shaped sample of the remnant material was then marked, collected, and transported for processing and analysis.

Each wedge or cross section was polished to a fine sheen so that tree rings, fire-scars, and fire seasonality could be determined under a 30x dissection microscope. Fire-scars are identified by the disruption of growth and subsequent healing patterns of radial tree-ring growth as well as charring at the point of injury (McBride 1983, Dietrich and Swetnam 1984). Fire years are determined by first cross-dating tree rings in the samples with nearby tree-ring chronologies obtained from the International Tree-ring Data Bank (Grissino-Mayer and Fritts 1998) using techniques described in Swetnam et al. (1985). Fire calendar years were then determined by noting the year of the ring in which the fire scarred occurred (Stokes and Smiley 1968, Swetnam et al. 1985, Baisan and Swetnam 1997). Years of scars and intraring seasonal positions were analyzed using fire-scar specific software, FHX2 (Grissino-Mayer 2001). Intraring position of the scar within the annular growth ring was described as EE (early earlywood), ME (middle earlywood), LE (late earlywood), LW (latewood), D (dormant), or U (undetermined) to serve as an estimate of the season of fire occurrence (Ahlstrand 1980, Dietrich and Swetnam 1984, Caprio and Swetnam 1995).

Standard fire frequency statistics were calculated for each site. Fire return intervals were analyzed at several composite levels (Johnson and Gutsell 1994, Skinner and Chang 1996, Baker and Ehle 2001, Stephens et al. 2003). Mean and median FRIs were developed for each tree as a point in the landscape (Taylor 2000). Composite fire chronologies involving fires that simultaneously scarred multiple trees provides a more scaled reference of past fires and fire size by aggregating individual records into large landscape-level groups (such as sample areas) or time-interval groups (e.g.: by century) (Dietrich 1980, Agee 1993). Composite fire chronologies were tabulated using the following classification: CO1) all fires scarring at least one tree; CO2) fires that scarred at least 2 trees; CO10) fires that scarred at least 2 trees and 10 percent of the available recording trees (ART); CO25) fires that scarred at least 3 trees and 25 percent of ART. CO1 composites should have the shortest FRIs because all small fires recorded by single trees are included. C025 should have the longest FRIs because this composite represents less common fires that scarred many trees over larger. CO10 - CO25 composites represent fires of intermediate size. Composite fire chronologies involving multiple trees were also broken out by century (Dietrich 1980, Agee 1993, Stephens et al. 2003).

RESULTS

Several hundred fire-scarred specimens were collected from dead, downed and remnant Jeffrey pine, ponderosa pine, and incense-cedar. Of these, 247 fire-scarred specimens with 1,953 fire scars were able to be cross-dated and used in reconstructing the fire history reported here for 17 sites from across the mixed conifer forests of southern California (Figure 1, Table 1). These sites combined covered approximately over 2,200 acres of sampled area.

- Fires were found to be frequent throughout the region (Table 2, Figures 2-6).
- Fire scars data from 1505 to 2003. However, the number of fire-scarred specimens varies considerably from site to site. Some sites have a good record extending back only to around 1800 while some have a good record to the early 1500s. Based on visual inspection of the fire chronologies (Figures 2-6), 1500 was chosen as a cutoff date for display of recorded fires and composites.
- Mean fire return intervals were generally shorter than 15 years for fires that scarred ≥ 10% of samples (Table 2).
- Los Padres National Forest:
    - This forest had the most limited set of samples. The fire-scar record extends back only to approximately the early 1800s.
    - Mean fire return intervals for all samples range from 3.15 years at Mt. Pinos, to 4.13 years at Frazier Peak (Table 2). Median fire return intervals for all samples range from 2 years, to 4 years. Median fire return intervals for 10% scarring ranges from 1 year at Mt. Pinos, to 4 years at Frazier Peak.
    - Fire seasonality is dominantly dormant season, with only a small amount of latewood (Table 3). This is very similar to intra-ring scar positions in forests of the northern Sierra Nevada, southern Cascade Range, and Klamath Mountains. .
- Angeles National Forest:
    - There is a moderately deep fire record here extending back to approximately 1700 before the record begins to drop off from lack of samples.
    - Mean fire return intervals for all samples range from 3.04 years at Grassy Hollow, to 5.92 years at Crystal Lake (Table 2). Median fire return intervals for all samples range from 2 years, to 4 years. Median fire return intervals for 10% scarring ranges was 4 years at all three sites.

  - Intra-ring fire seasonalities increased somewhat in non-dormant ring positions, but are still 65.5% dormant (Table 3). This is more similar to intra-ring scar positions in the southern Sierra Nevada.
- San Bernardino National Forest
  - Mean fire return intervals for fires that scarred ≥ 10% of samples range from 4.5 years at Section 9 to 36.8 years at Black Mountain 1 (Table 2).
  - Early wood intra-ring scarring increases within this forest, but is still dominated by latewood and dormant wood scars (30% to 60% respectively) (Table 3).
- Cleveland National Forest & Cuyamaca State Park
  - Mean fire return intervals for all samples range from 4.0 years at Cuyamaca State Park to 13.3 years at Mt. Laguna.
  - Seasonality shows an increase in the number of early season scars (14.2% early earlywood) in the area, although dormant season scarring (62.7%) still dominates the scarring seasonality (Table 3). With so much earlywood scarring, at least a significant component of the dormant wood scars are likely to have been spring fires. Seasonality has transitioned to earlier than the other, more northerly forests and is becoming more similar to those in Mexico.

A visual inspection of fire-history charts (figures 2-6) indicate that the fire intervals recorded as fire scars in the 20th century were not as frequent or widespread as in previous centuries. A discontinuity in frequent fires occurs in most sites, beginning as early as 1900, but becoming increasingly apparent after 1925 (Figures 2-6). Fire frequencies are shorter prior to the discontinuity than afterwards.

Drier sites, with desert exposures and lower annual precipitation (Table 1) such as Big Pine Flat, and Mt. Laguna, experience longer fire return intervals (10 year median FRI) than more mesic sample locations with higher precipitation.

Data from this study will contribute to a larger effort also supported by the Joint Fire Science Program:.*Fire / climate interactions and predicting fire season severity in the Mediterranean climate areas of California, southwestern Oregon, and western Nevada* – PIs Skinner, Taylor, Carleton, and Stephens. JFSP Project #03-1-1-22.

Figure 1. Location of sample sites across the southern California mountains.

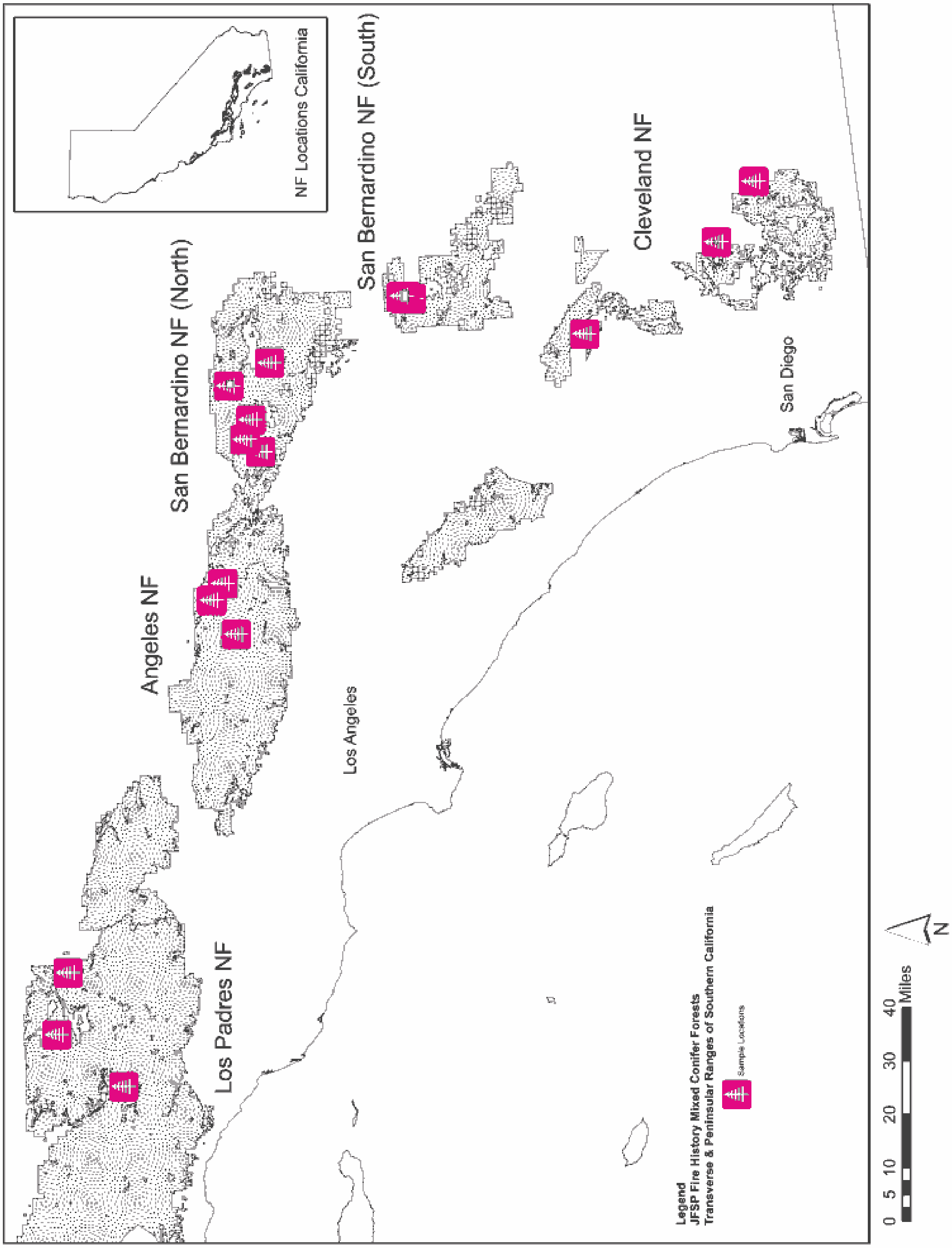

TABLE 1: Sample locations, mean elevations (nearest 100 m), annual rainfall, approximate area and primary cooperating agencies.

Location:	Latitude\Longitude	Elevation (m)	Precipitation (cm)	Agency
Pine Mountain	N34 39.1° W119 21.6°	1900	88.9	USFS Los Padres NF
Mt. Pinos	N34 48.8° W118 05.9°	2500	57.15	USFS Los Padres NF
Frazier	N34 48.6° W118 56.5°	2100	57.15	USFS Los Padres NF
Crystal Lake	N34 19.2° W117 50.8°	1750	88.9	USFS Angeles NF
Wright Mountain	N34 19.9° W117 37.9°	2400	88.9	USFS Angeles NF
Guffy	N34 20.8° W117 39.9°	2300	88.9	USFS Angeles NF
Grassy Hollow	N34 22.6° W117 43.5°	2200	69.85	USFS Angeles NF
Strawberry Peak	N34 13.9° W117 14.6°	1600	88.9	USFS San Bernardino NF
Shake Creek	N34 15.5° W117 07.5°	1700	88.9	USFS San Bernardino NF
Section 9	N34 16.5° W117 11.9°	1600	69.85	USFS San Bernardino NF
Big Pine Flat	N34 18.9° W117 00.6°	2100	57.15	USFS San Bernardino NF
Clark Grade	N34 12.1° W116 56.7°	2300	88.9	USFS San Bernardino NF
Black Mountain 1	N33 49.7° W116 45.1°	2300	69.85	USFS San Bernardino NF
Black Mountain 2	N33 50.5° W116 43.9°	2300	69.85	USFS San Bernardino NF
Fry Creek	N33 20.6° W116 53.0°	1600	27.94	USFS Cleveland NF
Cuyamaca Peak	N32 59.3° W116 36.2°	1700	69.85	Cuyamaca State Park
Mt. Laguna	N32 51.4° W116 25.0°	1800	22.86	USFS Cleveland NF

Table 2. Fire history statistics for each sample site.

Site	Area Acres	No. Trees	No. Scars	No. Yrs W/Fire	1st Scar	Last Scar	All Fires		≥10% Samples Scarred			≥25% Samples Scarred		
							Mean FRI	Med FRI	Min # Scars	Mean[1] FRI	Med[1] FRI	Min # Scars	Mean[2] FRI	Med[2] FRI
Pine Mountain	91.6	8	105	63	1843	1969	2.0	3.0	1	s	s	2	4.3	3.0
Mt. Pinos	47.5	5	54	41	1843	1969	3.2	2.0	1	s	s	2	8.8	8.0
Frazier Peak	30.1	8	85	40	1832	1984	4.1	4.0	1	s	s	2	8.5	8.0
Crystal Lake	36.3	6	58	37	1789	2002	5.9	4.0	1	s	s	2	14.4	8.0
Wright Mountain	50.8	4	43	27	1772	1938	6.4	6.0	1	s	s	2	12.3	12.0
Guffy	24.9	4	43	13	1681	1997	10.5	8.0	1	s	s	2	19.6	9.0
Grassy Hollow	312.9	19	153	101	1626	1997	3.7	2.0	2	10.9	7.0	5	n	n
Strawberry Peak	114.6	12	158	97	1549	2003	4.7	3.0	2	9.0	7.0	3	19.7	12.0
Shake Creek	237.2	21	165	92	1614	2003	4.3	2.0	2	8.6	4.0	5	77.0	81.0
Section 9	63.2	29	312	141	1617	1993	2.7	1.0	3	4.5	3.0	5	13.5	7.0
Big Pine Flat (D)	100.8	38	109	NA	1798	2002	5.7	1.0	4	n	n	9	n	n
Clark Grade	10.1	6	76	60	1505	1970	7.9	5.0	1	s	s	2	16.8	15.0
Black Mountain 1	667.1	29	240	96	1514	1972	4.5	2.0	3	36.8	42.0	7	n	n
Black Mountain 2	67.8	29	136	140	1549	1976	3.8	1.0	3	7.0	5.0	7	n	n
Fry Creek	139.4	8	79	50	1664	1960	6.0	4.0	1	s	s	2	8.4	7.0
Cuyamaca Peak	27.0	15	105	75	1704	2003	4.0	3.0	2	13.7	9.0	3	44.3	50.0
Mt. Laguna	205.0	6	32	17	1791	2003	13.3	10.0	1	s	s	2	9.6	9.0

[1]s=Due to low number of samples, where “s” appears, the value is the same as “All Fires.”

[2]n=There were no fires that scarred ≥ 25% of the samples.

Table 3: Fire scar intra-ring position (proxy for seasonality) by National Forest area.

Forest	N Scars	Undetermined	Determined	% Early Earlywood	%Middle Earlywood	%Late Earlywood	%Latewood	%Ring Boundary
LPNF	244	2	242	0.0	1.2	0.0	16.1	82.6
ANF	297	17	280	5.7	3.2	3.2	22.1	65.7
SBF-N	711	48	663	3.2	6.2	0.5	32.6	57.6
SBF-S	376	34	342	2.3	7.5	0.0	29.4	60.8
CNF[1]	216	4	212	14.2	4.2	2.4	16.5	62.7

[1]Summary here includes Cuyamuca Rancho State Park.

The following 5 fire history chart depict the fires by sample for each National Forest. In each chart, the horizontal lines are individual samples (single tree) and the vertical short lines crossing them are the dated year of a fire. At the bottom is a composite of fires that scarred at least 2 of the trees shown in the upper chart.

Figure 2. Fire history chart for Los Padres National Forest sites.

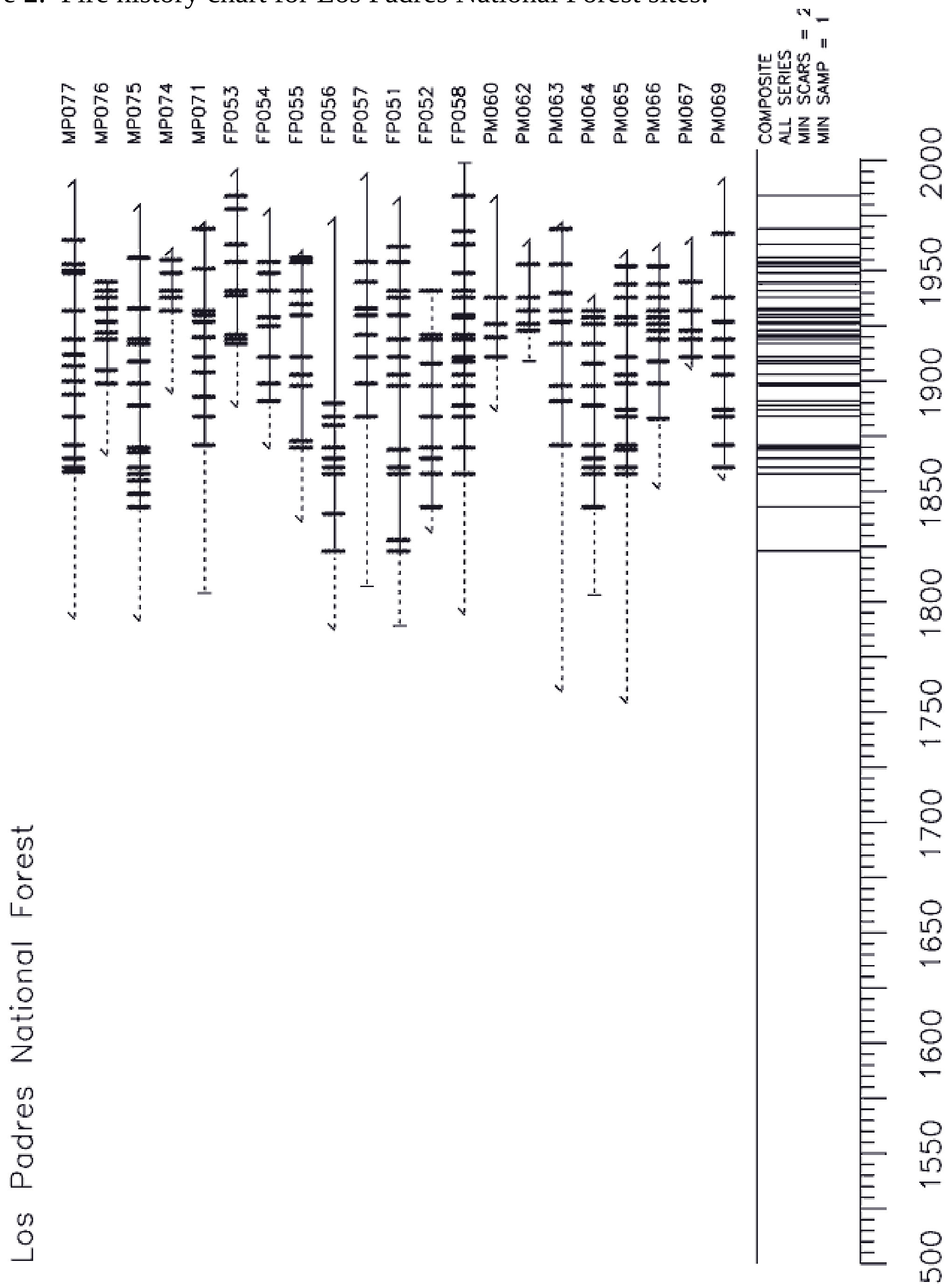

Figure 3. Fire history chart for Angeles National Forest sites.

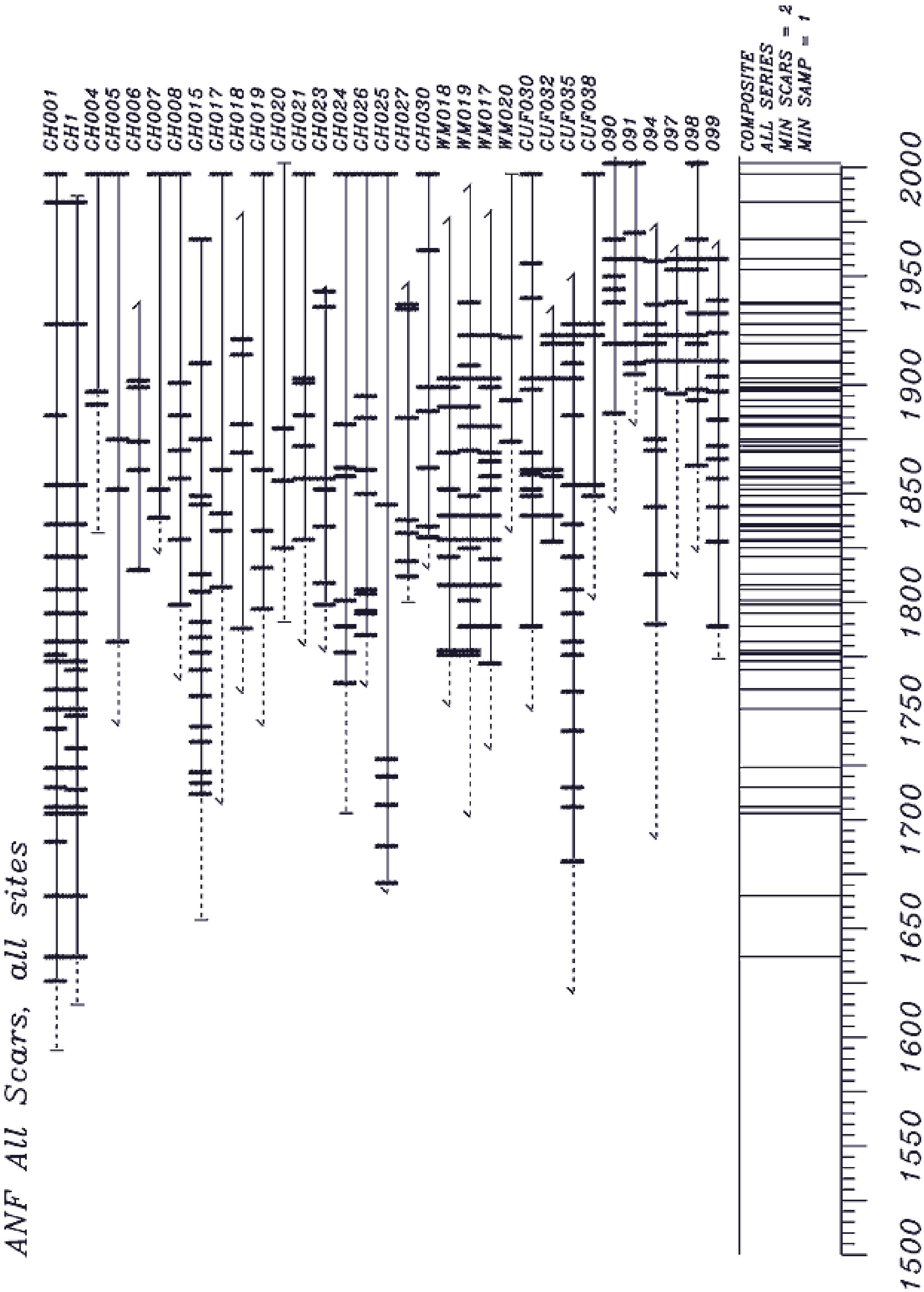

Figure 4. Fire history chart for San Bernardino National Forest northern sites (San Bernardino Mountains).

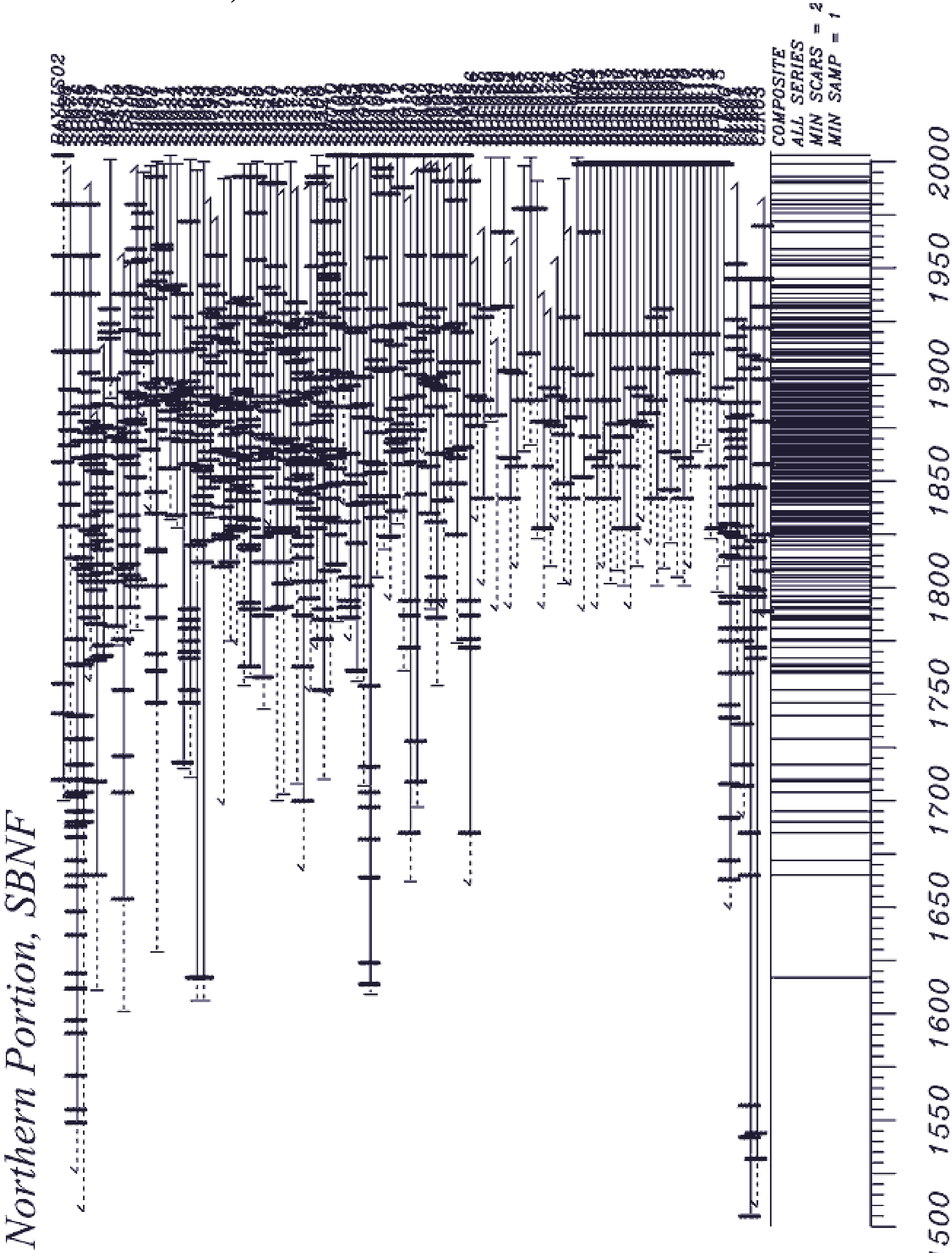

Figure 5. Fire history chart for San Bernardino National Forest southern sites (San Jacinto Mountains).

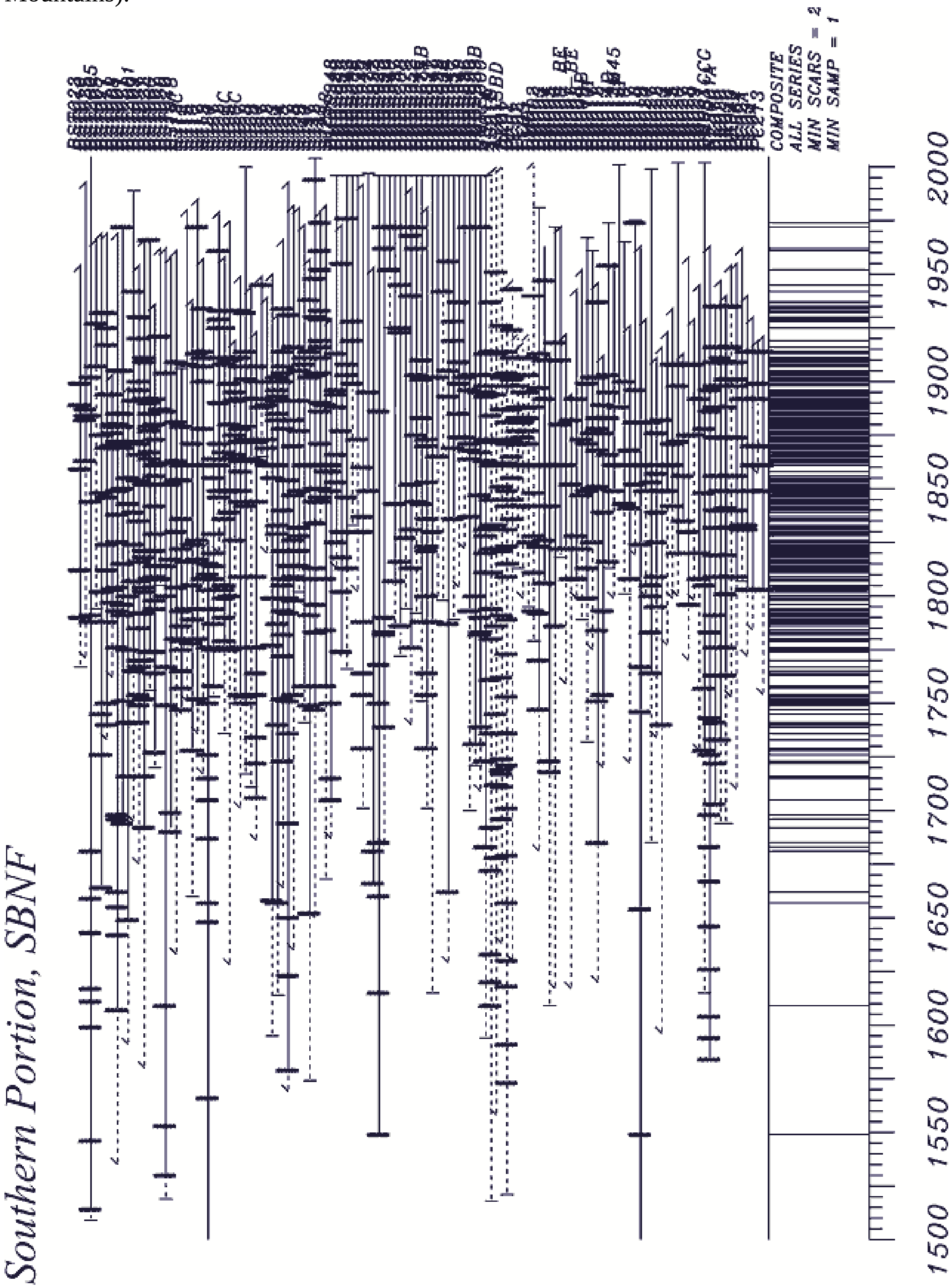

Figure 6. Fire history chart for Cleveland National Forest and Cuyamuca Rancho State Park sites.

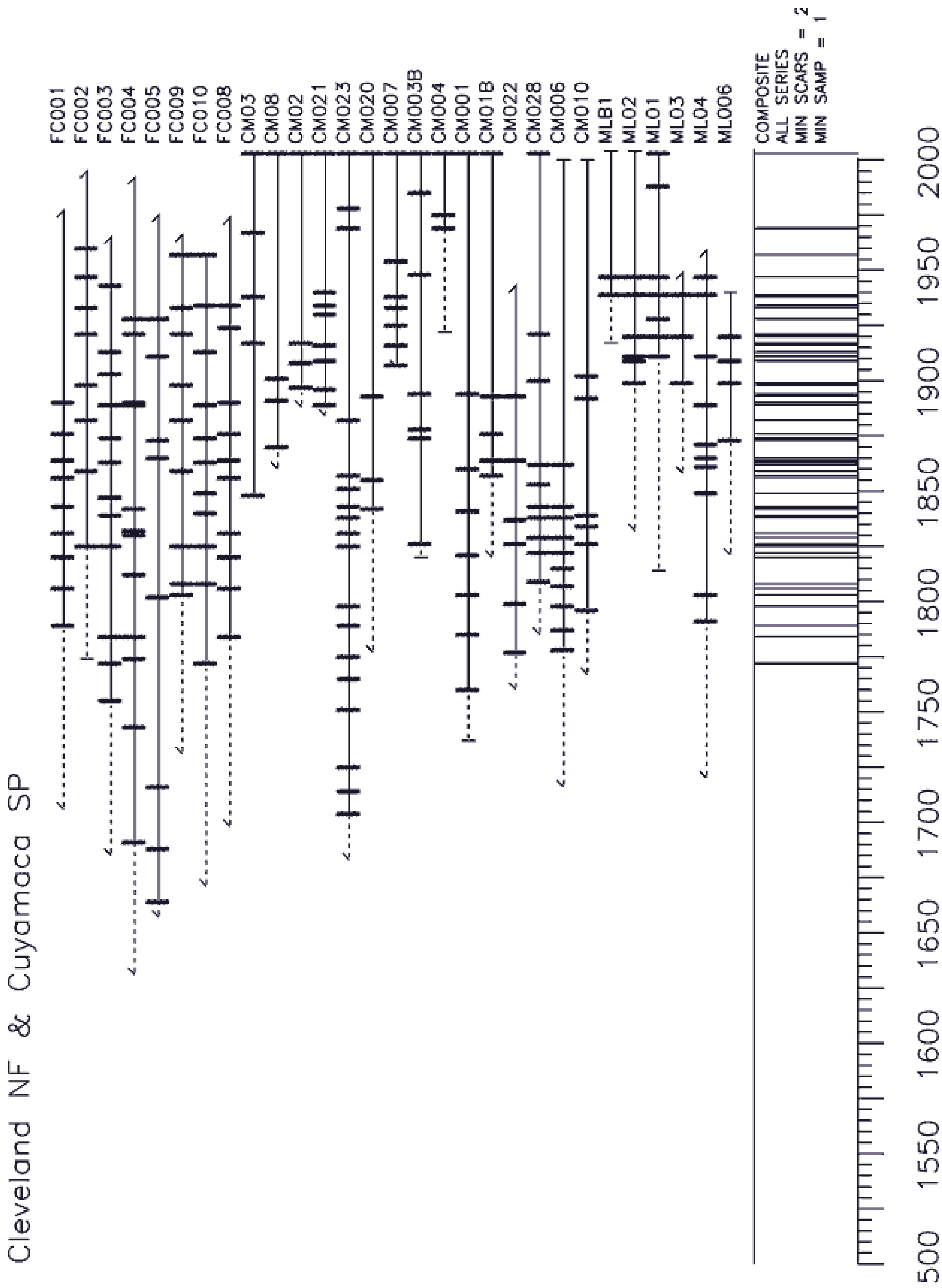

Table 4. Table lists fires in agency records. Fire dates from CDF database *Fire Perimeters: Wildfires Statewide interagency GIS polygon layer of fire history* (2006) and from local historical sources. Historical fire dates matching fire scar dates are shaded.

Pine Mountain	Mount Pinos	Frazier Peak	Crystal Lake	Wright Mountain	Guffy	Grassy Hollow	Strawberry Peak	Shake & Hook Creek	Section 9	Clark Grade	Black Mountain (All)	Fry Creek	Cuyamaca	Mount Laguna
1953	1945	**1984**	**2002**	**1997**	**1997**	**1997**	**2003**	**2003**	1993	1970	2003	1989	**2003**	**1999**
1952	1938	1962	1967	**1923**	1928	1984	**1980**	**1997**	**1990**	**1945**	**1976**	1987	1972	1989
1944	1933	**1954**	1953	**1903**	1923	1928	1959	**1956**	1972	1922	**1974**	1984	1970	**1947**
1938	**1932**	1949	1946		1919	1901	**1956**	1933	**1951**		1973	**1957**	1967	**1939**
1932	1927	**1941**	1938		1903		**1953**	1931	1942		**1972**	1955	1961	**1920**
1929	1919	1938	1933				**1938**	1924	1938		1966	**1934**	1956	1911
1927		**1930**	1928				1931	1923	1934		1954	**1928**		1909
1926		1929	1923				1924	1922	1929		1951	**1924**		
1923		**1921**	**1919**				1920	**1906**	1927		1947			
1919		1919	1911				1917		1924		1943			
1917		1911					1911		1922		1937			
1911		1903					1901		1919		1926			
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