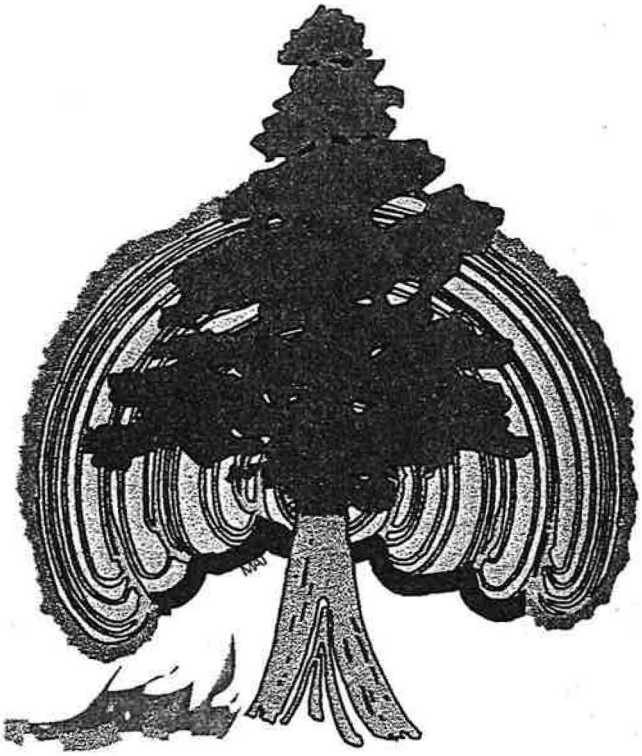
Expanded Fire Regime Studies in the Jemez Mountains, New Mexico



Final Report
Spring 1998

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INTRODUCTION

The forests of the Jemez Mountains, in north-central New Mexico, are relatively well-described in terms of historic fire regimes (Allen 1989; Touchan et al. 1996). Information from previous fire history studies has provided a solid knowledge base. However, these studies have also been a source of new questions and hypotheses about past variations in fire regimes, the environmental controls of these fire regimes, and their effects on ecosystem structures. To this end, an expanded fire regime study of the Jemez Mountains was proposed (Swetnam and Allen 1995).

Three main research objectives were outlined in the proposed study: (1) to expand fire regime studies in mixed conifer and aspen stands; (2) to reconstruct fire chronologies in areas impacted by early livestock grazing; and (3) to examine fire regimes of the piñon-juniper vegetation zone at the ponderosa pine ecotone (Swetnam and Allen 1995). Previous reports have already described and discussed part of this work; specifically, the fire history reconstruction in areas impacted by livestock grazing (Progress Report 1, Morino et al. 1996; Appendix B in this Report) and fire history reconstruction in piñon-juniper vegetation (Progress Report 2, Morino et al. 1997; Appendix C in this Report) . In this Final Report, we will present and summarize the data from the remaining collections: 1) El Valle peel and fire-scarred trees; 2) Alamo Bog Fire History; and 3) Camp May North / Cañada Bonito Mixed-Conifer Stand Dynamics.

METHODS and MATERIALS

Field Methods

All specimen and transect locations were determined by Craig Allen and David Snyderman, ecologists at the Bandelier National Monument, using a GPS (Global Positioning System) unit.

I. Fire History

Standard fire history collection methods were used to collect fire-scarred specimens (Arno and Sneck 1977; Swetnam and Baisan 1996). A chainsaw was used to collect whole or partial cross sections from both live and dead trees. Full cross sections were taken from dead trees and partial cross-sections were taken from live trees. Samples were labeled and securely wrapped in the field to reduce breakage and loss during transport

II. CMT's - Culturally Modified Trees: Peeled Trees

Peeled trees are cultural artifacts found sporadically throughout western North America (Swetnam 1984; Wilkinson 1997). They are attributed to certain Native groups who used the inner bark of particular tree species, primarily pines (*Pinus* spp.), as food and/or medicine. Peeled trees have a distinctive appearance, consisting of a large oval or rectangular scar starting above ground level. On the scar face, vertical scratches from the implement used to scrape off the inner bark are sometimes visible. The reason for peeling trees varies. Some groups apparently peeled trees as an emergency measure, performed during periods of duress, e.g., famine (Swetnam 1984). Others groups peeled trees on a seasonal basis, suggesting that peel products were a regular component of their diet. A set of peeled trees in El Valle were sampled to elucidate tree-peeling behaviour. These trees were sampled in a fashion similar to fire-scar collection methods (see previous section).

III. Stand Structure

Stand structure of mixed conifer was assessed by collecting age and tree size data along linear transects. Following a reconnaissance of the stand, transects were located subjectively in areas deemed to be representative of the whole stand.

Trees were sampled using a 'nested belt transect' strategy to obtain adequate representation of all size classes (Abolt 1997). Wider belts were sampled for larger diameter trees because larger (older) trees occur at lower densities. This strategy ensures collection of a sufficient number of larger/older trees so that earlier recruitment episodes may be detected. Transects were 300m long. Data were recorded for seedlings and saplings less than 2.5cm dbh (diameter at breast height) within one meter on each side of the center line. These data included species identification, linear position along the transect and height. For the smaller seedlings, the whole plant was harvested; for larger seedlings/saplings, cross-sections were taken from the base of the plant using either garden sheers or a small hand saw. The top and bottom of cross-sections were labeled on the specimen.

All trees with a dbh greater than 2.5cm were cored using the following criteria:

- only trees with a dbh ≥30cm were cored at distances > 1m from the center line;
- only trees with a dbh ≥60cm were cored at distances > 2m from the center line.

The maximum distance from the center line for sampling was three meters, producing a belt six meters wide. One exception to this sampling strategy was the CAMU plot. Due to the overall low density of trees in this stand, the transect was widened. Trees with dbh ≥60cm were cored at distances > 3m from the center line with the maximum distance from the center line equal to 4m, producing a belt 8m wide.

Trees were cored as close to the ground as possible. Data recorded for each tree consisted of (1) species identification; (2) position along the transect; (3) dbh; (4) drc (diameter at root crown); (5) coring height; and (6) relative height with respect to the stand canopy. Four categories were used to describe relative height. *Dominant* trees received direct sunlight on the sides and top of the crown; the tops of these trees were positioned above the canopy. *Co-dominant* trees received partial sunlight on the sides and full sunlight on the top of the crown; these trees represented average canopy height. *Sub-dominant* trees received direct sunlight only on the top of the crown; the tops of these trees were positioned at the lower canopy. *Understory* trees did not receive any direct sunlight; the tops of these trees were positioned under the canopy. Cores were inserted in paper straws, sealed by crimping the ends of the straws and labeled using numbers cross-referenced with the data recorded for each tree.

IV. Site Descriptions

See Table 1.

Laboratory Methods

I. Fire History

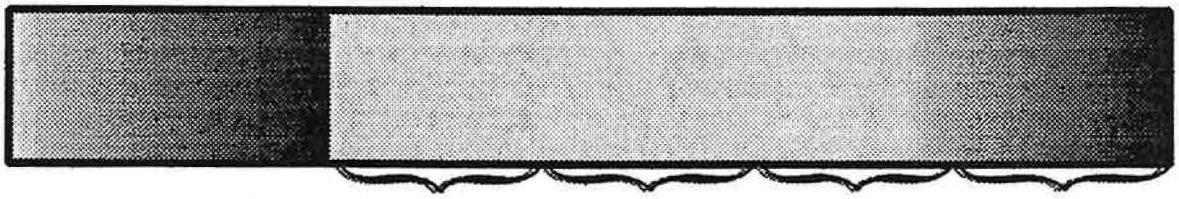
In the laboratory, all samples were re-assembled, re-sectioned on a band saw to manageable sizes, and sanded. Progressively finer grits were used (down to 320 grit) so that the cellular structure on a transverse section could be discerned using a dissecting scope (20-30x magnification). Each cross-section was examined and crossdated. The dates of the 1) inner-most ring, 2) the outer-most ring, 3) fire scars, and 4) unspecified injuries were then recorded.

The position of the scar within the tree-ring was also described (Dieterich and Swetnam 1984; Baisan and Swetnam 1990; Ortloff 1996). Scar position indicates the timing of fires with respect to the growing season of the tree, enabling us to infer the approximate timing of fires at an intra-annual scale. Scar position was described based on the location of the scar relative to ring morphology. Five scar position categories were used: 1) Dormant; 2) Early Earlywood; 3) Middle Earlywood; 4) Late Earlywood; and 5) Latewood (Fig. 1). If scar position could not be determined due to highly suppressed growth or damage to scar and vicinity by insects or subsequent fires, it was labeled, "Unknown."

Our current knowledge about tree-growth phenology in the Southwest (Fritts 1976; Baisan and Swetnam 1994) allows us to roughly estimate windows of time when the fire occurred. However, the interpretation of scar position is subject to many sources of variability. For example, species, elevation, climate during the preceding year, and climate during the current year all effect when growth begins, when growth ends and growth rate. Tree growth studies being conducted on ponderosa pine in the Jemez Mountains illustrate local trends in radial growth (Allen pers. comm.). For example, radial growth in lower-elevation pine (~6500ft) is largely influenced by the timing and quantity of the summer rains and to some extent winter/spring precipitation. Growth response to precipitation is immediate, resulting in highly variable growth rates over the course of growing season. Radial growth of mid-elevation pine are also affected by these factors but to a somewhat lesser extent. In contrast, upper-elevation pine are relatively unaffected by either winter or summer rains and tend to show a more consistent rate of growth throughout the growing season. These trends provide a basis for interpretation of the

Table 1. Site descriptions for Jemez Extended Fire Regime Study. ABCO = *Abies concolor;* ABLA = Abies lasiocarpa; ACGL = *Acer glabularum;* JUSC = *Juniperus scopulorum*; PIED = *Pinus edulis;* PIEN = *Picea Engelmannii;* PIFL = *Pinus flexilis;* PIPO = *Pinus ponderosa;* POTR = *Populus tremuloides;* PSME = *Pseudotsuga menzeisii;* QUGA = *Quercus gambelii*. "t" is "trees" and "s" is "seedlings."

Collection Site (Code)	Ranger District/Park	UTM (northing)	UTM (easting)	Elev. (ft)	Aspect	Map Figure	Current Vegetation	n	Specimen Species Composition
Baca Headquarters (**BAC**)	Baca Location #1 Grant	3969367	362513	-	E	N/A	PIPO	4	PIPO - 4
Alamo Bog (**ALA**)	Baca Location #1 Grant	see BOG and SAB				Map 3	PIFL, POTR, PSME, PIPO, POTR, JUSC, ABCO.	26	(see BOG and SAB)
At Bog (**BOG**)	Baca Location #1 Grant	3975172	356877	~8680	E	Map 3	PIPO, PIFL	14	PIPO - 11, PIFL - 2
South of Bog (**SAB**)	Baca Location #1 Grant	3974838	356080	~8800	N	Map 3	PIFL, POTR, PSME, PIPO, POTR, JUSC, ABCO.	12	PIPO - 8, PIFL - 2, PSME - 1, ABCO - 1
North of Alamo Bog (**NAB**)	Baca Location #1 Grant	3975860	356835	~8720	SW	Map 3	PIPO, PIFL	8	PIPO - 2, PIFL -6
Alamo Bog Aspen (**ALB**)	Baca Location #1 Grant	3974646	356840	~8800	N	Map 3	POTR	16	POTR - 16
Canada Bonito North (**CAN**)	Española RD	see BON				Map 4,5	PSME, PIEN, PIED, POTR, ABCO, ACGL	7	PSME - 4, ABCO - 1, PIFL? -1, UNK - 1
Camp May North (**CMN**)	Española RD	see CAM-U and CAM-L				Map 4,6	PSME, PIEN, PIED, POTR, ABCO, ACGL	15	PSME - 13, ABCO -2
Bonito Canyon (**BON**)	Española RD	3975150	374830	~9680	NE	Map 4,5	PSME, PIEN, PIED, POTR, ABCO, ACGL, ABLA	t-133 s-105	see Figure 8
Camp May Lower (**CAML**)	Española RD	3974134	374561	~9280 - ~9400	NE	Map 4,6	PSME, PIEN, PIED, POTR, ABCO, ACGL	t-172 s-191	see Figure 8
Camp May Upper (**CAMU**)	Española RD	3974200	374300	~9820	NE	Map 2,4	PSME, PIEN, PIED, POTR, ABCO, ACGL	t-124 s-52	see Figure 8
Baca Fence Aspen (**BAC**)	Española RD	3974678	373784	~9780	NE	Map 2	POTR	13	POTR - 13
El Valle (**EVF**)	El Valle Tract, Carson NF	3996935	432980	-	NE	Map 1	PIPO, JUSC, QUGA	14	PIPO -12, JUSC - 2
El Valle (**EVP**)	El Valle Tract, Carson NF	3996935	432980	-	NE	Map 1	PIPO, JUSC	18	PIPO - 18



	Dormant[1]	Earlywood			Latewood
		Early[2] (EE)	Middle (ME)	Late (LE)	
Low (~6500ft)	before early April	early April to late June	late June (beginning of summer rains) to early July	late June (beginning of summer rains) to early July	early July to late July (just after end of summer rains)
Mid (~7600ft)	before mid April	mid April to late June	late June to mid July	mid July to early August	early August to late August
High (~9200ft)	before late April	late April to late June	late June to mid July	mid July to early August	early August to late August/ early September (around the first frost)

1. Dormant-position scars represent fires occurring during the dormant season of the tree, *i.e.*, from fall to spring, a period spanning two years. In the Southwest, fires tend to be more common in the spring compared to the fall so these fire scars are assumed to be spring fires and are thus dated to the ring following the scar (Baisan and Swetnam 1990).

2. Approximate windows are shown here as discrete periods of time but due to the variability in the amount and timing of precipitation from year to year 2-4 week overlaps between windows are possible.

Figure 1. Scar position and corresponding interpretation of seasonality for the Jemez Mountains, New Mexico.

approximate calendar dates of fires to within several weeks (Fig. 1).

II. Stand Structure

Cores

Cores were allowed to air dry then glued onto wooden core mounts so that wood cells were oriented vertically. In instances when the core was twisted, the twisted section of the core was held above a stream of steam and slowly untwisted. Cores were surfaced with a belt sander using progressively finer grits of sandpaper, starting with 280 and ending with 320 grit. For core surfaces that needed further refinement, 400 grit sandpaper was applied by hand. All cores were crossdated and the dates of the innermost rings were recorded. For cores without a pith, piths

were estimated based on the curvature of the innermost ring and the (visually-determined) average width of the 10-15 innermost rings.

Seedlings and Cross-sections

For very small diameter seedlings (i.e., less than 0.3cm) a surface was obtained by first using a razor blade then 400 grit sandpaper. For seedlings with a basal diameter approximately greater than 0.3cm, a section was cut from the base of the seedling and glued onto a wooden board. The upper part of the section was glued to the board and the lower part was sanded to ensure the most accurate estimation of establishment date. In many cases, very tight rings and reaction wood made it difficult to cross-date specimens. In these cases, age was determined based on ring counts.

Analysis

I. Fire History

Fire-scarred trees were collected for three components of this study: 1) El Valle fire hsitory; 2) Alamo Bog fire history; and 3) mixed-conifer age structure study. Fire data (fire dates and corresponding scar positions) from fire-scarred trees collected for the fire history studies were analyzed and graphically represented using FHX2 (Grissino-Mayer 1995). Specifically, FHX2 was used to compute descriptive statistics for fire interval data and create fire history charts (Dieterich 1980).

II. Super-posed Epoch Analysis

The relation between fire and climate was examined using super-posed epoch analysis (SEA). A set of fire years were selected based on specific criteria, e.g., fire size. The selected fire events were then "superposed" onto a time series of reconstructed winter/spring precipitation based on trre-ring chronologies from the Jemez and Sangre de Christo Mountains of northern New Mexico (Touchan et al. 1996). Each event was described by an "event window" comprised of precipitation values of the event year and the four years prior. The set of selected events was summarized into a single event window by averaging values for each year in the event window for all of the selected fire years.

Actual data was statistically evaluated by comparing it to randomly generated data. One thousand "events" were randomly selected. The averaged data of the actual fire years was then

compared to the distribution of values from randomly-selected "events" for corresponding years in the event window. It was then possible to assess whether winter/spring precipitation associated with actual fire years occurred by chance at specific levels of confidence (Swetnam 1993, Holmes and Swetnam 1994).

EL VALLE - RESULTS and DISCUSSION

Peel Trees

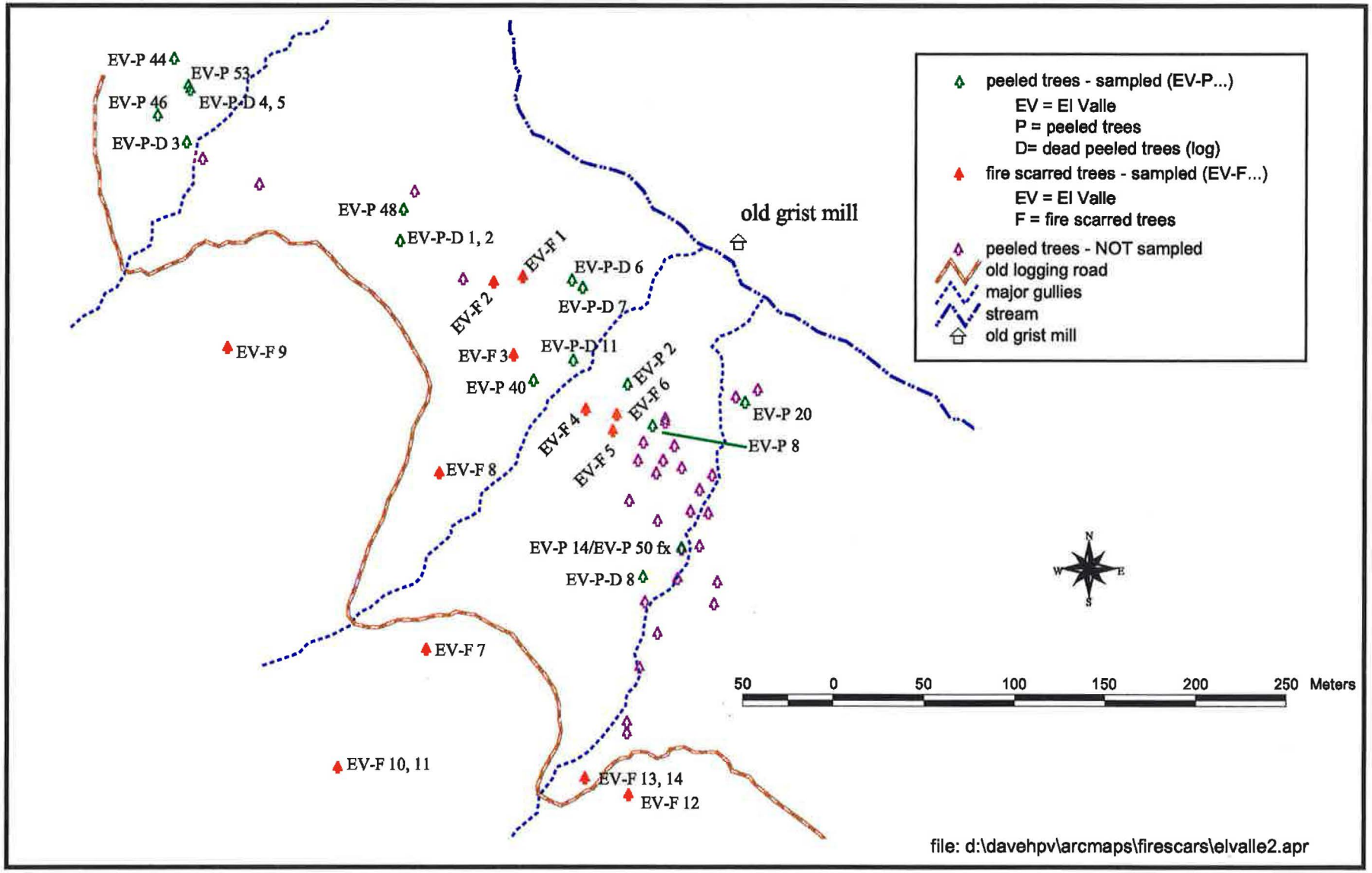
A total of 32 trees were sampled in El Valle for fire and peel scars. The majority of these trees were ponderosa pine (Table 1). Peel scars were sampled from 16 trees, all ponderosa pine. Seventeen peel scars were identified, representing 14 peel dates. Only one tree had multiple peel scars (EVPD06; Fig. 2a). The earliest peel date was 1774 and the latest was 1877 with the highest frequency of peel dates occurring between 1815 and 1877 (Fig. 2a). The mean interval between peel dates between 1815 and 1877 was 5.6 years (std dev = 3.0; min = 1 and max = 11 years).

The distribution of scar positions within the tree ring for peels suggests a seasonal preference for peeling. Scar position was determined for 15 out of the 17 peel scars. The majority of scars were positioned in the middle earlywood (9/17; see Methods for complete description of scar position), coinciding with the false ring. Other scars were located in the dormant (3/17) or late earlywood (3/17) positions. No scars were encountered in either the early earlywood or latewood positions. The observed preponderance of peel scars positioned at or near the false ring may indicate that certain physiological processes operating within the tree cambium during the dry foresummer may have optimized the quality of whatever material was extracted from these trees. Alternatively, the high frequency of peel scars positioned in the middle third of the earlywood may simply indicate when the individual(s) tended to be in the area.

Fire and peel scars were found on the same tree in ten out of 16 trees. In 7/10 cases, peel scars were not the initial scarring event of the tree, suggesting that trees with fire scars were more appealing candidates (for peeling) than trees without fire scars.

Fire History

The fire chronology at El Valle was constructed from 25 trees. One hundred and fourteen scars were dated comprising 33 fire years. The first fire scar was formed in 1607. The first fire recorded by at least two trees occurred in 1632. The last fire in El Valle occurred in 1890, scarring 13/22 trees. Fires tended to be widespread at this site as indicated by high synchrony of fire dates between most trees (Fig. 2b). Fire interval analysis showed no difference in fire interval statistics for all fires and for fires scarring at least 25% of the trees. The mean fire interval (MFI) for the period 1632 and 1996 was 17.2 years with a minimum fire interval of one year and a



Map 1. Location of trees sampled for peel and fire scars in El Valle.

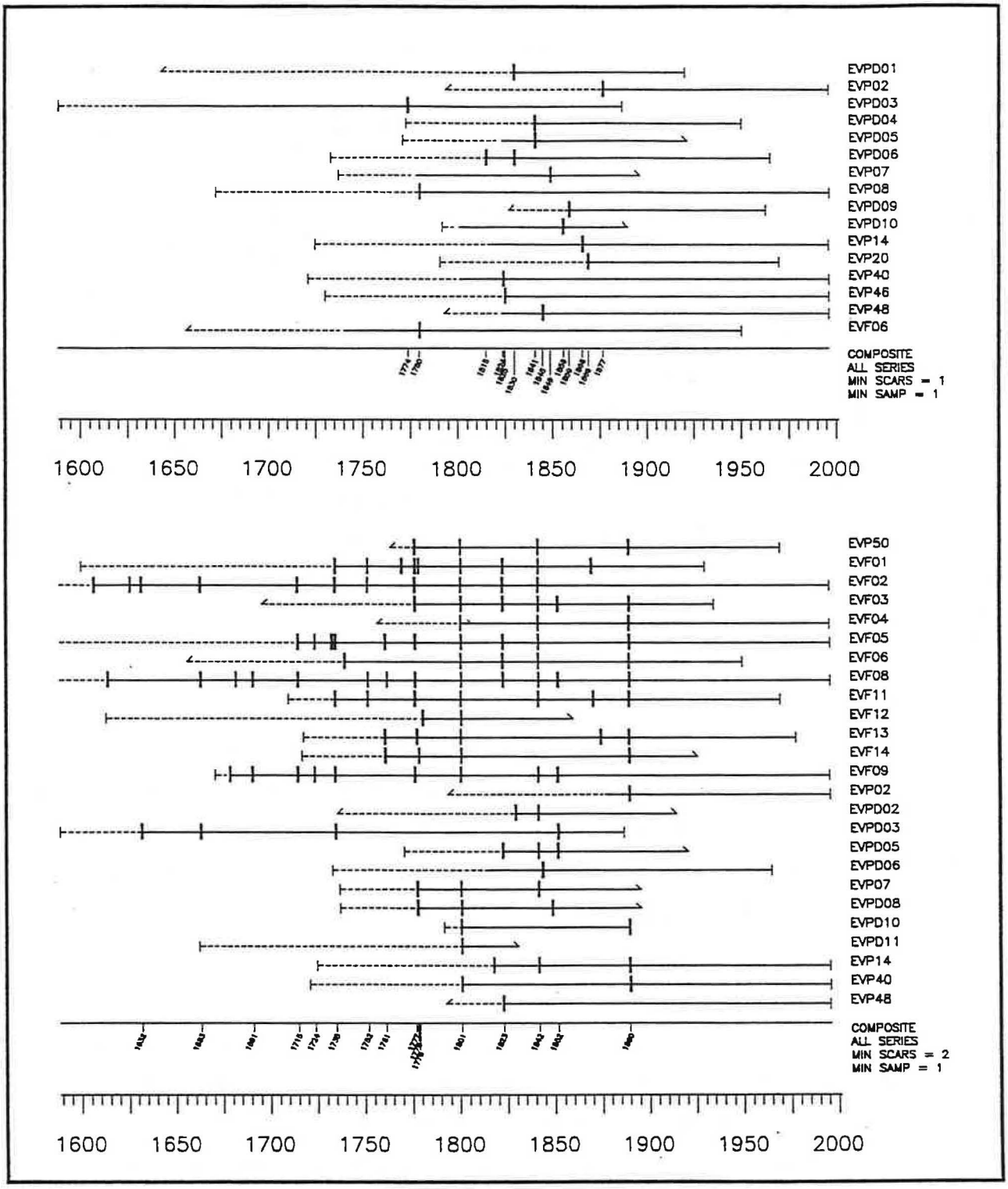


Figure 2. El Valle event chronologies for a) Peel Trees and b) Fire Scars.

maximum fire interval of 38 years. The Weibull Median probability interval was slightly lower at 14.7 years. Significantly short and long intervals based on the modeled Weibull distribution were less than 2.6 and greater than 38.9 years, respectively ($p<.05$). Three fires occurred in consecutive years (1777, 1778, and 1779), yielding two significantly short intervals of one year each. The distribution of trees recording these fires indicates that the 1777 and 1778 fires occurred in different areas of the site (Map 2). The two trees recording the 1779 fire were located on opposite sides of the study area (Map 2) and may have been the result of separate ignitions. Fire occurrence in the same area in consecutive years is shown by EVF13 and EVF14 which record the 1778 and 1779 fires, respectively (Map 2). Two significantly long intervals also occurred consecutively between 1842 and 1890 and between 1890 and the present.

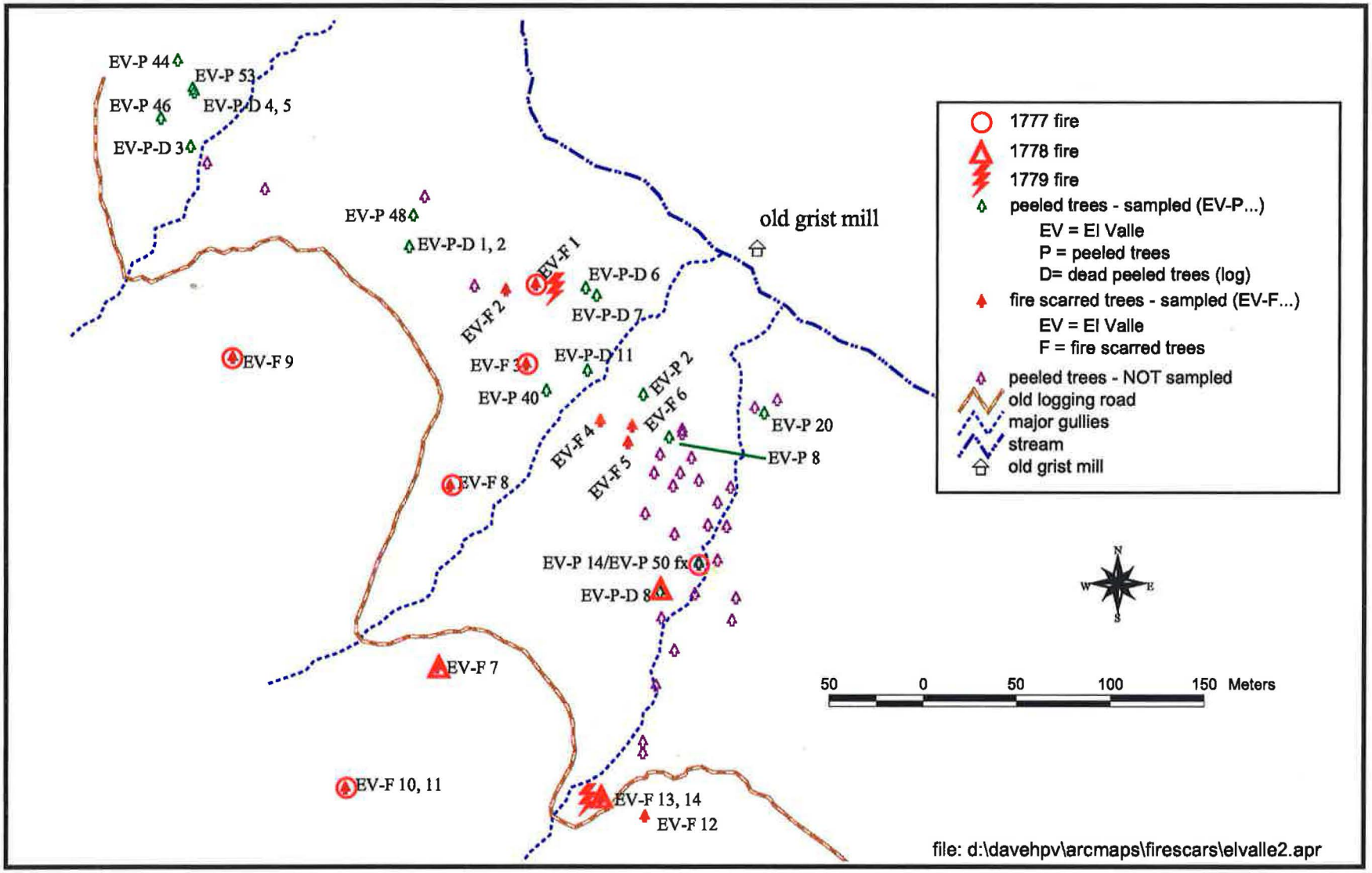
For the 114 fire scars dated at this site, scar position was determined for 103 (90.4%). Two-thirds of the scars occurred in the dormant and early earlywood positions, indicating that fire tended to occur during the period from mid-March to late June (see Fig. 1, "Low"). Only two fire years (for fires scarring at least two trees) did not include scars in either the dormant or early earlywood positions: 1777, with most scars occurring in the latewood position (6/8) and 1852, with all scars occurring in the middle earlywood position (5/5).

Climate, Fire and Peels

Larger fires in El Valle showed a strong and significant association ($p<.01$) with a dry winter/spring preceded by three years of wet winter/springs (Fig. 3a). These results are consistent with fire-climate associations found for other ponderosa pine sites in the Southwest (Swetnam and Baisan 1996), including the Jemez Mountains (Touchan et al. 1996). No association was found between peel dates and climate (Fig. 3b).

People and Fires

The occurrence of peel scars signifies that this area was being used by people. Evidence of human presence and resource use in El Valle poses the question of whether human activities in this area influenced fire occurrence. Fire frequencies before and after tree peeling were compared. No significant differences were found, suggesting no influence of fire occurrence by people in this area. The significant association between fire and climate further reinforces this conclusion, at least for larger fires.



Map 2. Location of trees recording fires in 1777, 1778 and 1779 in El Valle.

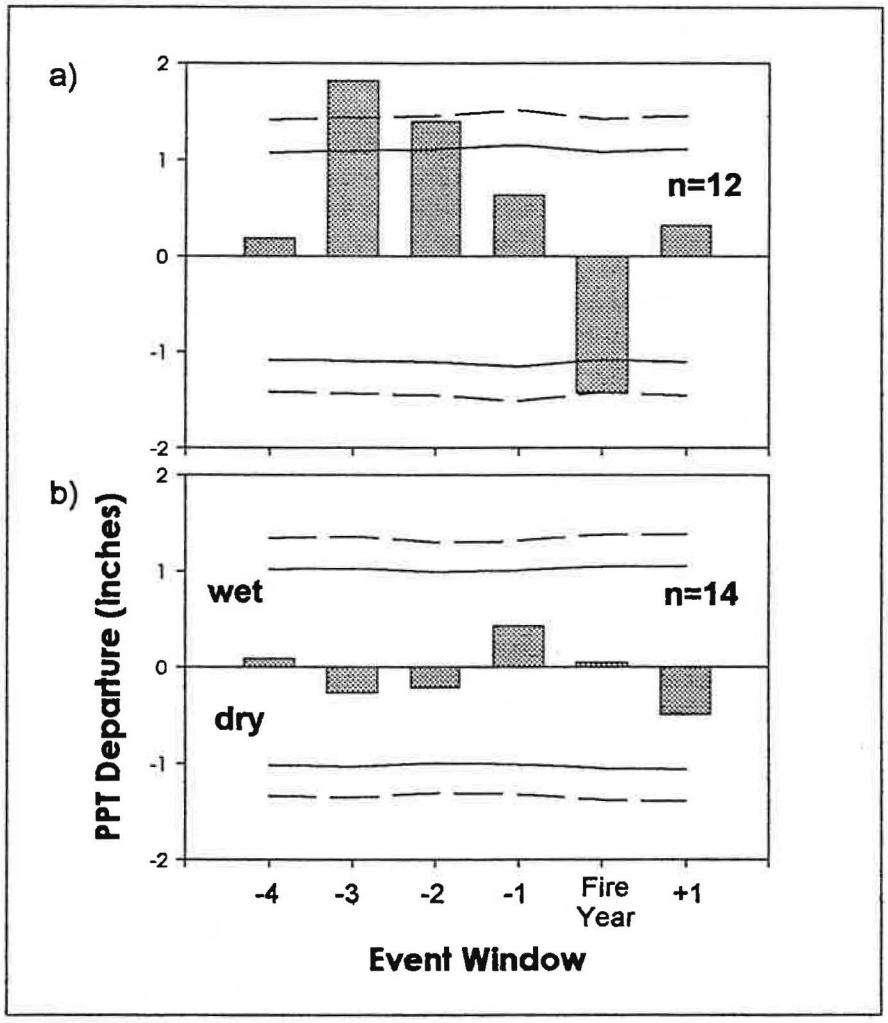


Figure 3. Superposed epoch analysis for a) larger fires (>25% scarred) and b) peel dates in El Valle for 1650 to 1996. Solid lines represent 95% Confidence Intervals (CI) and dashed lines represent 99% CI.

ALAMO BOG - RESULTS and DISCUSSION

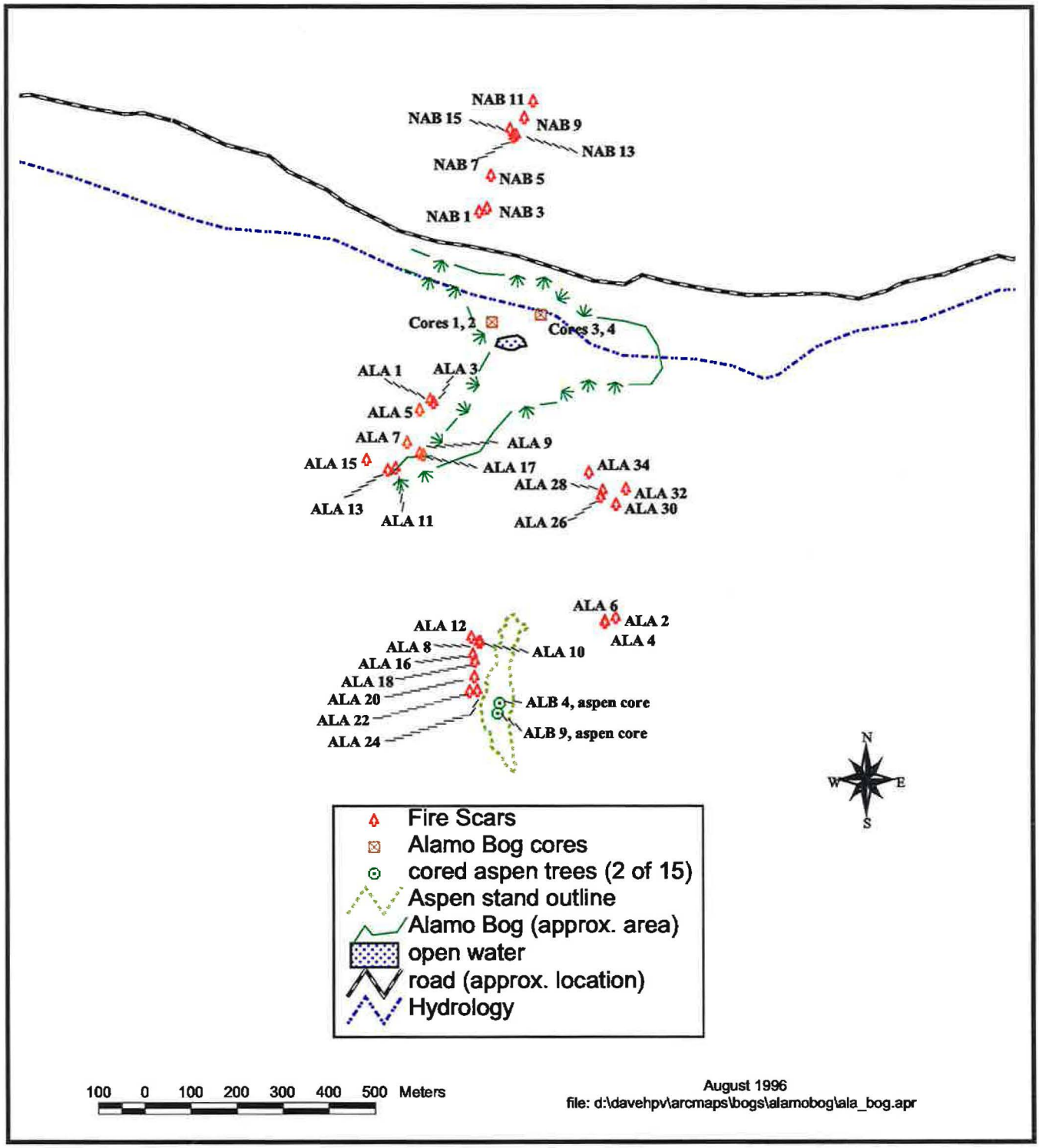
Fire History

The Alamo bog fire history was based on 32 fire-scarred trees comprising three sub-groups located to the north (NAB), south (SAB), and at the bog (BOG; Map 3). A total of 150 scars were dated yielding 42 fire years. Approximately two-thirds of these scars occurred in the early portion of the ring (D and EE positions; see Methods Fig. 1 for a detailed description of scar positions), indicating primarily spring and pre-monsoon fires.

The first fire recorded in this area occurred in 1422. The first fire recorded by at least two trees occurred in 1516. The last fire recorded in this area occurred in 1896 and was recorded only on one tree. The last widespread fire (recorded by >25% of the trees) in the Alamo bog area occurred in 1879. This event burned at a high enough intensity to initiate a stand of aspen located adjacent to the south sub-site (Map 3; Fig. 4). Between 1600 and 1996, a fire occurred somewhere around Alamo Bog within the area sampled every 14 years on average (Table 2a). Larger fires, represented by events recorded in at least two of the three sub-sites, occurred at a mean fire interval of 20 years for the same time period (Table 3).

Fires spread readily within and between sites. In NAB and SAB, mean fire intervals for large fires (scarring ≥25% and ≥2 trees scarred) are the same as mean fire intervals for all fires (≥2 trees scarred). In BOG, all but one fire is considered large (Table 2a&b). Approximately three quarters of all fires recorded in the Alamo Bog area were recorded in at least two out of three sub-sites (Table 3). A small collection of fire-scarred trees (n=3) made near the Baca Ranch headquarters (>10km away from Alamo Bog) shows some of the same fire dates that were recorded in the Alamo Bog area (e.g., 1716, 1806, and 1842), suggesting that these fires were very extensive.

Fire-year synchrony patterns between sub-sites suggest that BOG was a potential ignition source for SAB and NAB. In SAB, 9/10 fires (≥2 trees scarred) were also recorded at BOG; in NAB, 4/5 fires (≥2 trees scarred) were also recorded in BOG. Lower fire frequencies in SAB and NAB may be explained by fire spread barriers. For SAB, the bog could have sometimes constituted a formidable barrier to the spread of surface fires while for NAB, the sparse ground



Map 3. Location of trees sampled near Alamo Bog in the Baca Location #1 Land Grant.

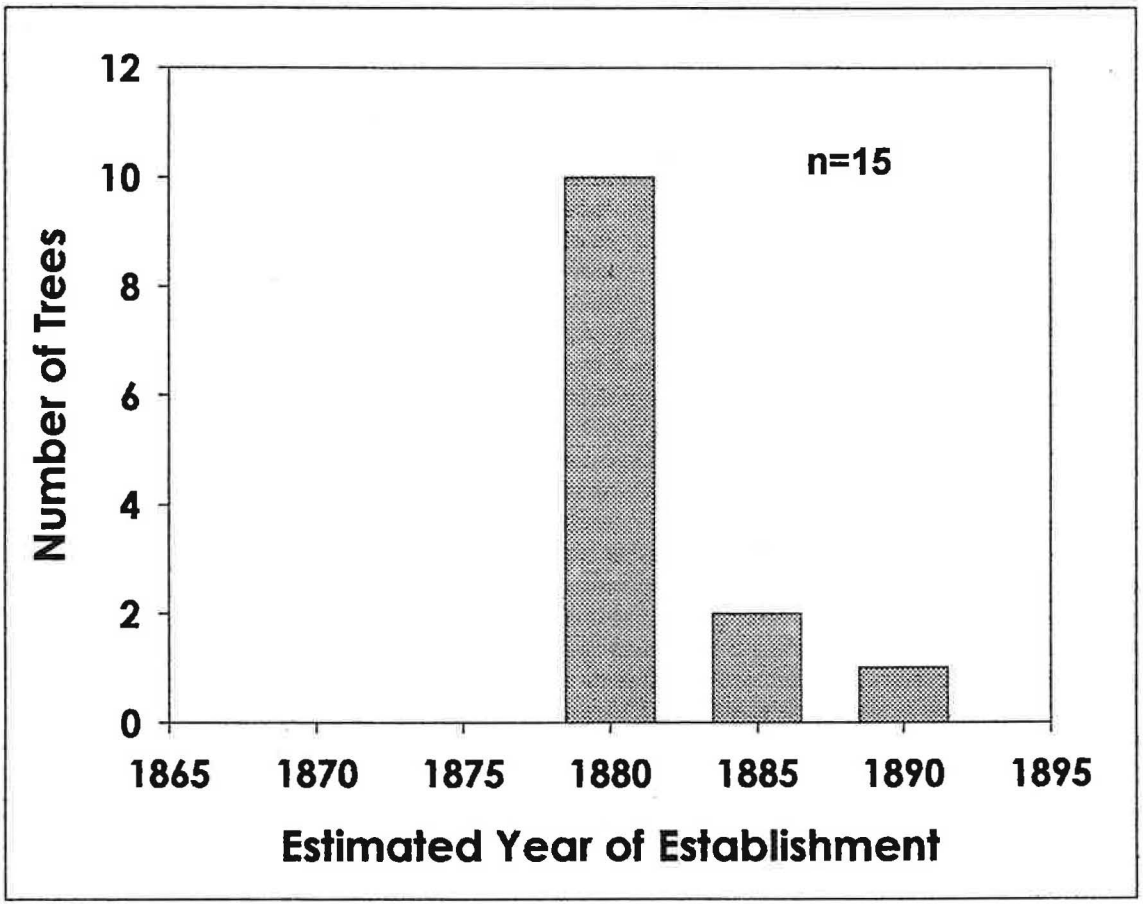


Figure 4. Estimated establishment dates for aspen cored at Alamo Bog (near SAB sub-site).

Table 2. Fire Interval Statistics for the period 1600 - 1879. Intervals were deemed to be significantly short or long at p<.05 based on the Weibull Probability Distribution Function.

a) All fires scarring ≥2 trees.

Site	n	Mean	Med	Weib Mod	Weib Med	Std Dev	Min	Max	Significantly Short	Significantly Long
Bog	15	17	13	7	14	13.6	1	53	4	32
North	4	48	47	42	46	26.9	18	80	22	76
South	9	28	28	21	26	17.1	9	54	11	48
All	18	14	11	6	12	11.6	1	49	4	27

b) Larger fires (≥25% and ≥2 trees scarred).

Site	n	Mean	Med	Weib Mod	Weib Med	Std Dev	Min	Max	Significantly Short	Significantly Long
Bog	14	18	13	8	15	14.3	1	53	5	34
North	4	48	47	42	46	26.9	18	80	22	76
South	9	28	28	21	26	17.1	9	54	11	48
All	13	20	14	12	17	14	5	53	6	35

cover could have impeded the spread of fire from BOG.

Two long fire-free intervals occur in sequence during the late 1700s and early 1800s. The first is over 50 years long, between 1748/52 and 1801/06, depending on the sub-site; and the second is over 35 years long, between 1801/06 and 1842, depending on the sub-site (Fig. 5) . Longer-than-average fire intervals in the early 1800s have been recorded in other Southwestern fire history sites (e.g., Swetnam 1990; Grissino-Mayer et al. 1994; Touchan et al. 1996). Climate is often invoked to explain reduced fire frequency during this period because of the spatial extent of this pattern. Local climate reconstructions, however, do not show a consistent pattern across the region. For example, in the Gila Wilderness in southwestern New Mexico, long fire-free intervals coincided with a wetter-than-average period (Swetnam and Dieterich 1985) while in the Pinaleño Mountains, long-fire-free intervals coincided with a severe drought followed by average to wet conditions (Grissino-Mayer et al 1994). Possibly changes in inter-annual climate are

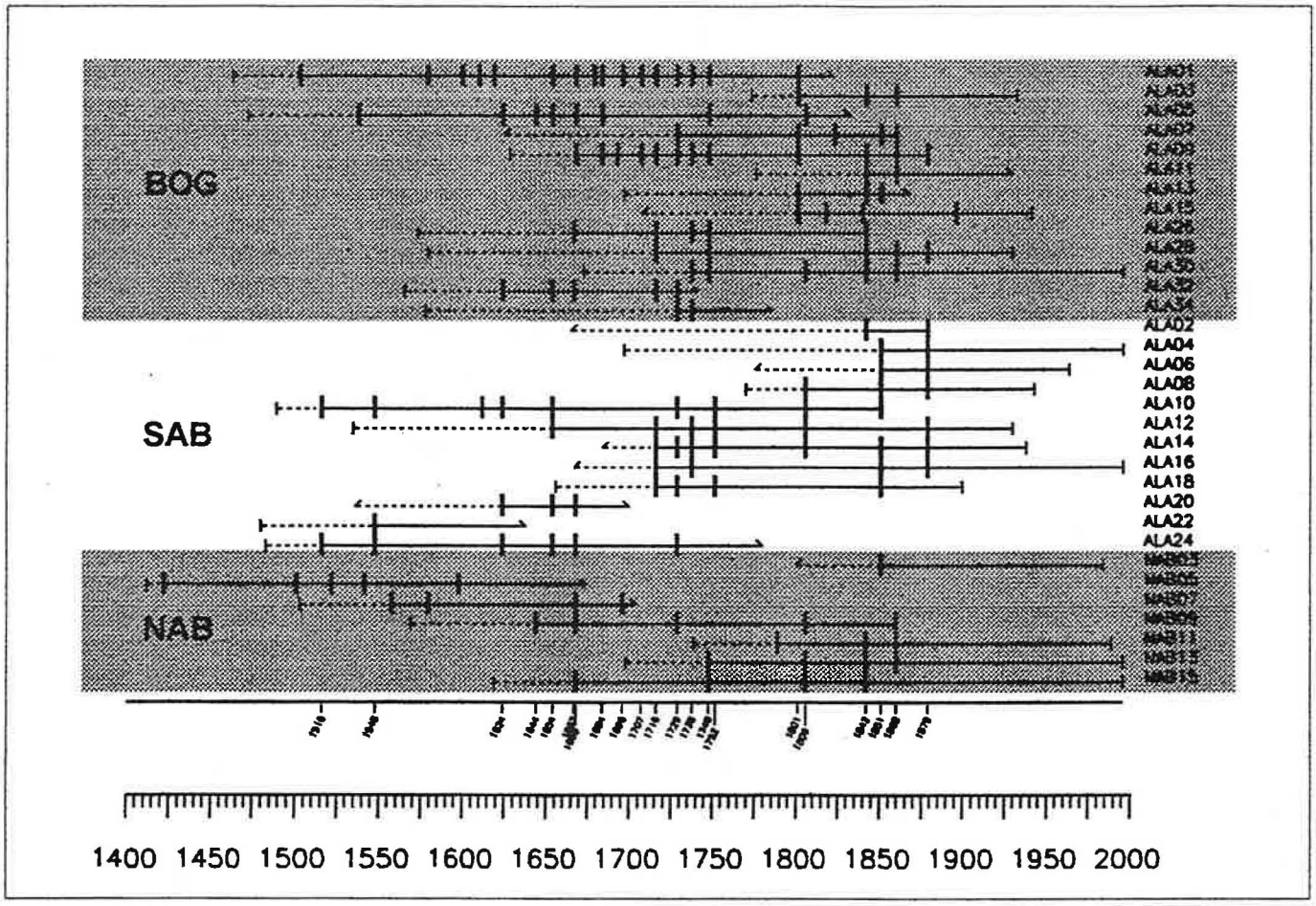


Figure 5. Alamo Bog Fire Chart. Composite shows all fires recorded by at least 2 trees.

Table 3. Fire interval statistics for fires recorded in at least two sub-sites for different periods. Intervals were deemed to be significantly short or long at p<.05 based on the Weibull Probability Distribution Function.

Period	n	Mean	Med	Weib Mod	Weib Med	Std Dev	Min	Max	Significantly Short	Significantly Long
1600-1879	13	20	14	12	18	14.2	9	58	6	35
1600-1752	8	16	14	15	15	6.6	9	28	8	23
1842-1879	3	12	9	12	12	5.8	9	19	7	18

related to the regional pattern of low fire frequencies in the early 1800s. Grissino-Mayer (1995) hypothesizes that the timing and intensity of the summer monsoons began to shift ca. 1800. A change in seasonal precipitation may have affected the species composition, and thereby the distribution and/or quantity, of the fine fuel dynamics that drive surface-fire fire regimes.

The absence of fire at the end of the 1700s is less common on a regional basis. Similar gaps were observed in other fire history studies conducted in the Jemez Mountains and were attributed to grazing by domestic animals, specifically sheep tended by Hispanic, Navajo or Tewa herdsmen (Touchan et. al 1995, 1996). Grazing reduces the amount and continuity of fine fuels, i.e., grass, impeding fire spread. During the 1700s, the sheep industry was a major component of the New Mexican economy (Baxter 1987). Sheep and/or other domestic animals may have grazed at or near Alamo Bog during the late 1700s.

The sheep industry in New Mexico also thrived in the early 1800s. The period, 1821 to 1847, were considered "peak years" for the industry, especially around Albuquerque and to a lesser extent around Santa Fe (Baxter 1987). Perhaps, the low fire frequency observed in the early 1800s at Alamo Bog is more directly related to grazing than climate. Other weak evidence that might corroborate a grazing hypothesis for explaining low fire frequency in the early 1800s is a peel scar found near the Baca Ranch House dated to 1820. Tree peeling was sometimes practiced by some Native American groups (see previous section *El Valle Fires and Peel Trees*), who perhaps also tended animals.

Upon the recurrence of fire in the mid-1800s, fire frequencies appear to be slightly higher

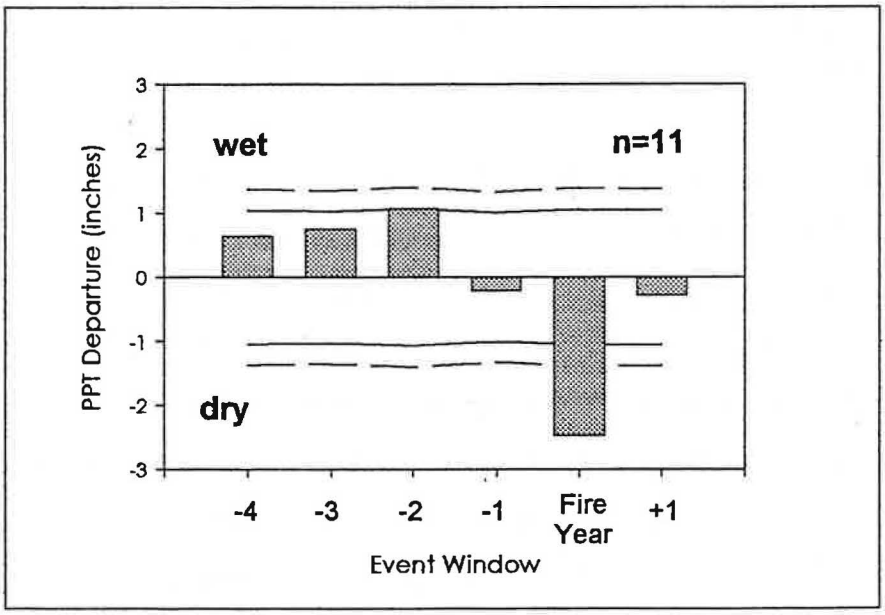


Figure 6. Superposed epoch analysis for fires recorded on at least two of the three sub-sites at Alamo Bog (BOG, SAB and NAB) between 1600 and 1879. Dashed lines represent 99%CI and solid lines represent 95%CI.

than prior to the fire-free intervals (before 1752; Table 3); however, sample sizes are too small to make meaningful comparisons. The last fire at Alamo Bog occurs in 1879 around the time when intensive and extensive grazing is documented throughout northern New Mexico (Wooton 1908; Allen 1989). In particular, by the late 1870s, the Baca Location #1 land grant (where Alamo Bog is located) was awarded to the Baca heirs as compensation for a previous claim lost in the confusion of the political turmoil that characterized New Mexico during the 1800s (Callon 1962; Knowlton 1980).

Fire and Climate

Statistical comparisons of fire and winter-spring precipitation show that larger fires (recorded in at least two of three sub-sites) tended to occur during drier than average years following a series of wet years (Fig. 6). The association of prior wet conditions with larger fires suggests that fire spread was related to fuel buildup. Baisan and Swetnam (1990) have hypothesized that in drier sites, greater-than-average precipitation promotes the increased production and perhaps more continuous distribution of the fine fuels (primarily grasses) that carry fire.

Summary and Conclusions

The earliest fire date for this site was 1422, suggesting that fire had been a force in ecosystem dynamics since at least the 15th century. Fires tended to be widespread although the bog sometimes acted as a barrier to fire spread. Fires tended to occur during drier-than-average years preceded by wet conditions, suggesting that fuel buildup was important. Fire effects of individual events were inferred to be spatially variable, show sharp gradients over short distances. For example, the 1879 fire produced many fire scars in BOG and SAB, indicating that it burned as a low intensity surface fires in these areas. Establishment dates of an aspen stand located adjacent to SAB, indicates that this fire was also a high intensity stand-replacing event.

The fire regime of the Alamo Bog area has potentially been influenced by human land use since the mid-1700s. During the 1600s up to the mid-1700s, widespread fires occurred every 16 years on average. Reduced fire frequency was observed from the mid-1700s to the mid 1800s,

possibly due to grazing or a combination of grazing and climate. When fire occurrence resumed in 1842, fire frequency was higher than it had been before 1752, with fires occurring every 12 years on average. The "new" fire regime, however, was short-lived, ending in 1879 with the advent of intensive grazing in the area.

This study shows that, historically, fire was a prevalent force and an important process in forest dynamics at Alamo Bog and surrounding areas. Human land use and management has effectively excluded fire from this area since the late 1800s, creating a fire-free interval that far exceeds any fire-free interval that occurred in the past. The absence of fire has likely already begun to initiate changes in forest, as well as landscape, structure and function. Re-introducing fire would be an effective way to restore the processes largely responsible for the underlying structure of contemporary forests and landscapes in the Jemez Mountains. This study provides some of the basic information to implement fire restoration, i.e., frequency, seasonality, relative size, and can be used to facilitate the development of a local fire management program.

MIXED-CONIFER FOREST DYNAMICS - RESULTS and DISCUSSION

This section is divided into two parts. The first part is a review of the historical fire regime of mixed-conifer stands in the Camp May / Cañada Bonito area. The second part is a description of stand structure and a discussion of the role of fire in the development of mixed-conifer stands.

Fire History

A previous fire history study was conducted in mixed-conifer forests of the Jemez Mountains, including the Camp May North / Cañada Bonito areas (Touchan et al 1996). The following summarizes the findings of that study:

- Fire frequencies in the Camp May North / Cañada Bonito areas were typical of fire frequencies characterizing southwestern mixed-conifer forests. In Camp May North, fires (≥10% trees scarred) occurred every 11 years on average and in Cañada Bonito, fires occurred every 15 years on average. The Mean Fire Intervals (MFIs) for other southwestern mixed-conifer forests range between 7 and 22 years (Swetnam and Baisan 1996).

- Fires tended to occur following a winter/spring that was drier than average. No significant lagging associations were found. The authors interpret this as indicating the primary importance of fuel moisture, as opposed to fuel accumulation, in the occurrence of large fires. This result is consistent with fire-climate associations tested for other southwestern mixed-conifer forests (Swetnam and Baisan 1996).

- Some fires dates were found to coincide with estimated establishment dates of monospecific aspen stands while other fire dates showed no corresponding association. The authors conclude that the fire regime was comprised of both low-intensity surface fires and high-intensity crown fires.

The collection of additional fire-scarred material from the Camp May North and Cañada Bonito areas for this study reinforce the findings of Touchan et al. (1996). Historically, fire was an integral component of the landscape. A notable feature of the fire regime was that it was comprised of both high and low-intensity fires. This conclusion was made based on comparisons between fire events (Touchan et al. 1996) but also applies to comparisons within fire events. For example, in a 1893 fire in the Cañada Bonito area, some areas burned at high intensities, enabling the establishment of monospecific aspen stands and in other areas, the same fire burned at low intensities, producing scars on trees (Touchan et al. 1996). The same pattern of extreme

differences in intensity within individual events was noted in this study. A fire in 1861 in the Camp May North area was found to be associated with both estimated establishment dates of an aspen stand (Map 4; Fig. 7), indicating a high-intensity crown fire and fire-scarred trees, indicating a low-intensity surface fire.

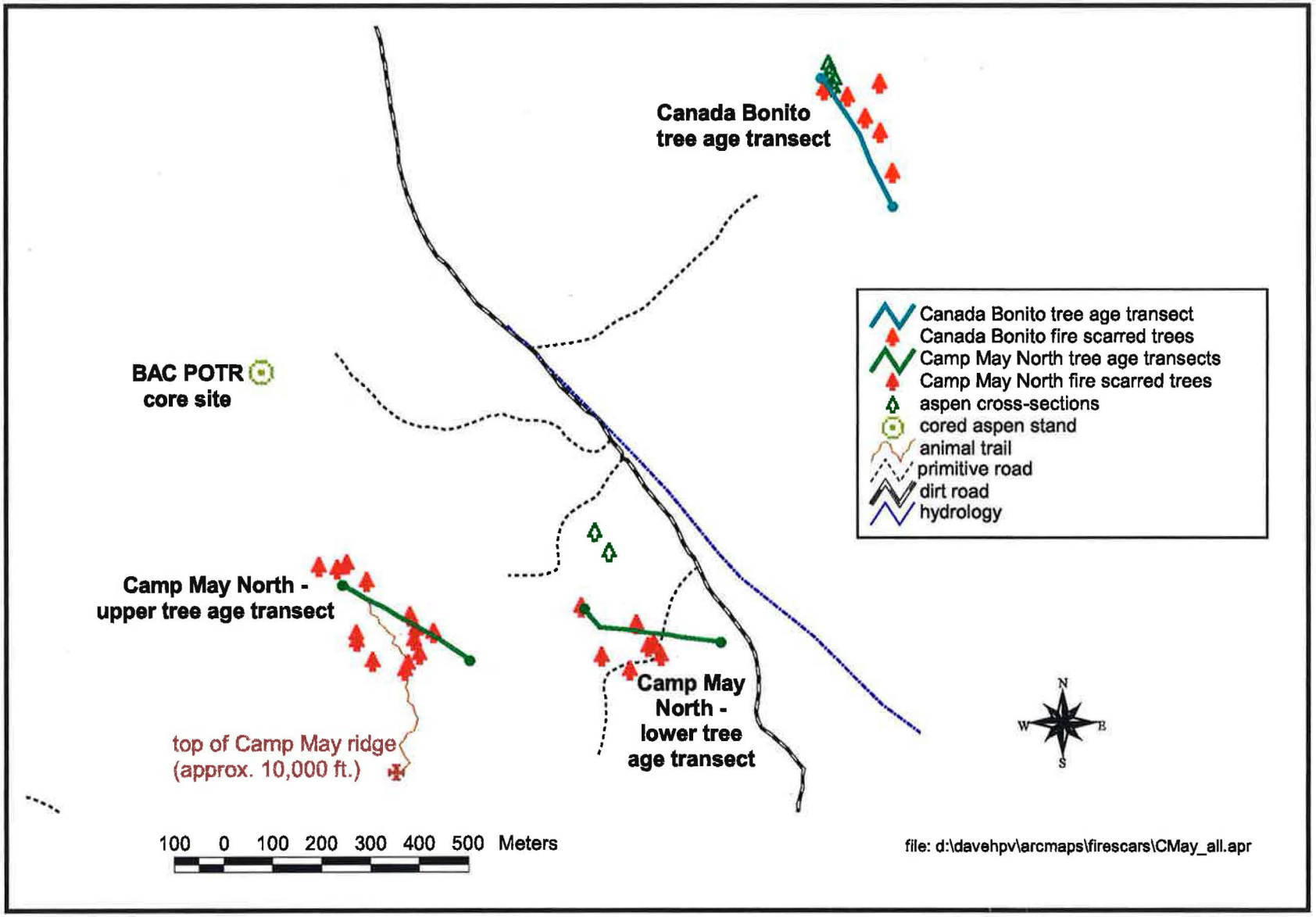
Fire effects are straightforward at a landscape scale. Monospecific aspen stands, embedded in a matrix of mixed-conifer forest, denote where high-intensity crown fires occurred. At a stand scale, fire effects are less obvious, especially within mixed-conifer stands. The following is a description of the stand structure and a discussion of the role of fire in stand development in the mixed-conifer forests of the Camp May North / Cañada Bonito area.

Stand Structure and the Role of Fire in Stand Development

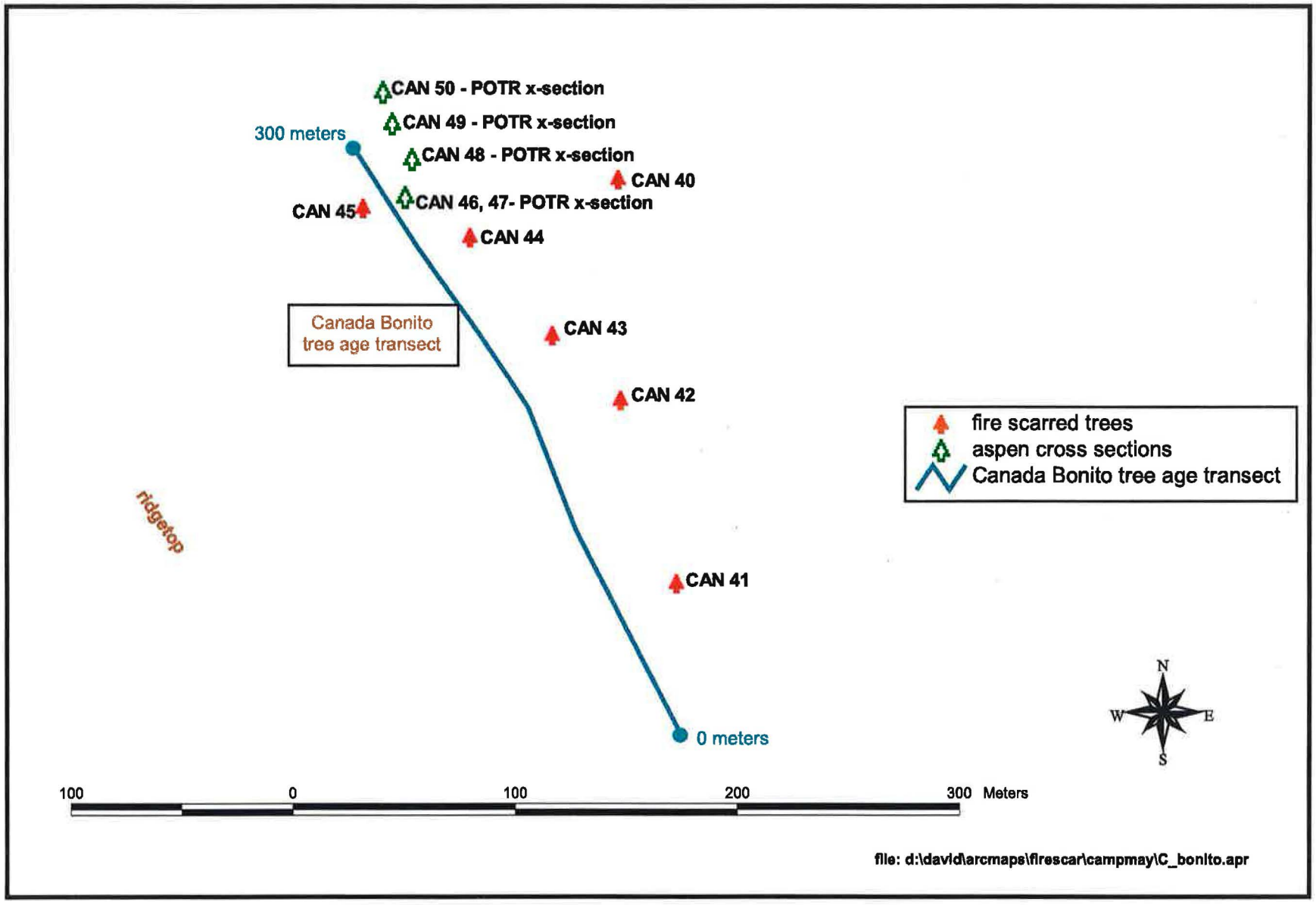
I. Stand Structure -- Species Composition

Species encountered in the three transects include: corkbark fir (*Abies lasiocarpa* (Hook.) Nutt.), white fir (*Abies concolor* (Gord&Glend.) Lindl.ex Hildebr.), Rocky Mountain maple (*Acer glabrum* Torr.), piñon (*Pinus edulis* Engelm.), Engelmann spruce (*Picea engelmannii* Parry) ponderosa pine (*Pinus ponderosa* Dougl. Ex Laws), aspen (*Populus tremuloides* Michx.) and Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco). All species were found in all transects except corkbark fir which was found only in the Cañada Bonito (BON) transect and ponderosa pine which was not found in BON. The most common species were Engelmann spruce and Douglas-fir (Fig. 8). The number of living Engelmann spruce and Douglas-fir trees was similar in all transects except Camp May North - Lower (CAML) where there were almost three times as many spruce trees as Douglas-fir. In contrast, among dead trees, there were more Douglas-fir than spruce (Fig. 8). Ponderosa pine was the most rare species for all transects. Only three very decayed logs were encountered.

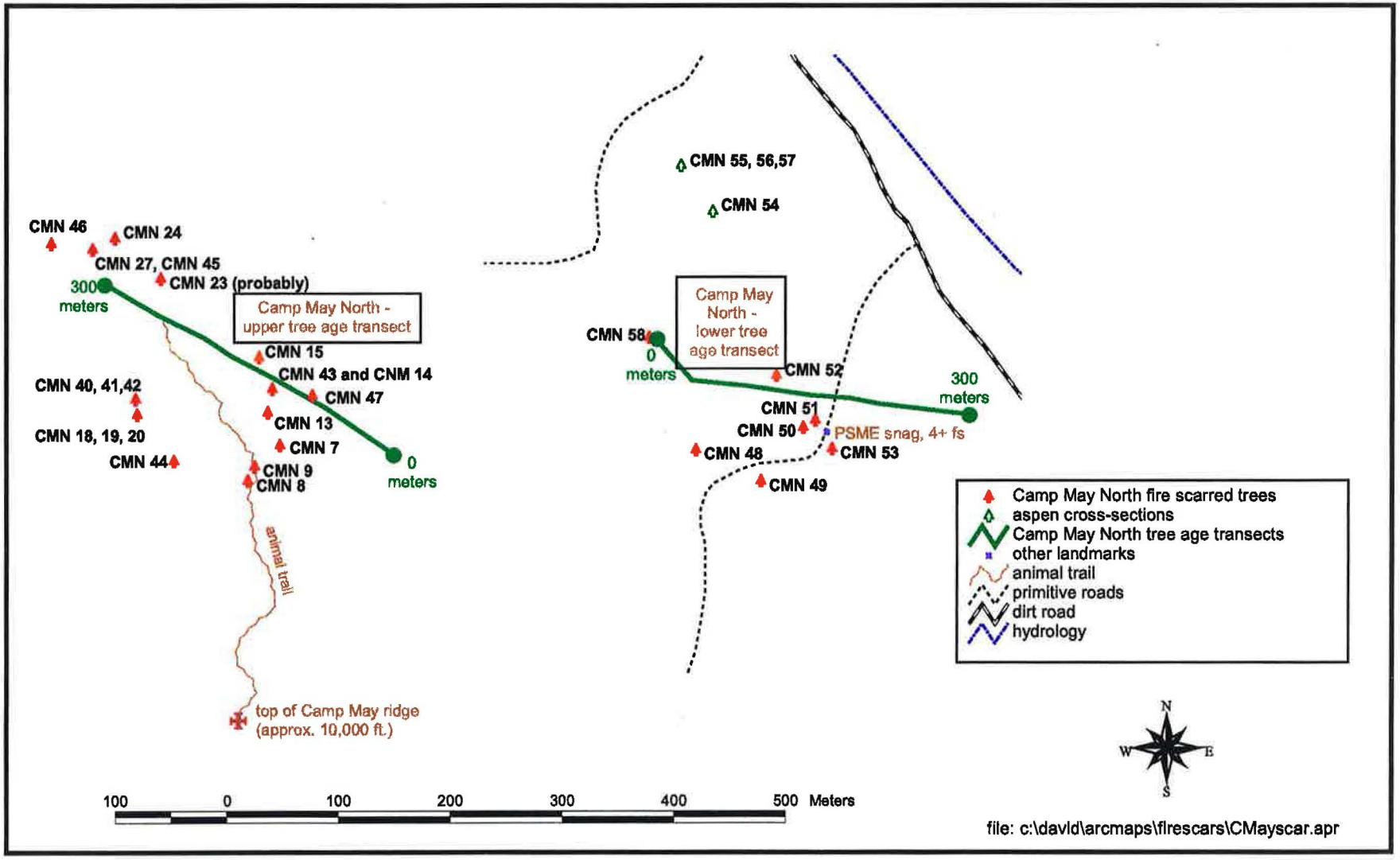
The most common seedling species was Engelmann spruce except in BON where the number of corkbark fir seedlings were three times the number of spruce seedlings (Fig. 8). The second most common seedling species were aspen and maple. The number of Douglas-fir seedlings tended to be low. No piñon seedlings were identified.



Map 4. Location of trees sampled in the Camp May North and Canada Bonito sampling areas.



Map 5. Location of trees samples in the Canada Bonito area.



Map 6. Location of trees sampled in the Camp May North area.

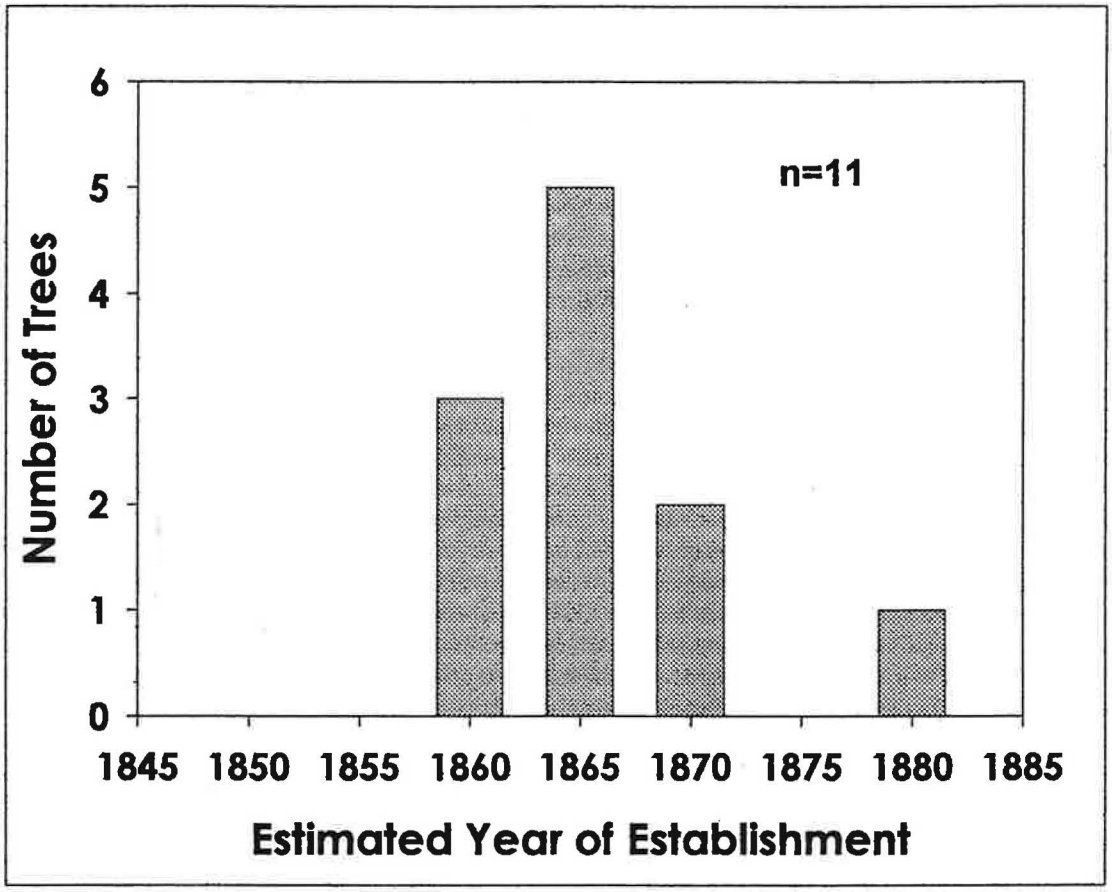


Figure 7. Estimated establishment dates for aspen cored near the Baca Location #1 Grant Fence line. A fire was recorded in this area in 1861.

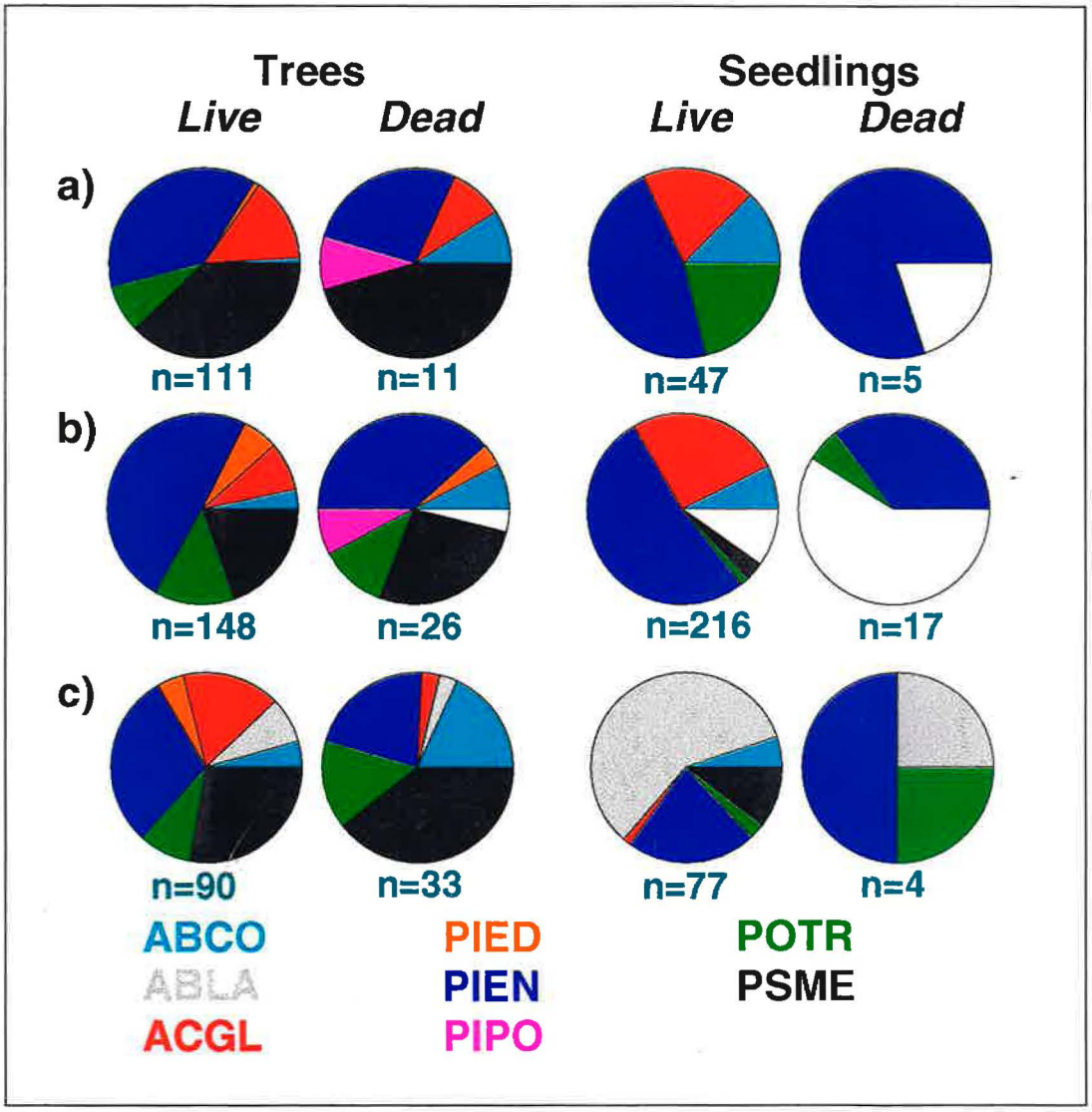


Figure 8. Percent composition of trees and seedlings/saplings, dead and alive for a) CAMU; b) CAML; and c) BON. Uncolored pie segments represent unknown species. ABCO = *Abies concolor;* ABLA = *A. lasiocarpa;* ACGL = *Acer glabularum;* PIED = *Pinus edulis;* PIEN = *Picea engelmannii;* PIPO = *P.ponderosa;* POTR = *Populus tremuloides;* PSME = *Pseudotsuga menzeisii.*

II. Stand Structure -- Canopy Position

Douglas-fir and Engelmann spruce were generally similar in terms of number of live trees / transect; however, these species occupied different positions in the canopy. Douglas-fir tended to be the primary component of the overstory (e.g. Camp May North - Upper (CAMU) and BON) while Engelmann spruce was the primary component of the understory (eg. CAMU and CAML; Fig. 9). Aspen was the only other species that was a conspicuous component of the overstory (especially in CAML; Fig. 9b). Although numbers of corkbark fir and white fir were very low (a total of 17 trees for both species for all three transects), trees of both species were found in the overstory. In contrast, maple which occurred at a relatively high frequency (a total of 43 trees for all transects) was an exclusively understory species. Piñon also occurred only in the understory.

III. The Role of Fire in Mixed-Conifer Stand Development

Species composition and forest structure in the mixed-conifer forests of the Jemez Mountains were probably influenced by the periodic occurrence of low-intensity surface fires. Surface fires can affect species composition by acting as a "species filter." Characteristic morphological traits confer different tolerances of species to fire. Surface fires affect forest structure by periodically acting as a thinning agent for younger trees.

It is somewhat counterintuitive to think of crown fires occurring during the development of mixed-conifer stands because aspen would be expected to immediately colonize the affected area. Results from this study, however, suggest that crown fires may have occurred in the past in these mixed-conifer stands without wholesale conversion to monospecific aspen stands.

Low-Intensity Surface Fires

Several lines of evidence in common among all three transects demonstrate the possible role of low-intensity surface fires in the stand development of mixed-conifer forests. First, for all transects, the oldest surviving trees are Douglas-fir, establishing from the early to late 1700s. Second, there is a concurrent reduction in Douglas-fir recruitment and increase in spruce recruitment ca. 1800 (in particular, see CAMU; Fig. 10). Third, species composition after the late 1800s is more diverse compared to before the late 1800s. And lastly, stand density has increased since the late 1800s.

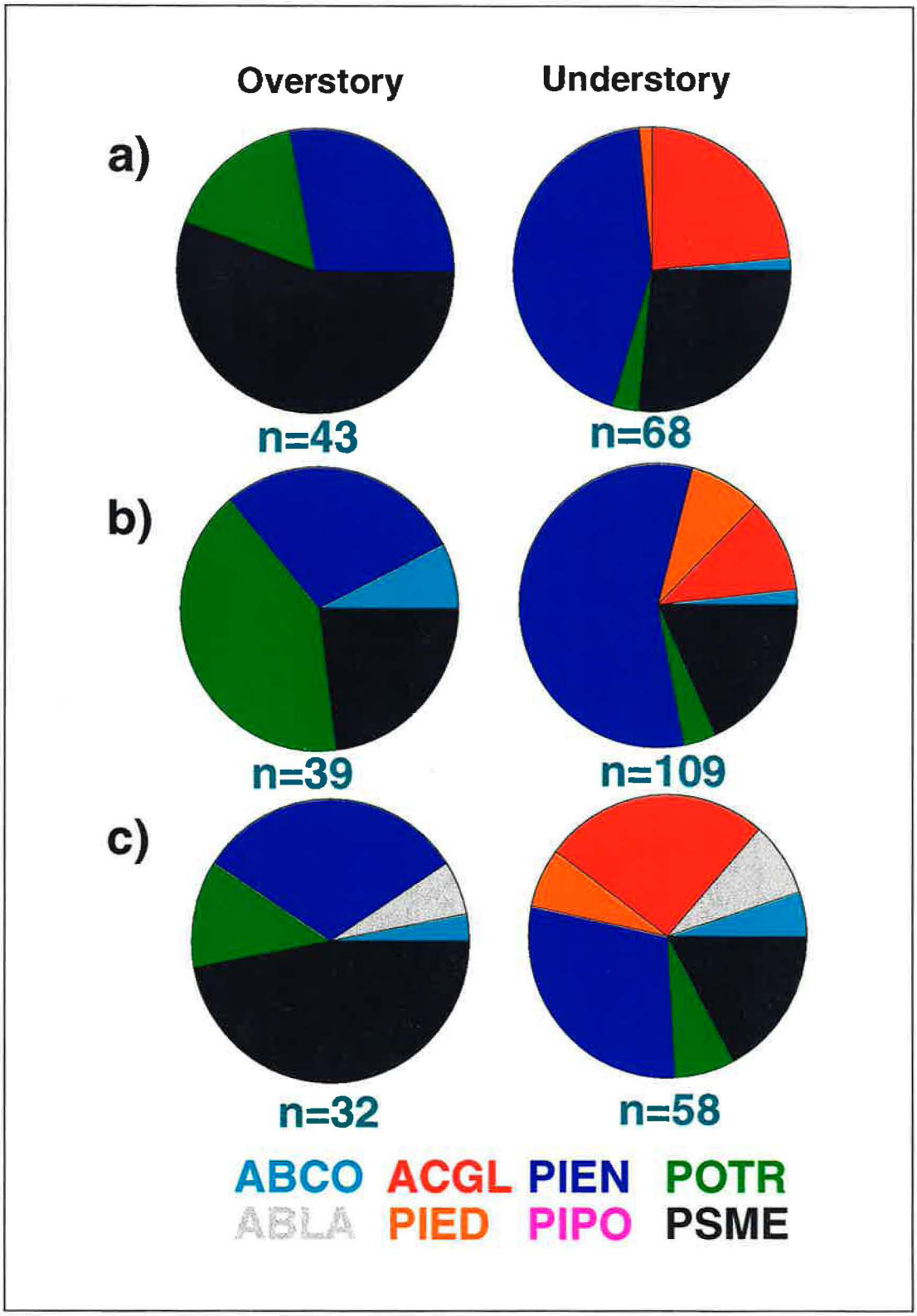


Figure 9. Percent composiiton of speces in the understory and overstory for CAMU; b) CAML; and c) BON. (For four letter species codes, see Fig. 8)

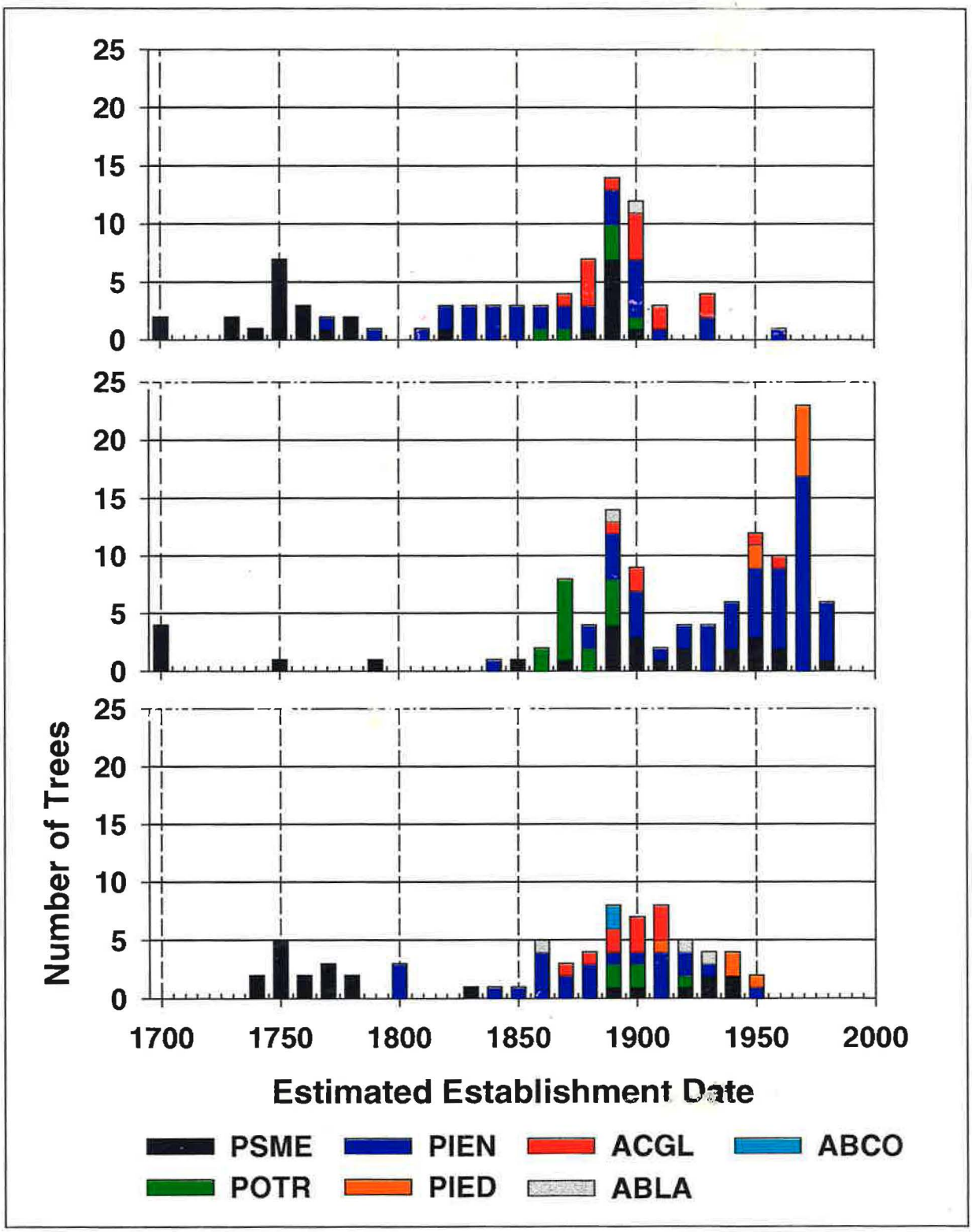


Figure 10. Estimated establishment dates for trees (>2.5 cm dbh) in a) CAMU; b)CAML; and c) BON. Establishment dates were tallied by decade between 1700 and 2000. Trees having establishment dates prior to 1700 were tallied into one age class (indicated by the "1700" bar). For four letter species codes, see Fig 8.

1) Douglas-fir and Spruce Recruitment

Age structure data is a record of survival. Patterns in these data may be the result of variable establishment rates, variable mortality rates or a combination of both. Fire-induced mortality is possible explanation for the higher recruitment of Douglas-fir compared to spruce in the 1700s. Mature Douglas-fir trees show higher survival than mature spruce trees after fire primarily because of thicker bark. Characteristics of spruce that make this species especially prone to high mortality following fire include thin bark, a shallow root system, low branches and a tendency to grow in dense stands. Frequent periodic surface fires would have caused high mortality in spruce saplings and young trees compared to Douglas-fir.

The record of fire and patterns of age structure in the 1800s suggest that fire-induced mortality may not be the only factor explaining the absence of spruce recruitment in the 1700s. Three fires (scarring ≥2 trees) are recorded by trees sampled near CAMU and CAML during the 1800s: 1847, 1861 and 1880; similarly, trees sampled near the BON transect show fires (scarring ≥2 trees) in 1861 and 1893 (Fig. 11). In all transects, age structure data illustrates the persistence of some spruce trees despite these events. Assuming similar regeneration rates of spruce in the 1700s and 1800s, it seems improbable that fire would have virtually eliminated all spruce establishing in the 1700s. This begs the question of whether spruce regeneration was constant from one century to the next.

Patterns of Douglas-fir and spruce recruitment in the 18th and 19th centuries may also be related to a possible change in climate ca. 1800. Spruce seedling survival is generally more successful under cool, wet conditions (Alexander and Shepperd 1990). A tree-ring reconstruction of climate in northern New Mexico indicates that the late 1700s was a period of transition from below average to above average rainfall (Grissino-Mayer 1995). A shift to lower than average temperatures may have also occurred during this period (Fritts 1991; Luckman 1997; Baisan et al. 1998). It is possible that during the 1700s, the combination of low spruce establishment rates and fire-induced mortality resulted in low spruce recruitment. While in the 1800s, higher spruce establishment rates, because of a more favorable climate, resulted in higher recruitment despite the occurrence of several fires during this period.

2) Increases in Species Diversity and Stand Density

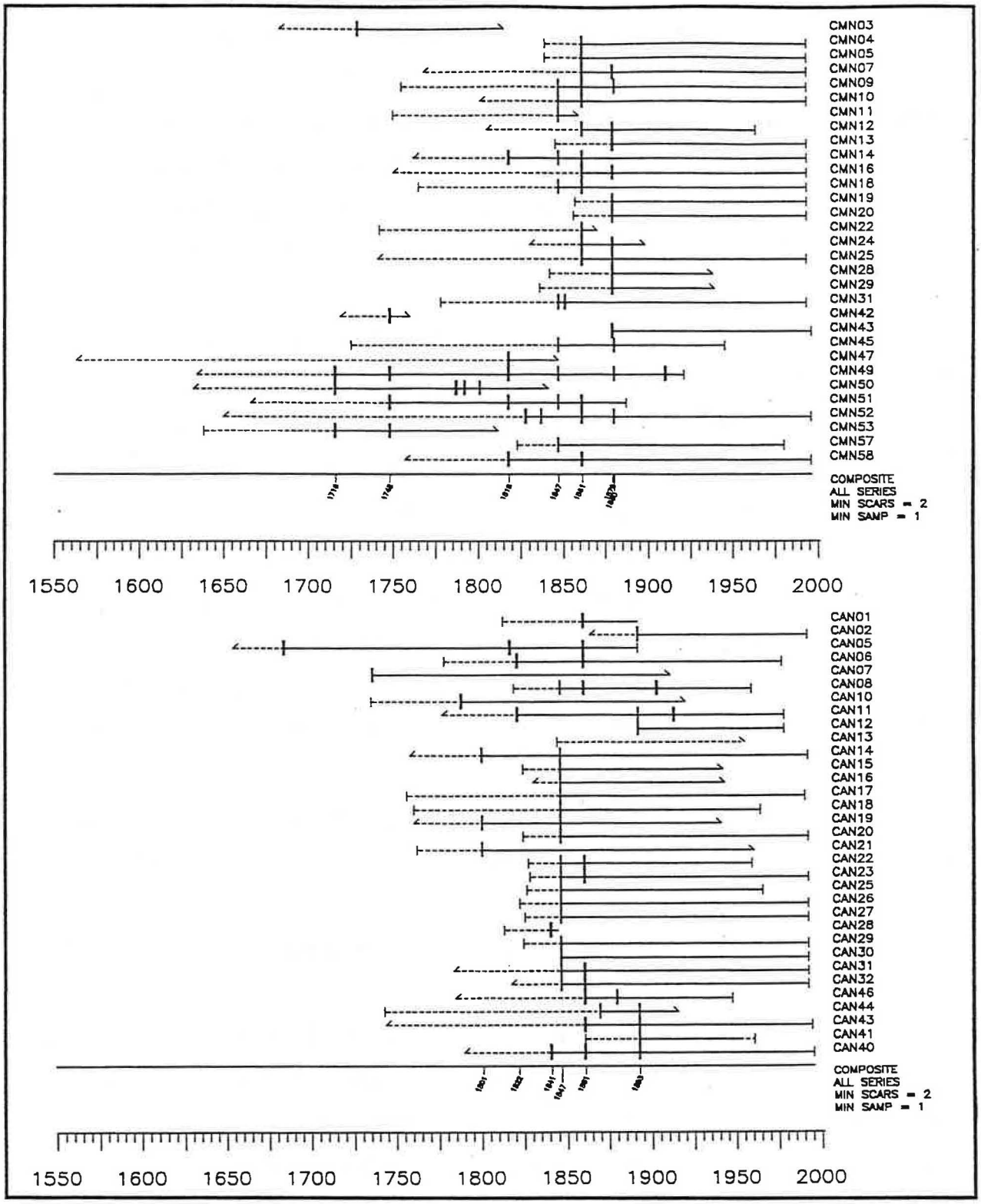


Figure 11. Fire History chart for a) Camp May North area and b) Cañada Bonito area. Trees sampled for this study in the Camp May North area include CMN42, 43, 45 and 47 near CAMU, and CMN49, 50, 51, 52, 53, 57 and 58 near CAML. Trees sampled for this study in the Cañada Bonito area include CAN40, 41, 43, 44, 46 near BON. All other trees were sampled for a previous study (Touchan et al 1996).

Since the late 1800s, there has been a recruitment of species not present in the earlier record, including maple, white fir, corkbark fir and piñon (Fig. 10a,b&c). Except for white fir, it is probable that the historical presence of fire in this system prevented recruitment of these fire-intolerant species before the late 1800s. The absence of fire has led to their proliferation. Ultimately, if fire continues to be excluded from this area, these species may gain dominance. In the case of white fir, the presence of large and possibly old trees have been documented previously (Allen 1984).

The cessation of fire has resulted in increases in tree density, partly because of the recruitment of fire-intolerant species and partly because of reduced mortality in general. The higher densities can be attributed primarily to increasing numbers of understory trees in these stands. There has been a slight increase in the density of canopy trees since fire cessation but relative to the change in understory tree density, it's been minimal. Since ca. 1930 for all transects, no trees have grown into the canopy. This pattern suggests that sub-canopy trees are in a "holding pattern," poised to take advantage in the event of an opening in the canopy.

Currently, understory development appears to be influenced by light availability. For example, in CAMU, understory and canopy tree density are inversely proportional (compare the first 100m with the last 200m; Fig. 12a). Another example can be found in CAML. Between meters 150 and 250, understory tree density is considerably higher than other parts of the transect (Fig 13a). However, contrary to the pattern observed in CAMU, there is no notable difference in canopy density. Further examination reveals that where understory density is high, the canopy consists mostly of aspen and where understory density is low, the canopy consists mostly of spruce (Fig. 13a&b). Thus, there is a qualitative difference in canopy composition that can impart the same effect as differences in density.

One important question related to the observed pattern is to what extent are current understory densities are different from historical densities. True, the data show a greater number of understory trees after the late 1800s compared to before, especially in CAML (Fig.'s 13a, 14a, 15a). However, the contrast in number of understory trees before fire cessation and after fire cessation periods may be an artifact of age structure data. The death of young trees, saplings and seedlings and their subsequent decay makes it difficult, if not impossible, to accurately document

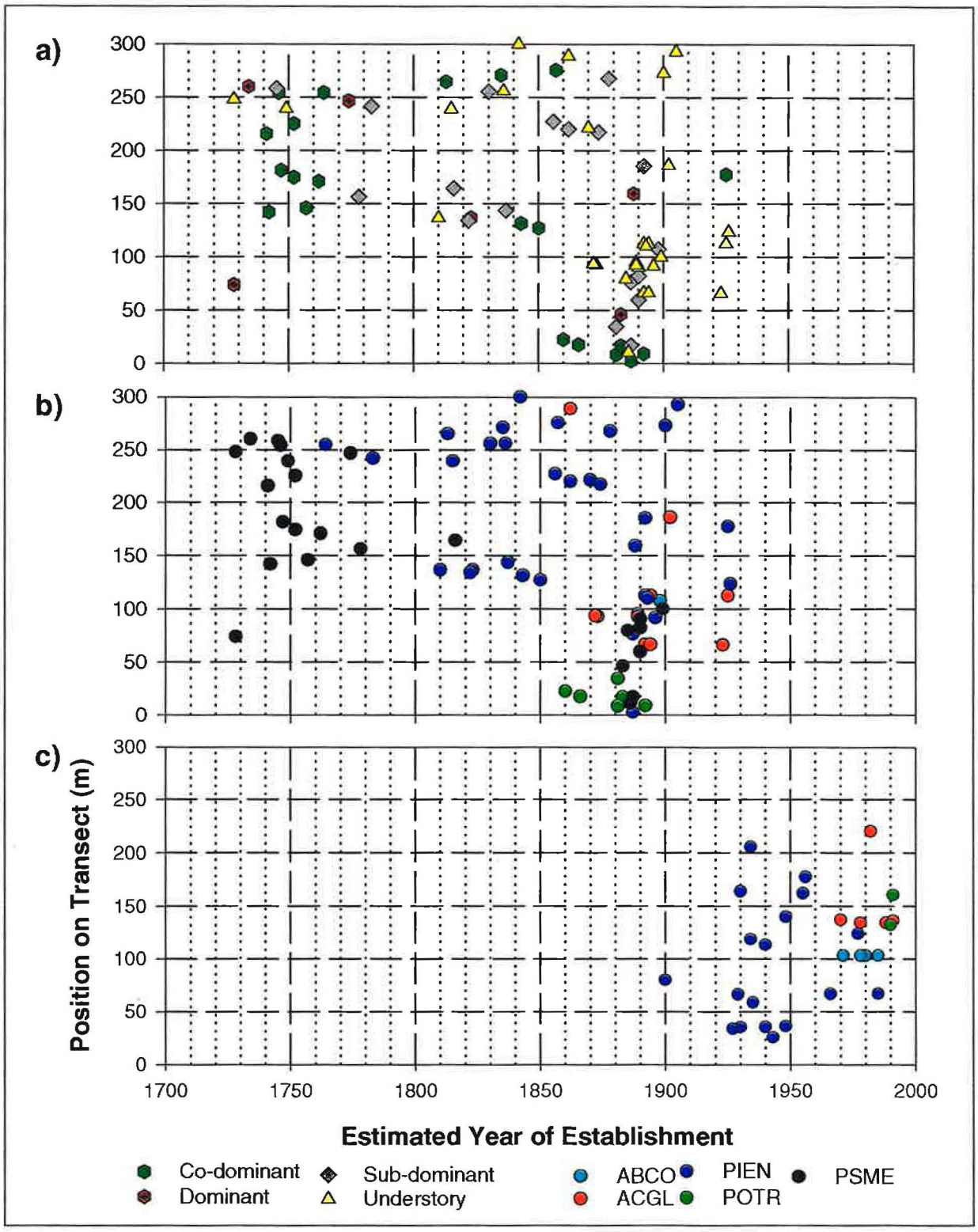


Figure 12. CAMU. Tree position along transect vs. estimated establishment dates by a) canopy position (see Methods Section for classification scheme); b) tree species (dbh≥2.5 cm); and c) sapling/seedling species (dbh<2.5cm).

ABCO = *Abies concolor;* ACGL = *Acer glabularum;* PIEN = *Picea engelmannii;* POTR = *Populus tremuloides;* PSME = *Pseudotsuga menzeisii.*

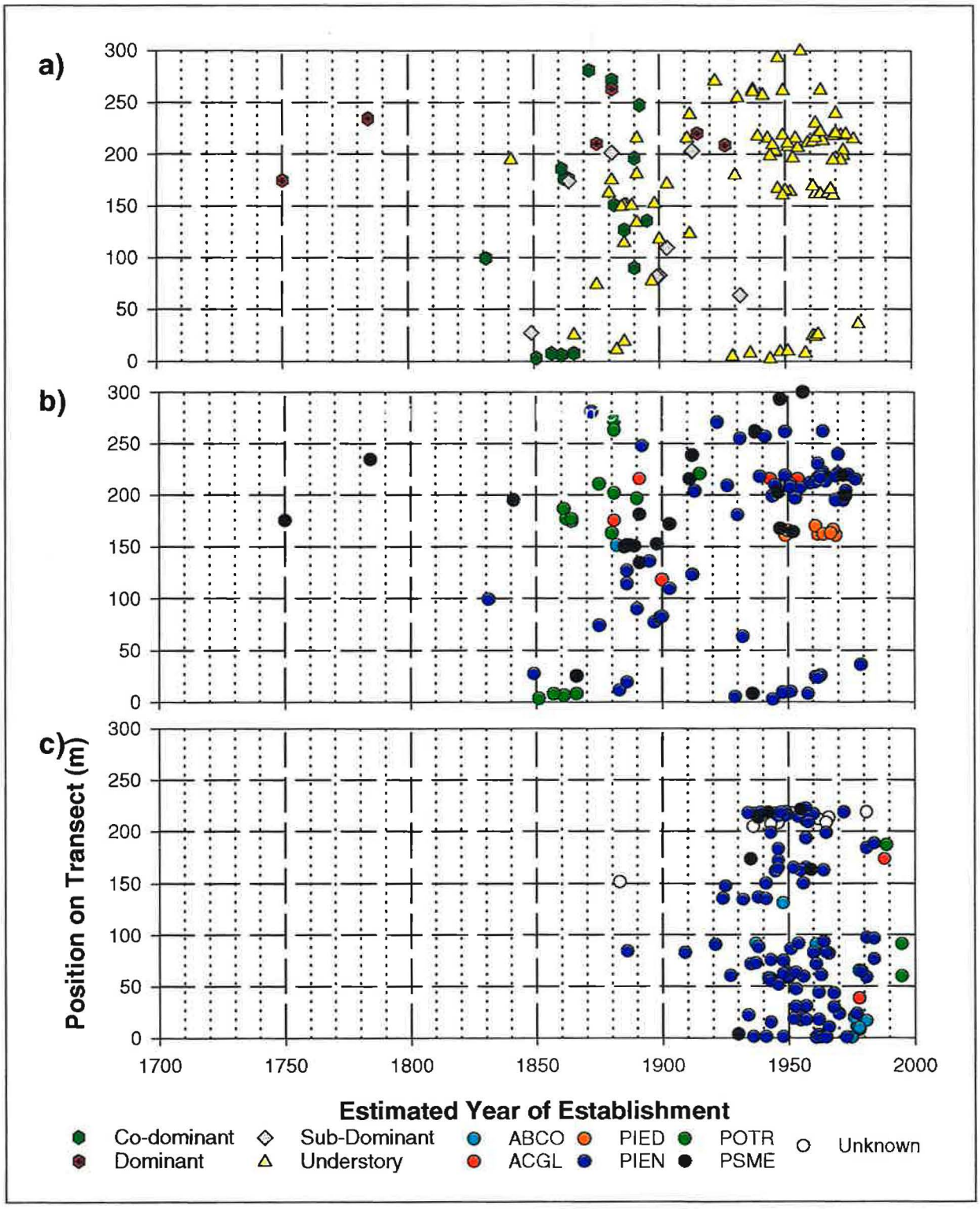


Figure 13. CAML. Tree position along transect vs. estimated establishment dates by a) canopy position (see Methods Section for classification scheme); b) tree species (dbh≥2.5 cm); and c) sapling/seedling species (dbh<2.5cm).

ABCO = *Abies concolor;* ACGL = *Acer glabularum;* PIEN = *Picea engelmannii;* POTR = *Populus tremuloides;* PSME = *Pseudotsuga menzeisii.*

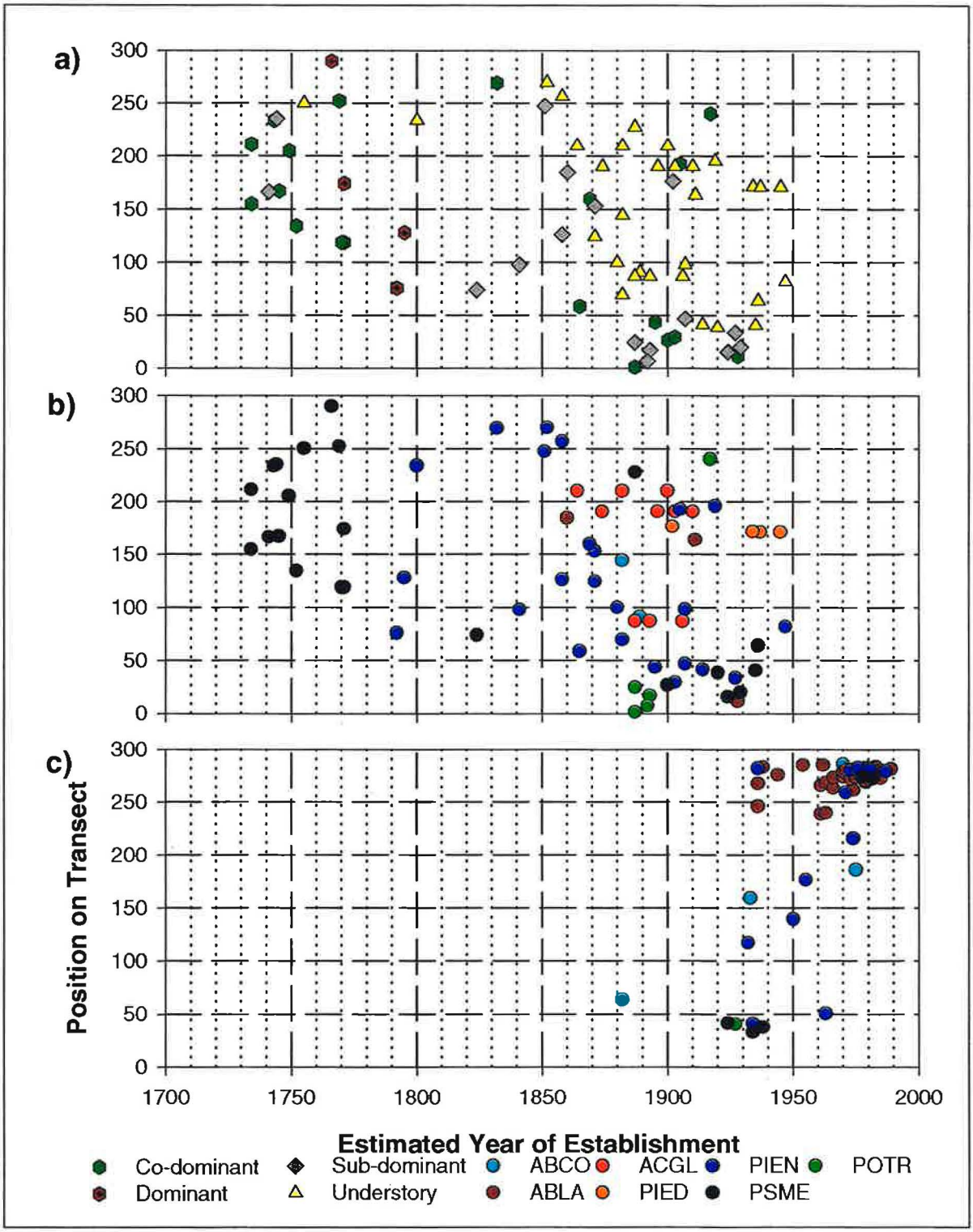


Figure 14. BON. Tree position along transect vs. estimated establishment dates by a) canopy position (see Methods Section for classification scheme); b) tree species (dbh≥2.5 cm); and c) sapling/seedling species (dbh<2.5cm).

ABCO = *Abies concolor;* ACGL = *Acer glabularum;* PIEN = *Picea engelmannii;* POTR = *Populus tremuloides;* PSME = *Pseudotsuga menzeisii.*

fluctuations in the density of trees below the canopy over time

It is possible that understory tree densities as high as the ones currently observed occurred at times in the past. However, subsequent fires would have eventually thinned these patches. The difference, then, between historical and current conditions is that in the past, dense understories were less persistent than they are today.

High-Intensity Crown Fires

Age structure patterns suggest that crown fires also occurred in these mixed-conifer stands. For example, in CAMU, the first 100 m shows a notable gap in recruitment prior to 1850 (Figure 12b). The majority of the trees in this portion of the transect, in fact, establish in a twenty year period between ca. 1880 and ca. 1900. Based on the absence, except one tree, of recruitment dates prior to 1850, it appears that a crown fire occurred during the last half of the 1800s, possibly in 1880. Interestingly, aspen did not effectively colonize this patch. Some aspen established along with spruce, maple, Douglas-fir and one white fir. The spatial distribution of trees in the post-1880 fire cohort suggest an influence of the lone tree that survived this event: all "non-aspen" species established under the surviving Douglas-fir (Fig 12b).

The unique feature of CAML is its overall young age compared to CAMU and BON (Fig. 10). Except for five trees, all recruitment occurs after 1850, suggesting that a crown fire occurred in this area. A mixture of species subsequently colonized the area, including aspen, white fir, maple, Douglas-fir, and Engelmann spruce. (Piñon is also found on this transect but it arrives on the scene almost 100 years later; Fig. 10). It is unclear when the crown fire occurred. A group of aspen at the beginning of the transect (~ meter 0) show establishment dates in the 1850s and 1860s, suggesting that perhaps the 1847 fire crowned in this area (Fig. 13). Another group of aspen (~ meter 175) show tightly clustered establishment dates in the early 1860s, suggesting that the 1861 fire crowned in this area (Fig. 13). Perhaps both fires, 1847 and 1861 crowned in different parts of the transect.

In contrast to the shade-intolerant nature of aspen, a group of aspen at meter 175 established directly beneath a Douglas-fir (Fig. 13a&b). This tree was classified as "dominant" indicating that its crown is positioned above the average level of the canopy. Perhaps the high crown and the absence of neighbouring trees allowed enough light for the establishment and

growth of aspen.

BON also shows evidence of a crown fire in the late 1800s within the first 50m of the transect (Fig. 14b). In this portion of the transect, there are no trees with establishment dates earlier than 1880. It is likely that this pattern is the result of the 1893 fire which crowned over much of the slope where BON is located (Touchan et al. 1996). Possibly, BON is positioned so that it extends into the edge of this aspen stand. In any case, aspen may have been the first species to colonize this space; however, other species established soon thereafter (Fig. 14b)

Summary and Conclusions

Historically, both low-intensity surface and high-intensity crown fires influenced the structure and function of the mixed-conifer forests in the Camp May North / Cañada Bonito area. Periodic surface fires probably influenced species composition and forest structure. Age structure data suggests crown fires also occurred within these mixed-conifer stands. Long periods with little or no recruitment in portions of the transects was interpreted to signify overstory mortality caused by crown fires. Crown fire patches in mixed-conifer forest ranged from approximately 50-100 m (e.g., CAMU and BON) to approximately 300 m in diameter (e.g., CAML). Curiously, recruitment following these high-intensity events was not dominated by aspen although was often the first species to colonize the area. These results suggest that the ability of aspen to colonize gaps created by crown fires is not constant over time and space.

As a result of human land use and management, fire has been effectively excluded from this area since the late 1800s. The recent longer-than-average interval without fire has had a noticeable impact on the structure of mixed-conifer forest. In the past, prior to the cessation of fire, tree regeneration, survival and mortality were inextricably linked to the fire regime, e.g., intensity, frequency, size, shape, location. In the absence of fire, structural changes have occurred and other factors have become more important in controlling forest dynamics. Structural changes documented by this study include: 1) increases in tree densities; 2) a more closed canopy; and 3) increases in species number. And, in the absence of fire, light availability now appears to have assumed a primary role influencing forest structure of the mixed-conifer forests in the study area.

Continued fire exclusion has many consequences. For example, these mixed-conifer

forests may gradually convert into spruce-fir forests. Engelmann spruce is already a large component of the overstory and dominates the understory and seedling/sapling classes in most cases. Over time, the "true" firs, white fir and corkbark fir, will probably increase in number as well, possibly making these forests more susceptible to other disturbances, in particular western spruce budworm. Landscape structure may also change, as well; specifically, there may be a fading and eventual disappearance of aspen patches as aspen eventually get overtopped by the more shade-tolerant species. And lastly, continued fire exclusion increases the probability of catastrophic fire, unprecedented in size and intensity (Swetnam 1990; Covington and Moore 1994; Swetnam and Baisan 1996). Potential outcomes of such an event include, for example, soil sterilization and extremely high rates of erosion (e.g., the "Rattlesnake" fire in 1994 in the Chiricahua Mountains, pers. obs.). The incredible risk to human life in fighting such a fire cannot be overlooked either, e.g., the Storm King Mountain fire in 1994 in Colorado that killed 14 people.

This study shows that fire was an important ecological force in the past, contributing largely to the underlying structure of the vegetation in the Jemez Mountains. This study also shows that in the absence of fire, the mixed-conifer forest and landscape are changing in structure and function. Related to these changes are an increasing risk of catastrophic fire which would have negative implications for both forest and human health. Based on the results of this study, we strongly recommend and support any management plans to restore fire into this landscape.

APPENDIX A

APPENDIX A – Individual Summaries for Culturally Modified Tree site: El Valle (EV_PEEL)
file: ev_peel.fhx

Series 1 : EVPD01
Inner Ring : 1643
Bark Date : 1920
Length of sample : 278
Number in final analysis : 91
Information on fire history :
1830 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 91.0

Series 2 : EVP02
Inner Ring : 1794
Bark Date : 1996
Length of sample : 203
Number in final analysis : 120
Information on fire history :
1877 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 120.0

Series 3 : EVPD03
Pith Date : 1589
Bark Date : 1887
Length of sample : 299
Number in final analysis : 256
Information on fire history :
1774 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 256.0

Series 4 : EVPD04
Pith Date : 1773
Bark Date : 1950
Length of sample : 178
Number in final analysis : 110
Information on fire history :
1841 L fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 110.0

Series 5 : EVPD05
Pith Date : 1771
Outer Ring : 1921
Length of sample : 151
Number in final analysis : 99
Information on fire history :
1841 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 99.0

Series 6 : EVPD06
Pith Date : 1733
Bark Date : 1965
Length of sample : 233
Number in final analysis : 151
Information on fire history :
1815 L fire scar
1830 M fire scar FI = 15
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 75.5
Sample mean fire interval : 15.0

Series 7 : EVP07
Pith Date : 1737
Outer Ring : 1896
Length of sample : 160
Number in final analysis : 119
Information on fire history :
1849 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 119.0

Series 8 : EVP08
Pith Date : 1672
Bark Date : 1996
Length of sample : 325
Number in final analysis : 217
Information on fire history :
1780 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 217.0

Series 9 : EVPD09
Inner Ring : 1827
Bark Date : 1963
Length of sample : 137
Number in final analysis : 105
Information on fire history :
1859 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 105.0

Series 10 : EVPD10
Pith Date : 1792
Outer Ring : 1890
Length of sample : 99
Number in final analysis : 90
Information on fire history :
1856 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 90.0

Series 11 : EVP14
Pith Date : 1725
Bark Date : 1996
Length of sample : 272
Number in final analysis : 179
Information on fire history :
1866 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 179.0

Series 12 : EVP20
Pith Date : 1791
Bark Date : 1970
Length of sample : 180
Number in final analysis : 102
Information on fire history :
1869 L fire scar
Total number of fire scars : 1
Total number all indicators : 1

APPENDIX A – Individual Summaries for Culturally Modified Tree site: El Valle (EV_PEEL)
file: ev_peel.fhx

Average number years per fire :
102.0

Series 13 : EVP40
Pith Date : 1721
Bark Date : 1996

Length of sample : 276
Number in final analysis : 196
Information on fire history :
1824 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 196.0

Series 14 : EVP46
Pith Date : 1730
Bark Date : 1996
Length of sample : 267
Number in final analysis : 172
Information on fire history :
1825 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 172.0

Series 15 : EVP48
Inner Ring : 1793
Bark Date : 1996
Length of sample : 204
Number in final analysis : 174
Information on fire history :
1845 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 174.0

Series 16 : EVF06
Inner Ring : 1656
Bark Date : 1950
Length of sample : 295
Number in final analysis : 211
Information on fire history :
1780 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 211.0

APPENDIX A -- Individual Summaries for Fire History site: El Valle (EV_FIRE)
file: ev_fire.fhx

Series 1 : EVP50
Inner Ring : 1764
Bark Date : 1970
Length of sample : 207
Number in final analysis : 194
Information on fire history :
1777 A fire scar
1801 D fire scar FI = 24
1842 D fire scar FI = 41
1890 D fire scar FI = 48
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 48.5
Sample mean fire interval : 37.7

Series 2 : EVF01
Pith Date : 1600
Bark Date : 1930
Length of sample : 331
Number in final analysis : 196
Information on fire history :
1735 E fire scar
1752 D fire scar FI = 17
1770 L fire scar FI = 18
1777 A fire scar FI = 7
1779 L fire scar FI = 2
1801 U fire scar FI = 22
1823 D fire scar FI = 22
1842 D fire scar FI = 19
1852 M injury
1870 D fire scar FI = 28
Total number of fire scars : 9
Total number all indicators : 10
Average number years per fire : 21.8
Sample mean fire interval : 16.9

Series 3 : EVF02
Pith Date : 1552
Bark Date : 1996
Length of sample : 445
Number in final analysis : 390
Information on fire history :
1607 U fire scar
1626 U fire scar FI = 19
1632 U fire scar FI = 6
1663 L fire scar FI = 31
1715 D fire scar FI = 52
1735 D fire scar FI = 20
1752 D fire scar FI = 17
1777 A fire scar FI = 25
1801 D fire scar FI = 24
1823 A fire scar FI = 22
1842 D fire scar FI = 19
1978 U injury
Total number of fire scars : 11
Total number all indicators : 12
Average number years per fire : 35.5
Sample mean fire interval : 23.5

Series 4 : EVF03
Inner Ring : 1696
Bark Date : 1935
Length of sample : 240
Number in final analysis : 159
Information on fire history :
1777 L fire scar
1801 M fire scar FI = 24
1823 M fire scar FI = 22
1842 D fire scar FI = 19
1852 M fire scar FI = 10
1890 D fire scar FI = 38
1928 E injury
Total number of fire scars : 6
Total number all indicators : 7
Average number years per fire : 26.5
Sample mean fire interval : 22.6

Series 5 : EVF04
Inner Ring : 1757
Bark Date : 1996
Length of sample : 240
Number in final analysis : 196
Information on fire history :
1801 M fire scar
1842 D fire scar FI = 41
1890 E fire scar FI = 48
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 65.3
Sample mean fire interval : 44.5

Series 6 : EVF05
Pith Date : 1588
Bark Date : 1996
Length of sample : 409
Number in final analysis : 282
Information on fire history :
1715 D fire scar
1724 D fire scar FI = 9
1733 U fire scar FI = 9
1735 U fire scar FI = 2
1761 D fire scar FI = 26
1777 M fire scar FI = 16
1801 D fire scar FI = 24
1823 E fire scar FI = 22
1842 D fire scar FI = 19
1890 D fire scar FI = 48
1977 U injury
Total number of fire scars : 10
Total number all indicators : 11
Average number years per fire : 28.2
Sample mean fire interval : 19.4

Series 7 : EVF06
Inner Ring : 1656
Bark Date : 1950
Length of sample : 295
Number in final analysis : 211
Information on fire history :
1740 U fire scar
1801 L fire scar FI = 61
1823 D fire scar FI = 22
1842 D fire scar FI = 19
1890 D fire scar FI = 48
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 42.2
Sample mean fire interval :

APPENDIX A – Individual Summaries for Fire History site: El Valle (EV_FIRE)
file: ev_fire.fhx

37.5

Series 8 : EVF08
Inner Ring : 1550
Bark Date : 1996
Length of sample : 447
Number in final analysis : 383
Information on fire history :
1614 D fire scar
1663 M fire scar FI = 49
1682 D fire scar FI = 19
1691 E fire scar FI = 9
1715 D fire scar FI = 24
1752 D fire scar FI = 37
1762 D fire scar FI = 10
1777 A fire scar FI = 15
1801 D fire scar FI = 24
1823 E fire scar FI = 22
1842 E fire scar FI = 19
1852 M fire scar FI = 10
1890 U fire scar FI = 38
Total number of fire scars : 13
Total number all indicators : 13
Average number years per fire : 29.5
Sample mean fire interval : 23.0

Series 9 : EVF11
Pith Date : 1710
Bark Date : 1970
Length of sample : 261
Number in final analysis : 236
Information on fire history :
1735 M fire scar
1752 D fire scar FI = 17
1777 A fire scar FI = 25
1801 E fire scar FI = 24
1842 D fire scar FI = 41
1871 D fire scar FI = 29
1890 D fire scar FI = 19
Total number of fire scars : 7
Total number all indicators : 7
Average number years per fire : 33.7
Sample mean fire interval :

25.8

Series 10 : EVF12
Pith Date : 1613
Outer Ring : 1860
Length of sample : 248
Number in final analysis : 81
Information on fire history :
1781 D fire scar
1801 U fire scar FI = 20
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 40.5
Sample mean fire interval : 20.0

Series 11 : EVF13
Pith Date : 1718
Bark Date : 1978
Length of sample : 261
Number in final analysis : 218
Information on fire history :
1761 D fire scar
1778 M fire scar FI = 17
1801 L fire scar FI = 23
1875 D fire scar FI = 74
1890 E fire scar FI = 15
1928 U injury
Total number of fire scars : 5
Total number all indicators : 6
Average number years per fire : 43.6
Sample mean fire interval : 32.2

Series 12 : EVF14
Pith Date : 1717
Outer Ring : 1926
Length of sample : 210
Number in final analysis : 166
Information on fire history :
1761 D fire scar
1779 D fire scar FI = 18
1801 D fire scar FI = 22
1890 E fire scar FI = 89
Total number of fire scars : 4
Total number all indicators : 4

Average number years per fire : 41.5
Sample mean fire interval : 43.0

Series 13 : EVF09
Pith Date : 1671
Bark Date : 1996
Length of sample : 326
Number in final analysis : 318
Information on fire history :
1679 D fire scar
1691 M fire scar FI = 12
1715 E fire scar FI = 24
1724 M fire scar FI = 9
1735 E fire scar FI = 11
1777 A fire scar FI = 42
1801 D fire scar FI = 24
1842 D fire scar FI = 41
1852 M fire scar FI = 10
Total number of fire scars : 9
Total number all indicators : 9
Average number years per fire : 35.3
Sample mean fire interval : 21.6

Series 14 : EVP02
Inner Ring : 1794
Bark Date : 1996
Length of sample : 203
Number in final analysis : 120
Information on fire history :
1890 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 120.0

Series 15 : EVPD02
Inner Ring : 1736
Outer Ring : 1915
Length of sample : 180
Number in final analysis : 86
Information on fire history :
1830 M fire scar
1842 U fire scar FI = 12
Total number of fire scars : 2

APPENDIX A – Individual Summaries for Fire History site: El Valle (EV_FIRE)
file: ev_fire.fhx

Total number all indicators : 2
Average number years per fire : 43.0
Sample mean fire interval : 12.0

Series 16 : EVPD03
Pith Date : 1589
Bark Date : 1887
Length of sample : 299
Number in final analysis : 256
Information on fire history :
1632 M fire scar
1636 D injury
1663 E fire scar FI = 31
1735 E fire scar FI = 72
1842 D injury
1852 M fire scar FI = 117
Total number of fire scars : 4
Total number all indicators : 6
Average number years per fire : 64.0
Sample mean fire interval : 73.3

Series 17 : EVPD05
Pith Date : 1771
Outer Ring : 1921
Length of sample : 151
Number in final analysis : 99
Information on fire history :
1823 M fire scar
1842 D fire scar FI = 19
1852 M fire scar FI = 10
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 33.0
Sample mean fire interval : 14.5

Series 18 : EVPD06
Pith Date : 1733
Bark Date : 1965
Length of sample : 233
Number in final analysis : 151
Information on fire history :
1844 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 151.0

Series 19 : EVP07
Pith Date : 1737
Outer Ring : 1896
Length of sample : 160
Number in final analysis : 119
Information on fire history :
1778 D fire scar
1801 E fire scar FI = 23
1839 D injury
1842 E fire scar FI = 41
Total number of fire scars : 3
Total number all indicators : 4
Average number years per fire : 39.7
Sample mean fire interval : 32.0

Series 20 : EVPD08
Pith Date : 1737
Outer Ring : 1896
Length of sample : 160
Number in final analysis : 119
Information on fire history :
1778 D fire scar
1801 D fire scar FI = 23
1849 L fire scar FI = 48
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 39.7
Sample mean fire interval : 35.5

Series 21 : EVPD10
Pith Date : 1792
Outer Ring :1890
Length of sample : 99
Number in final analysis : 90
Information on fire history :
1801 M fire scar
1890 U fire scar FI = 89
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 45.0
Sample mean fire interval : 89.0

Series 22 : EVPD11
Pith Date : 1662
Outer Ring : 1831
Length of sample : 170
Number in final analysis : 32
Information on fire history :
1685 A injury
1801 L fire scar
Total number of fire scars : 1
Total number all indicators : 2
Average number years per fire : 32.0

Series 23 : EVP14
Pith Date : 1725
Bark Date : 1996
Length of sample : 272
Number in final analysis : 179
Information on fire history :
1818 M fire scar
1842 D fire scar FI = 24
1890 D fire scar FI = 48
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 59.7
Sample mean fire interval : 36.0

Series 24 : EVP40
Pith Date : 1721
Bark Date : 1996
Length of sample : 276
Number in final analysis : 196
Information on fire history :
1801 D fire scar
1890 D fire scar FI = 89
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 98.0
Sample mean fire interval : 89.0

APPENDIX A – Individual Summaries for Fire History site: El Valle (EV_FIRE)
file: ev_fire.fhx

Series 25 : EVP48
Inner Ring : 1793
Bark Date : 1996
Length of sample : 204
Number in final analysis : 174
Information on fire history :
1823 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire :
174.0

APPENDIX A – Individual Summaries for Fire History: Site = Alamo Bog (ALA = BOG + SAB)
file: ala.fhx

Series 1 : ALA01
Pith Date : 1463
Outer Ring : 1822
Length of sample : 360
Number in final analysis : 320
Information on fire history :
1503 D fire scar
1521 D injury
1531 D injury
1579 A fire scar FI = 76
1600 D fire scar FI = 21
1610 D fire scar FI = 10
1619 D fire scar FI = 9
1622 L injury
1654 E fire scar FI = 35
1668 D fire scar FI = 14
1679 D fire scar FI = 11
1684 E fire scar FI = 5
1696 D fire scar FI = 12
1707 D fire scar FI = 11
1716 D fire scar FI = 9
1729 D fire scar FI = 13
1738 D fire scar FI = 9
1748 D fire scar FI = 10
1801 U fire scar FI = 53
Total number of fire scars : 16
Total number all indicators : 19
Average number years per fire : 20.0
Sample mean fire interval : 19.9

Series 2 : ALA03
Pith Date : 1773
Bark Date : 1932
Length of sample : 160
Number in final analysis : 132
Information on fire history :
1801 L fire scar
1842 L fire scar FI = 41
1860 L fire scar FI = 18
1870 U injury
Total number of fire scars : 3
Total number all indicators : 4
Average number years per fire : 44.0
Sample mean fire interval : 29.5

Series 3 : ALA05
Pith Date : 1472
Outer Ring : 1832
Length of sample : 361
Number in final analysis : 295
Information on fire history :
1538 D fire scar
1624 E fire scar FI = 86
1644 D fire scar FI = 20
1654 D fire scar FI = 10
1668 E fire scar FI = 14
1684 M fire scar FI = 16
1748 U fire scar FI = 64
1806 U fire scar FI = 58
Total number of fire scars : 8
Total number all indicators : 8
Average number years per fire : 36.9
Sample mean fire interval : 38.3

Series 4 : ALA07
Inner Ring : 1625
Outer Ring :1860
Length of sample : 236
Number in final analysis : 132
Information on fire history :
1729 D fire scar
1801 D fire scar FI = 72
1823 D fire scar FI = 22
1851 D fire scar FI = 28
1860 U fire scar FI = 9
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 26.4
Sample mean fire interval : 32.8

Series 5 : ALA09
Pith Date : 1628
Outer Ring :1879
Length of sample : 252
Number in final analysis : 212
Information on fire history :
1668 L fire scar
1674 D injury
1680 D injury
1684 L fire scar FI = 16
1693 D fire scar FI = 9
1696 E injury
1707 L fire scar FI = 14
1716 E fire scar FI = 9
1729 D fire scar FI = 13
1738 E fire scar FI = 9
1748 D fire scar FI = 10
1801 A fire scar FI = 53
1842 D fire scar FI = 41
1860 D fire scar FI = 18
1879 E fire scar FI = 19
Total number of fire scars : 12
Total number all indicators : 15
Average number years per fire : 17.7
Sample mean fire interval : 19.2

Series 6 : ALA11
Pith Date : 1776
Outer Ring : 1930
Length of sample : 155
Number in final analysis : 89
Information on fire history :
1842 L fire scar
1860 E fire scar FI = 18
1877 D injury
Total number of fire scars : 2
Total number all indicators : 3
Average number years per fire : 44.5
Sample mean fire interval : 18.0

Series 7 : ALA13
Pith Date : 1697
Outer Ring : 1868
Length of sample : 172
Number in final analysis : 69
Information on fire history :
1764 E injury
1801 E fire scar
1842 D fire scar FI = 41
1851 M fire scar FI = 9

APPENDIX A – Individual Summaries for Fire History: Site = Alamo Bog (ALA = BOG + SAB)
file: ala.fhx

Total number of fire scars : 3
Total number all indicators : 4
Average number years per fire : 23.0
Sample mean fire interval : 25.0

Series 8 : ALA15
Inner Ring : 1707
Bark Date : 1941
Length of sample : 235
Number in final analysis : 141
Information on fire history :
1801 U fire scar
1818 U fire scar FI = 17
1840 D fire scar FI = 22
1873 U injury
1896 U fire scar FI = 56
Total number of fire scars : 4
Total number all indicators : 5
Average number years per fire : 35.3
Sample mean fire interval : 31.7

Series 9 : ALA26
Pith Date : 1573
Outer Ring :1842
Length of sample : 270
Number in final analysis : 176
Information on fire history :
1667 A fire scar
1716 D fire scar FI = 49
1738 M fire scar FI = 22
1748 D fire scar FI = 10
1842 U fire scar FI = 94
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 35.2
Sample mean fire interval : 43.8

Series 10 : ALA28
Pith Date : 1579
Bark Date : 1930
Length of sample : 352
Number in final analysis : 215
Information on fire history :
1716 D fire scar
1748 D fire scar FI = 32
1842 D fire scar FI = 94
1860 E fire scar FI = 18
1879 D fire scar FI = 19
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 43.0
Sample mean fire interval : 40.7

Series 11 : ALA30
Pith Date : 1673
Bark Date : 1996
Length of sample : 324
Number in final analysis : 259
Information on fire history :
1738 E fire scar
1748 D fire scar FI = 10
1764 U injury
1806 E fire scar FI = 58
1842 M fire scar FI = 36
1860 M fire scar FI = 18
Total number of fire scars : 5
Total number all indicators : 6
Average number years per fire : 51.8
Sample mean fire interval : 30.5

Series 12 : ALA32
Pith Date : 1565
Outer Ring : 1742
Length of sample : 178
Number in final analysis : 119
Information on fire history :
1624 M fire scar
1654 M fire scar FI = 30
1667 A fire scar FI = 13
1716 D fire scar FI = 49
1729 E fire scar FI = 13
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 23.8
Sample mean fire interval : 26.3

Series 13 : ALA34
Pith Date : 1578
Outer Ring : 1786
Length of sample : 209
Number in final analysis : 59
Information on fire history :
1674 U injury
1729 D fire scar
1738 D fire scar FI = 9
Total number of fire scars : 2
Total number all indicators : 3
Average number years per fire : 29.5
Sample mean fire interval : 9.0

Series 14 : ALA02
Inner Ring : 1665
Outer Ring :1879
Length of sample : 215
Number in final analysis : 38
Information on fire history :
1842 E fire scar
1879 U fire scar FI = 37
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 19.0
Sample mean fire interval : 37.0

Series 15 : ALA04
Pith Date : 1697
Bark Date : 1996
Length of sample : 300
Number in final analysis : 146
Information on fire history :
1851 M fire scar
1879 L fire scar FI = 28
1906 L injury
Total number of fire scars : 2
Total number all indicators : 3
Average number years per fire : 73.0
Sample mean fire interval : 28.0

APPENDIX A -- Individual Summaries for Fire History: Site = Alamo Bog (ALA = BOG + SAB)
file: ala.fhx

Series 16 : ALA06
Inner Ring : 1775
Bark Date : 1964
Length of sample : 190
Number in final analysis : 114
Information on fire history :
1851 M fire scar
1879 M fire scar FI = 28
1938 D injury
Total number of fire scars : 2
Total number all indicators : 3
Average number years per fire : 57.0
Sample mean fire interval : 28.0

Series 17 : ALA08
Pith Date : 1770
Bark Date : 1943
Length of sample : 174
Number in final analysis : 139
Information on fire history :
1806 D fire scar
1851 D fire scar FI = 45
1879 E fire scar FI = 28
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 46.3
Sample mean fire interval : 36.5

Series 18 : ALA10
Pith Date : 1489
Outer Ring :1851
Length of sample : 363
Number in final analysis : 336
Information on fire history :
1516 E fire scar
1548 L fire scar FI = 32
1612 L fire scar FI = 64
1624 E fire scar FI = 12
1654 E fire scar FI = 30
1729 D fire scar FI = 75
1752 M fire scar FI = 23
1806 U fire scar FI = 54
1851 E fire scar FI = 45
Total number of fire scars : 9
Total number all indicators : 9
Average number years per fire : 37.3
Sample mean fire interval : 41.9

Series 19 : ALA12
Pith Date : 1535
Bark Date : 1930
Length of sample : 396
Number in final analysis : 277
Information on fire history :
1654 D fire scar
1716 D fire scar FI = 62
1738 D fire scar FI = 22
1752 L fire scar FI = 14
1806 D fire scar FI = 54
1879 A fire scar FI = 73
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 46.2
Sample mean fire interval : 45.0

Series 20 : ALA14
Inner Ring : 1684
Bark Date : 1938
Length of sample : 255
Number in final analysis : 223
Information on fire history :
1716 M fire scar
1724 D injury
1729 E fire scar FI = 13
1738 M fire scar FI = 9
1752 M fire scar FI = 14
1806 E fire scar FI = 54
1851 D fire scar FI = 45
1862 E injury
1879 M fire scar FI = 28
Total number of fire scars : 7
Total number all indicators : 9
Average number years per fire : 31.9
Sample mean fire interval : 27.2

Series 21 : ALA16
Inner Ring : 1667
Bark Date : 1996
Length of sample : 330
Number in final analysis : 281
Information on fire history :
1716 M fire scar
1738 L fire scar FI = 22
1851 D fire scar FI = 113
1856 U injury
1879 U fire scar FI = 28
Total number of fire scars : 4
Total number all indicators : 5
Average number years per fire : 70.3
Sample mean fire interval : 54.3

Series 22 : ALA18
Pith Date : 1656
Bark Date : 1900
Length of sample : 245
Number in final analysis : 185
Information on fire history :
1716 E fire scar
1726 D injury
1727 D injury
1729 E fire scar FI = 13
1752 M fire scar FI = 23
1851 D fire scar FI = 99
Total number of fire scars : 4
Total number all indicators : 6
Average number years per fire : 46.3
Sample mean fire interval : 45.0

Series 23 : ALA20
Inner Ring : 1536
Outer Ring : 1700
Length of sample : 165
Number in final analysis : 77
Information on fire history :
1624 L fire scar
1654 E fire scar FI = 30
1668 L fire scar FI = 14
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire :

APPENDIX A – Individual Summaries for Fire History: Site = Alamo Bog (ALA = BOG + SAB)
file: ala.fhx

25.7
Sample mean fire interval :
22.0

Series 24 : ALA22
Pith Date : 1480
Outer Ring : 1638
Length of sample : 159
Number in final analysis : 91
Information on fire history :
1548 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire :
91.0

Series 25 : ALA24
Pith Date : 1483
Outer Ring : 1780
Length of sample : 298
Number in final analysis : 265
Information on fire history :
1516 M fire scar
1548 E fire scar FI = 32
1624 D fire scar FI = 76
1654 D fire scar FI = 30
1668 E fire scar FI = 14
1729 D fire scar FI = 61
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire :
44.2
Sample mean fire interval :
42.6

APPENDIX A -- Individual Summaries for Fire History site: Alamo Bog (NAB)
file: nab.fhx

Series 1 : NAB03
Inner Ring : 1800
Bark Date : 1984
Length of sample : 185
Number in final analysis : 134
Information on fire history :
1851 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 134.0

Series 2 : NAB05
Pith Date : 1412
Outer Ring : 1675
Length of sample : 264
Number in final analysis : 254
Information on fire history :
1422 L fire scar
1501 A fire scar FI = 79
1522 D fire scar FI = 21
1542 M fire scar FI = 20
1598 D fire scar FI = 56
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 50.8
Sample mean fire interval : 44.0

Series 3 : NAB07
Pith Date : 1503
Outer Ring : 1704
Length of sample : 202
Number in final analysis : 147
Information on fire history :
1558 A fire scar
1580 D fire scar FI = 22
1668 U fire scar FI = 88
1696 L fire scar FI = 28
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 36.7
Sample mean fire interval : 46.0

Series 4 : NAB09
Pith Date : 1569
Outer Ring :1860
Length of sample : 292
Number in final analysis : 217
Information on fire history :
1644 D fire scar
1668 U fire scar FI = 24
1729 D fire scar FI = 61
1806 D fire scar FI = 77
1860 U fire scar FI = 54
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 43.4
Sample mean fire interval : 54.0

Series 5 : NAB11
Pith Date : 1739
Bark Date : 1989
Length of sample : 251
Number in final analysis : 201
Information on fire history :
1789 L fire scar
1842 E fire scar FI = 53
1860 M fire scar FI = 18
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 67.0
Sample mean fire interval : 35.5

Series 6 : NAB13
Pith Date : 1698
Bark Date : 1996
Length of sample : 299
Number in final analysis : 249
Information on fire history :
1748 D fire scar
1806 D fire scar FI = 58
1842 E fire scar FI = 36
1860 E fire scar FI = 18
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 62.2
Sample mean fire interval : 37.3

Series 7 : NAB15
Pith Date : 1619
Bark Date : 1996
Length of sample : 378
Number in final analysis : 329
Information on fire history :
1668 E fire scar
1748 D fire scar FI = 80
1806 D fire scar FI = 58
1842 E fire scar FI = 36
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 82.3
Sample mean fire interval : 58.0

APPENDIX A – Individual Summaries for Fire History and Peel Tree site: Baca Ranch House (BRH)
file: brh.fhx

Series 1 : BRH01
Inner Ring : 1643
Bark Date : 1983
Length of sample : 341
Number in final analysis : 96
Information on fire history :
1888 M peel scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 96.0

Series 2 : BRH02
Pith Date : 1658
Outer Ring : 1877
Length of sample : 220
Number in final analysis : 73
Information on fire history :
1782 D injury
1806 M fire scar
1842 U injury
Total number of fire scars : 1
Total number all indicators : 3
Average number years per fire : 73.0

Series 3 : BRH03
Inner Ring : 1697
Bark Date : 1989
Length of sample : 293
Number in final analysis : 274
Information on fire history :
1716 D fire scar
1727 D fire scar FI = 11
1782 D fire scar FI = 55
1806 D fire scar FI = 24
1842 D fire scar FI = 36
1861 E fire scar FI = 19
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 45.7
Sample mean fire interval : 29.0

Series 4 : BRH04
Pith Date : 1637
Bark Date : 1982
Length of sample : 346
Number in final analysis : 163
Information on fire history :
1820 M peel scar
1847 D fire scar
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 81.5
Sample mean fire interval : 27.0

APPENDIX A

Alamo Bog aspen stand cored in summer 1996			
id	**est pith**	**inner ring**	**comments**
1	1876	1892	
2	1880	1880	
3	x	x	no curve
4	1888	1898	
5	1892	1910	
6	1879	1879	
7	1876	1892	
8	1881	1881	
9	1877	1884	
10	1879	1885	
11	1880	1882	
12	1879	1882	
13	1879	1883	
14	1881	1881	
15	1880	1883	
16	1893	1911	

APPENDIX A – Individual Summaries for Fire History site: Cañada Bonito (CAN)
file: bon.fhx

Series in bold are trees collected for the Jemez Extended Fire Regime Study. Other series are trees collected for fire history study by Touchan et al. (1996).

Series 1 : CAN01
Pith Date : 1814
Outer Ring : 1892
Length of sample : 79
Number in final analysis : 32
Information on fire history :
1861 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 32.0

Series 2 : CAN02
Inner Ring : 1865
Bark Date : 1993
Length of sample : 129
Number in final analysis : 101
Information on fire history :
1893 L fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 101.0

Series 3 : CAN05
Inner Ring : 1655
Bark Date : 1893
Length of sample : 239
Number in final analysis : 209
Information on fire history :
1685 U fire scar
1818 U fire scar FI = 133
1831 U injury
1861 U fire scar FI = 43
Total number of fire scars : 3
Total number all indicators : 4
Average number years per fire : 69.7
Sample mean fire interval : 88.0

Series 4 : CAN06
Pith Date : 1779
Bark Date : 1978
Length of sample : 200
Number in final analysis : 157
Information on fire history :
1822 E fire scar
1861 E fire scar FI = 39
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 78.5
Sample mean fire interval : 39.0

Series 5 : CAN07
Inner Ring : 1737
Outer Ring : 1912
Length of sample : 176
Number in final analysis : 176
Information on fire history :
1737 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 176.0

Series 6 : CAN08
Pith Date : 1820
Bark Date : 1960
Length of sample : 141
Number in final analysis : 114
Information on fire history :
1847 U fire scar
1861 U fire scar FI = 14
1904 U fire scar FI = 43
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 38.0
Sample mean fire interval : 28.5

Series 7 : CAN10
Pith Date : 1736
Outer Ring : 1921
Length of sample : 186
Number in final analysis : 133
Information on fire history :
1789 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 133.0

Series 8 : CAN11
Inner Ring : 1778
Bark Date : 1979
Length of sample : 202
Number in final analysis : 158
Information on fire history :
1822 E fire scar
1893 U fire scar FI = 71
1914 U fire scar FI = 21
1934 U injury
1947 U injury
1955 U injury
Total number of fire scars : 3
Total number all indicators : 6
Average number years per fire : 52.7
Sample mean fire interval : 46.0

Series 9 : CAN12
Inner Ring : 1893
Bark Date : 1979
Length of sample : 87
Number in final analysis : 87
Information on fire history :
1893 U fire scar
1900 U injury
1932 U injury
1948 U injury
1969 U injury
1972 U injury
Total number of fire scars : 1
Total number all indicators : 6
Average number years per fire : 87.0

Series 10 : CAN13
Pith Date : 1845
Outer Ring : 1956

APPENDIX A – Individual Summaries for Fire History site: Cañada Bonito (CAN)
file: bon.fhx

Length of sample : 112
Number in final analysis : 1
Information on fire history :
1923 U injury
No information in this range.
Total number all indicators : 1

Series 11 : CAN14
Inner Ring : 1759
Bark Date : 1993
Length of sample : 235
Number in final analysis : 193
Information on fire history :
1801 U fire scar
1847 E fire scar FI = 46
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 96.5
Sample mean fire interval : 46.0

Series 12 : CAN15
Pith Date : 1825
Outer Ring : 1943
Length of sample : 119
Number in final analysis : 97
Information on fire history :
1847 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 97.0

Series 13 : CAN16
Inner Ring : 1831
Outer Ring : 1944
Length of sample : 114
Number in final analysis : 98
Information on fire history :
1847 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 98.0

Series 14 : CAN17
Pith Date : 1757
Bark Date : 1991
Length of sample : 235
Number in final analysis : 145
Information on fire history :
1847 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 145.0

Series 15 : CAN18
Pith Date : 1761
Bark Date : 1965
Length of sample : 205
Number in final analysis : 119
Information on fire history :
1847 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 119.0

Series 16 : CAN19
Inner Ring : 1761
Outer Ring : 1942
Length of sample : 182
Number in final analysis : 142
Information on fire history :
1801 U fire scar
1847 E fire scar FI = 46
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 71.0
Sample mean fire interval : 46.0

Series 17 : CAN20
Pith Date : 1825
Bark Date : 1993
Length of sample : 169
Number in final analysis : 147
Information on fire history :
1847 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 147.0

Series 18 : CAN21
Pith Date : 1763
Outer Ring : 1961
Length of sample : 199
Number in final analysis : 161
Information on fire history :
1801 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 161.0

Series 19 : CAN22
Pith Date : 1828
Bark Date : 1960
Length of sample : 133
Number in final analysis : 114
Information on fire history :
1847 U fire scar
1861 U fire scar FI = 14
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 57.0
Sample mean fire interval : 14.0

Series 20 : CAN23
Pith Date : 1829
Bark Date : 1993
Length of sample : 165
Number in final analysis : 147
Information on fire history :
1847 E fire scar
1861 U fire scar FI = 14
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 73.5
Sample mean fire interval : 14.0

Series 21 : CAN25
Pith Date : 1827
Bark Date : 1966
Length of sample : 140
Number in final analysis : 120
Information on fire history :

APPENDIX A -- Individual Summaries for Fire History site: Cañada Bonito (CAN)
file: bon.fhx

1847 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 120.0

Series 22 : CAN26
Pith Date : 1823
Bark Date : 1993
Length of sample : 171
Number in final analysis : 147
Information on fire history :
1847 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 147.0

Series 23 : CAN27
Pith Date : 1826
Bark Date : 1993
Length of sample : 168
Number in final analysis : 147
Information on fire history :
1847 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 147.0

Series 24 : CAN28
Pith Date : 1814
Outer Ring :1845
Length of sample : 32
Number in final analysis : 5
Information on fire history :
1841 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 5.0

Series 25 : CAN29
Pith Date : 1825
Bark Date : 1993
Length of sample : 169
Number in final analysis : 147
Information on fire history :
1847 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 147.0

Series 26 : CAN30
Inner Ring : 1847
Bark Date : 1993
Length of sample : 147
Number in final analysis : 147
Information on fire history :
1847 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 147.0

Series 27 : CAN31
Inner Ring : 1784
Bark Date : 1993
Length of sample : 210
Number in final analysis : 147
Information on fire history :
1847 U fire scar
1861 E fire scar FI = 14
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 73.5
Sample mean fire interval : 14.0

Series 28 : CAN32
Inner Ring : 1818
Bark Date : 1993
Length of sample : 176
Number in final analysis : 147
Information on fire history :
1847 E fire scar
1861 E fire scar FI = 14
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 73.5
Sample mean fire interval : 14.0

Series 29 : CAN46
Inner Ring : 1785
Bark Date : 1948
Length of sample : 164
Number in final analysis : 88
Information on fire history :
1861 D fire scar
1880 D fire scar FI = 19
1910 D injury
Total number of fire scars : 2
Total number all indicators : 3
Average number years per fire : 44.0
Sample mean fire interval : 19.0

Series 30 : CAN44
Pith Date : 1743
Outer Ring : 1916
Length of sample : 174
Number in final analysis : 47
Information on fire history :
1870 D fire scar
1893 L fire scar FI = 23
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 23.5
Sample mean fire interval : 23.0

Series 31 : CAN43
Inner Ring : 1744
Bark Date : 1995
Length of sample : 252
Number in final analysis : 135
Information on fire history :
1861 D fire scar
1893 A fire scar FI = 32
Total number of fire scars : 2
Total number all indicators : 2
Average number years per

APPENDIX A – Individual Summaries for Fire History site: Cañada Bonito (CAN)
file: bon.fhx

fire : 67.5
Sample mean fire interval :
32.0

Series 32 : CAN41
Pith Date : 1861
Bark Date : 1951
Length of sample : 91
Number in final analysis : 59
Information on fire history :
1893 U fire scar
Total number of fire scars :
1
Total number all indicators :
1
Average number years per
fire : 59.0

Series 33 : CAN40
Inner Ring : 1790
Bark Date : 1996
Length of sample : 207
Number in final analysis : 156
Information on fire history :
1841 U fire scar
1861 D fire scar FI = 20
1893 M fire scar FI = 32
Total number of fire scars :
3
Total number all indicators :
3
Average number years per
fire : 52.0
Sample mean fire interval :
26.0

APPENDIX A – Individual Summaries for Fire History site: Camp May North (CMN)
file: may.fhx

Series in bold are trees collected for the Jemez Extended Fire Regime Study. Other series are trees collected for fire history study by Touchan et al. (1996).

Series 1 : CMN03
Inner Ring : 1683
Outer Ring : 1815
Length of sample : 133
Number in final analysis : 87
Information on fire history :
1729 U fire scar
1755 U injury
1766 U injury
1779 U injury
1799 U injury
Total number of fire scars : 1
Total number all indicators : 5
Average number years per fire : 87.0

Series 2 : CMN04
Pith Date : 1839
Bark Date : 1993
Length of sample : 155
Number in final analysis : 133
Information on fire history :
1861 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 133.0

Series 3 : CMN05
Pith Date : 1839
Bark Date : 1993
Length of sample : 155
Number in final analysis : 133
Information on fire history :
1861 U fire scar
1870 U injury
1872 U injury
1876 U injury
1878 U injury
1897 U injury
Total number of fire scars : 1
Total number all indicators : 6
Average number years per fire : 133.0

Series 4 : CMN07
Inner Ring : 1768
Bark Date : 1993
Length of sample : 226
Number in final analysis : 133
Information on fire history :
1861 E fire scar
1879 U fire scar FI = 18
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 66.5
Sample mean fire interval : 18.0

Series 5 : CMN09
Pith Date : 1755
Bark Date : 1993
Length of sample : 239
Number in final analysis : 147
Information on fire history :
1847 U fire scar
1861 E fire scar FI = 14
1880 U fire scar FI = 19
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 49.0
Sample mean fire interval : 16.5

Series 6 : CMN10
Inner Ring : 1801
Bark Date : 1993
Length of sample : 193
Number in final analysis : 147
Information on fire history :
1847 U fire scar
1861 E fire scar FI = 14
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 73.5
Sample mean fire interval : 14.0

Series 7 : CMN11
Pith Date : 1750
Outer Ring : 1859
Length of sample : 110
Number in final analysis : 13
Information on fire history :
1847 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 13.0

Series 8 : CMN12
Inner Ring : 1805
Bark Date : 1963
Length of sample : 159
Number in final analysis : 103
Information on fire history :
1861 E fire scar
1879 L fire scar FI = 18
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 51.5
Sample mean fire interval : 18.0

Series 9 : CMN13
Pith Date : 1845
Bark Date : 1993
Length of sample : 149
Number in final analysis : 115
Information on fire history :
1879 L fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 115.0

Series 10 : CMN14
Inner Ring : 1762
Bark Date : 1993
Length of sample : 232
Number in final analysis : 176
Information on fire history :

APPENDIX A -- Individual Summaries for Fire History site: Camp May North (CMN)
file: may.fhx

1818 U fire scar
1847 U fire scar FI = 29
1861 U fire scar FI = 14
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 58.7
Sample mean fire interval : 21.5

Series 11 : CMN16
Inner Ring : 1750
Bark Date : 1993
Length of sample : 244
Number in final analysis : 133
Information on fire history :
1861 U fire scar
1876 U injury
1879 U fire scar FI = 18
1912 U injury
Total number of fire scars : 2
Total number all indicators : 4
Average number years per fire : 66.5
Sample mean fire interval : 18.0

Series 12 : CMN18
Pith Date : 1765
Bark Date : 1993
Length of sample : 229
Number in final analysis : 147
Information on fire history :
1847 U fire scar
1861 E fire scar FI = 14
1983 U injury
Total number of fire scars : 2
Total number all indicators : 3
Average number years per fire : 73.5
Sample mean fire interval : 14.0

Series 13 : CMN19
Pith Date : 1857
Bark Date : 1993
Length of sample : 137
Number in final analysis : 115
Information on fire history :
1879 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 115.0

Series 14 : CMN20
Pith Date : 1856
Bark Date : 1993
Length of sample : 138
Number in final analysis : 115
Information on fire history :
1879 L fire scar
1964 U injury
Total number of fire scars : 1
Total number all indicators : 2
Average number years per fire : 115.0

Series 15 : CMN22
Pith Date : 1742
Outer Ring : 1870
Length of sample : 129
Number in final analysis : 10
Information on fire history :
1861 E fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 10.0

Series 16 : CMN24
Inner Ring : 1830
Outer Ring : 1898
Length of sample : 69
Number in final analysis : 38
Information on fire history :
1861 U fire scar
1879 L fire scar FI = 18
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 19.0
Sample mean fire interval : 18.0

Series 17 : CMN25
Inner Ring : 1741
Bark Date : 1993
Length of sample : 253
Number in final analysis : 133
Information on fire history :
1861 U fire scar
1879 L fire scar FI = 18
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 66.5
Sample mean fire interval : 18.0

Series 18 : CMN28
Pith Date : 1842
Outer Ring : 1938
Length of sample : 97
Number in final analysis : 60
Information on fire history :
1879 L fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 60.0

Series 19 : CMN29
Pith Date : 1836
Outer Ring : 1939
Length of sample : 104
Number in final analysis : 61
Information on fire history :
1879 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 61.0

Series 20 : CMN31
Pith Date : 1778
Bark Date : 1993
Length of sample : 216
Number in final analysis : 147
Information on fire history :
1847 U fire scar
1851 D fire scar FI = 4
Total number of fire scars : 2
Total number all indicators : 2

APPENDIX A -- Individual Summaries for Fire History site: Camp May North (CMN)
file: may.fhx

Average number years per fire : 73.5
Sample mean fire interval : 4.0

Series 21 : CMN42
Inner Ring : 1719
Outer Ring : 1760
Length of sample : 42
Number in final analysis : 13
Information on fire history :
1748 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 13.0

Series 22 : CMN43
Inner Ring : 1879
Bark Date : 1996
Length of sample : 118
Number in final analysis : 118
Information on fire history :
1879 U fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 118.0

Series 23 : CMN45
Pith Date : 1725
Bark Date : 1945
Length of sample : 221
Number in final analysis : 99
Information on fire history :
1847 D fire scar
1880 U fire scar FI = 33
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 49.5
Sample mean fire interval : 33.0

Series 24 : CMN47
Inner Ring : 1563
Outer Ring : 1847
Length of sample : 285
Number in final analysis : 30
Information on fire history :
1818 A fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 30.0

Series 25 : CMN49
Inner Ring : 1634
Bark Date : 1921
Length of sample : 288
Number in final analysis : 206
Information on fire history :
1716 D fire scar
1748 D fire scar FI = 32
1818 M fire scar FI = 70
1847 U fire scar FI = 29
1880 D fire scar FI = 33
1910 D fire scar FI = 30
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 34.3
Sample mean fire interval : 38.8

Series 26 : CMN50
Inner Ring : 1632
Outer Ring : 1841
Length of sample : 210
Number in final analysis : 126
Information on fire history :
1716 E fire scar
1787 U fire scar FI = 71
1792 U fire scar FI = 5
1801 U fire scar FI = 9
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 31.5
Sample mean fire interval : 28.3

Series 27 : CMN51
Inner Ring : 1666
Bark Date : 1887
Length of sample : 222
Number in final analysis : 140
Information on fire history :
1748 D fire scar
1763 D injury
1771 D injury
1818 D fire scar FI = 70
1847 D fire scar FI = 29
1861 E fire scar FI = 14
Total number of fire scars : 4
Total number all indicators : 6
Average number years per fire : 35.0
Sample mean fire interval : 37.7

Series 28 : CMN52
Inner Ring : 1650
Bark Date : 1996
Length of sample : 347
Number in final analysis : 169
Information on fire history :
1828 D fire scar
1837 D fire scar FI = 9
1861 D fire scar FI = 24
1864 E injury
1880 D fire scar FI = 19
1992 D injury
1994 D injury
Total number of fire scars : 4
Total number all indicators : 7
Average number years per fire : 42.2

APPENDIX A – Individual Summaries for Fire History site: Camp May North (CMN)
file: may.fhx

Sample mean fire interval :
17.3

Sample mean fire interval :
43.0

Series 29 : CMN53
Pith Date : 1638
Outer Ring : 1812
Length of sample : 175
Number in final analysis : 97
Information on fire history :
1716 U fire scar
1748 D fire scar FI = 32
Total number of fire scars :
2
Total number all indicators :
2
Average number years per fire : 48.5
Sample mean fire interval :
32.0

Series 30 : CMN57
Pith Date : 1823
Bark Date : 1980
Length of sample : 158
Number in final analysis : 134
Information on fire history :
1847 D fire scar
Total number of fire scars :
1
Total number all indicators :
1
Average number years per fire : 134.0

Series 31 : CMN58
Inner Ring : 1757
Bark Date : 1996
Length of sample : 240
Number in final analysis : 179
Information on fire history :
1818 M fire scar
1861 U fire scar FI = 43
Total number of fire scars :
2
Total number all indicators :
2
Average number years per fire : 89.5

APPENDIX A

CAMU-T: Camp May Upper Tree Transect, Jemez Mtn., Aug., 1996										
note: "dX" denotes a dead tree whereby "X" is the estimated canopy position; when X=d, tree is dead and down										
tree	**posn**		**dbh**	**rch**	**core h**	**cover**		**inner**	**est**	
no.	**(at Meter)**	**Sp.**	**cm**	**cm**	**cm**	**class**	**Field Comments**	**ring**	**pith**	**Lab Comments**
1	2.40	Pien	29.7	33.5	24	C		1900	1887	
2	3.60	Potr	38.5	39.5	x	C	rotten	x	x	
3	8.80	Potr	32.3	35.0	x	C	hit rot	x	x	
4	8.50	Potr	37.7	41.0	36	C		1888	1881	
5	10.80	Psme	16.5	18.6	21	U		1888	1886	
6	16.90	Psme	30.2	36.8	cores	S	a~25, b~33	1892	1887	
7	17.59	Potr	29.8	33.7	52	C		1871	1866	
8	19.50	Psme?	6.1	6.3	36	dU	dead		x	
9	22.60	Potr	28.0	32.0	cores	C	a~22,b~30	1860	1860	two cores marked 'b'
10	26.80	Psme	29.2	35.0	34	S		1891	1883	
11	22.70	Psme?	x	65.0	x	d	rotten root crown	x	x	
12	31.20	Psme?	x	x	x	dd	rotten log	x	x	
13	34.50	Potr	22.7	25.0	31	S		1886	1881	
14	36.42	Pien	3.7	4.9	0	U		1925	1925	
15	38.50	Pien	28.0	30.6	43	S				missing
16	39.90	Pien	7.7	10.1	11	dU	dead	x	x	
17	46.30	Psme	39.6	45.1	36	D		1883	1883	
18	48.27	Pien	6.6	8.8	27	U				missing
19	50.80	Pien	3.5	5.5	8	U		1957	1954	
20	55.10	Pien	14.8	20.1	33	U		1941	x	no curvature
21	56.20	Pien	4.7	5.5	0	U		1935	1935	
22	60.05	Psme	28.7	34.7	28	S		1896	1890	
23	61.50	Psme	75.3	85.0	cores	C	b=32,c=38	1845	x	no curvature
24	66.68	Acgl	8.7	9.6	10	U		1901	1892	
25	66.39	Acgl	7.0	8.7	20	U		1923	1923	
26	66.55	Acgl	5.8	6.1	43	U		1881	1878	
27	66.64	Acgl	8.0	8.7	8	U		1894	1894	
28	74.00	Psme	44.3	53.2	46?	D		1803	1728	
29	76.75	Pien	25.3	29.4	27	S		1891	1887	
30	79.80	Psme	11.2	14.5	33	U		1885	1885	
31	80.25	Pien	4.3	6.0	0	U				missing

APPENDIX A

CAMU-T: Camp May Upper Tree Transect, Jemez Mtn., Aug., 1996										
note: "dX" denotes a dead tree whereby "X" is the estimated canopy position; when X=d, tree is dead and down										
tree	**posn**		**dbh**	**rch**	**core h**	**cover**		**inner**	**est**	
no.	**(at Meter)**	**Sp.**	**cm**	**cm**	**cm**	**class**	**Field Comments**	**ring**	**pith**	**Lab Comments**
32	82.35	Psme	23.1	29.2	30	S		1895	1890	
33	87.90	Psme	82.0	93.0	87	C		1565	1547	
34	90.65	Psme	70.7	22.5	31	U		1895	1890	
35	90.85	Pien?	4.2	6.4	0	dU	dead	x	x	
36	91.85	Pien	12.7	15.8	40	U		1906	1896	
37	93.15	Acgl	14.2	16.0	29	U		1882	1873	
38	93.90	Acgl	10.5	11.5	28	U		1883	1872	
39	92.78	Acgl	11.1	10.5	75	U		1889	1889	
40	92.80	Acgl	10.3	11.7	54	U		1889	1880	
41	93.55	Acgl	8.3	10.0	35	U		1892	1892	
42	93.30	Acgl	5.8	6.0	13	dU	dead	x	x	
43	95.20	Abco	27.3	30.7	40	dU	dead	1894	1889	
44	*NO TREE*									
45	100.70	Psme	99.5	121.0	148	D		1588	x	no curvature
46	100.25	Psme	10.6	14.6	0	U		1899	1899	
47	100.90	Psme	5.3	8.0	0	U				
48	105.20	Psme	73.3	97.5	27	D		1781	x	no curvature
49	107.70	Abco	38.9	50.9	10	S	nearly dead	1906	1898	
50	110.55	Pien	6.9	8.4	23	U		1898	1893	
51	67.70	Pipo?	x	50.0	x	d	only rotten root crown	x	x	
52	112.85	Pien	8.0	9.8	21	U		1898	1892	
53	112.80	Acgl	11.8	11.9	36	U		1903	1894	
54	112.90	Acgl	4.5	5.4	30	U		1925	1925	ring count
55	120.20	Psme	61.7	71.0	cores	D	a=40,b=10	1811	x	no curvature
56	123.90	Pien	9.8	13.2	24	U		1926	1926	
57	9.00	Potr	25.4	29.4	33	C		1908	1892	
58	16.95	Potr	26.7	31.8	46	C		1887	1883	
59	23.50	Psme	39.9	58.9	29	C		1899	x	no curvature
60	127.50	Pien	33.1	40.1	40	C		1860	1850	
61	129.61	Psme	73.3	74.9	31	S	rotten	x	x	
62	131.60	Pien	48.4	56.3	40	C		1854	1843	

APPENDIX A

CAMU-T: Camp May Upper Tree Transect, Jemez Mtn., Aug., 1996										
note: "dX" denotes a dead tree whereby "X" is the estimated canopy position; when X=d, tree is dead and down										
tree	**posn**		**dbh**	**rch**	**core h**	**cover**		**inner**	**est**	
no.	**(at Meter)**	**Sp.**	**cm**	**cm**	**cm**	**class**	**Field Comments**	**ring**	**pith**	**Lab Comments**
63	134.30	Pien	29.3	36.6	32	S		1842	1822	
64	136.70	Pien	54.5	62.1	43	D		1834	1823	
65	136.70	Pien	30.4	38.1	cores	U	a=37,b=105	1814	1810	
66	142.15	Psme	59.4	72.1	40	C		1748	1742	
67	143.35	Psme	76.2	93.0	74	C		1884	x	no curvature
68	143.90	Pien	26.4	32.7	24	S		1871	1837	
69	146.05	Psme	40.2	56.4	cores	C	a=42,b=102	1760	1757	b core
70	147.60	Pien	12.3	13.6	10	dS	dead	1901	1897	
71	156.60	Psme	63.3	74.0	42	S		1787	1778	
72	159.76	Pien	55.1	70.3	42	D		1902	1888	
73	164.70	Psme	36.0	54.4	166	S		1839	1816	
74	165.59	Psme	60.5	74.2	x	C	rotten	x	x	
75	168.50	Pien	7.4	8.1	21	U				missing
76	171.10	Psme	51.6	59.3	47	C		1780	1762	
77	174.80	Psme	64.4	73.6	136	C		1758	1752	
78	177.90	Pien	69.1	89.6	62	C		1928	1925	
79	181.70	Pied	25.5	28.8	108	S		x	x	core broken up
80	181.80	Psme	56.6	57.0	cores	C	a=25,b=87	1754	1747	b core
81	*NO TREE*									
82	185.60	pien	27.6	31.3	45	S		1904	1892	
83	185.00	Psme?	x	40.0	x	d	root crown	x	x	
84	186.30	Acgl	8.3	11.8	16	U		x	x	tight on outside
85	186.40	Acgl	8.2	10.6	25	U		1911	1902	ring count
86	186.55	Acgl	9.6	11.5	40	U		1916	1902	
87	194.00	Potr	28.5	32.2	47	S		x	x	no curvature
88	215.60	Acgl	13.1	16.0	23	U		x	x	no curvature
89	215.90	Psme	61.0	72.8	84	C		1758	1741	
90	217.70	Pien	34.0	41.8	55	S		1874	1874	
91	221.68	Pien	20.8	28.0	cores	U	a=37,b=95	1890	1870	
92	220.15	Pien	23.2	27.7	36	S		1867	1862	
93	225.40	Psme	64.2	77.3	62	C		1771	1752	

APPENDIX A

CAMU-T: Camp May Upper Tree Transect, Jemez Mtn., Aug., 1996										
note: "dX" denotes a dead tree whereby "X" is the estimated canopy position; when X=d, tree is dead and down										
tree	**posn**		**dbh**	**rch**	**core h**	**cover**		**inner**	**est**	
no.	**(at Meter)**	**Sp.**	**cm**	**cm**	**cm**	**class**	**Field Comments**	**ring**	**pith**	**Lab Comments**
94	227.35	Pien	28.1	32.5	110	S		1865	1856	
95	234.10	Psme	90.3	109.5	58	D		1762	x	no curvature
96	235.50	Pien	48.5	57.5	x	C	no core	x	x	
97	239.40	Pien	12.0	15.0	29	U		1827	1815	
98	239.50	Psme	12.1	76.7	25	U		1755	1749	suppressions
99	239.50	Psme	34.0	44.6	39	S		x	x	no curvature
100	242.10	Pien	19.2	24.9	cores	S	a=24,b=83	1791	1783	
101	244.70	Pien	46.1	45.3	34	C				missing
102	247.00	Psme	86.4	107.6	30	D		1781	1774	
103	248.18	Psme	18.8	24.3	?	U		1769	1728	
104	258.60	Psme	44.2	49.9	22	S		1752	1745	
105	251.00	Psme	34.0	43.6	50	S		1883	1875	
106	254.70	Pien	40.7	56.4	26	C		1774	1764	
107	254.35	Psme	45.9	57.3	33	C		1759	1746	
108	255.84	Pien	34.0	38.8	31	S		1839	1830	
109	256.15	Pien	10.0	12.3	20	U		1840	1836	
110	260.30	Psme	63.9	74.5	33	D		1737	1734	
111	265.10	Pien	62.0	72.0	70	C		1840	1813	
112	267.90	Pien	24.9	29.8	40	S		1895	1878	
113	268.80	Psme	29.8	43.1	111	U		1752	1749	
114	271.15	Pien	45.6	59.1	54	C		1841	1835	
115	273.10	Pien	20.8	25.0	28	U	broken top	1912	1900	
116	275.80	Pien	38.1	48.7	20	C		1864	1857	
117	286.40	Psme?	x	102.0	x	dd	dead decayed log	x	x	
118	287.25	Psme	47.5	59.7	cores	C	a=39,b=113	1840	x	no curvature
119	289.20	Acgl	8.2	10.2	18	U		1870	1862	
120	293.30	Psme	49.0	68.0	x	dd	log; some bark	x	x	
121	293.15	Pien	8.0	11.2	84	U		1907	1905	
122	295.00	Psme	80.4	96.8	60	C		1557	1546	
123	297.75	Psme	52.5	63.5	cores	C	a=94,b=103; rotten	1879	x	
124	300.00	Pien	11.2	13.0	35	U		1842	1842	

APPENDIX A

CAMU-T: Camp May Upper Tree Transect, Jemez Mtn., Aug., 1996										
note: "dX" denotes a dead tree whereby "X" is the estimated canopy position; when X=d, tree is dead and down										
tree	**posn**		**dbh**	**rch**	**core h**	**cover**		**inner**	**est**	
no.	**(at Meter)**	**Sp.**	**cm**	**cm**	**cm**	**class**	**Field Comments**	**ring**	**pith**	**Lab Comments**
125	300.00	Pien	27.0	37.0	26	S		1919	x	no curvature

APPENDIX A

CAML-T, Camp May Lower Transect, Trees, Jemez Mtn. , Aug., 1996										
tree no.	posn (at Meter)	Sp.	dbh cm	rch cm	core h cm	cover class	Field Comments	inner ring	est pith	Lab Comments
1	3.10	Potr	32.0	35.0	35	C		1855	1851	
2	5.67	Potr	30.0	29.5	x	C	rotten	x	x	
3	6.05	Potr	26.5	28.5	25	C		1866	1861	
4	7.55	Potr	27.9	28.0	30	C		1862	1857	
5	7.85	Potr	27.5	29.5	84	C		1872	1866	
6	3.48	Abco	3.5	5.0	10	U		1924	x	no curvature
7	7.80	Psme	7.0	8.2	15	U		1948	1936	
8	9.70	Pien	8.0	9.5	34	U		1951	1951	
9	9.15	Pien	5.0	6.0	15	U		1948	1948	
10	11.15	Pien	3.0	4.5	15	U		1884	1883	
11	19.00	Pien	27.4	33.5	25	U		1886	1886	
12	23.85	Pien	5.2	6.0	32	U		1962	1962	
13	24.55	Pien	3.4	6.2	12	U		1967	1961	
14	25.75	Pien	2.5	4.5	20	U		1968	1963	
15	23.00	Pien	0.0	60.0	x	d	rotten stump; no core	x	x	
16	7.87	Pien	7.0	8.0	9	U		1963	1958	
17	4.85	Pien	7.5	8.0	9	U		1934	1929	
18	2.53	Pien	4.0	5.4	8	U		1949	1944	
19	-0.50	Abco	103.5	116.6	70	D	rotten core	x	x	
20	27.13	Psme	48.0	55.0	30	C		x	x	no curvature
21	27.45	Pien	28.6	37.5	105	dS	dead	1849	1849	
22	25.40	Psme	27.5	34.0	35	U		1884	1866	
23	36.35	Pien	3.2	5.0	20	U		1979	1979	
24	51.65	Pien	36.5	41.5	x		no core	x	x	
25	29.35	Pien	67.5	81.8	cores	C	a=80,b=125,c=114	x	x	no curvature
26	49.00	Pien	43.8	56.9	x	C	no core	x	x	
27	52.90	Pien	27.5	30.9	110	dS	dead,down	x	x	
28	57.50	Psme	19.0	79.5	x	dC	downed log, no core	x	x	
29	56.40	Psme	17.0	56.5	x	dC	downed log, no core	x	x	
30	63.75	Pien	18.5	21.5	90	S		1935	1932	
31	63.90	Psme	75.0	92.0	0	dC	dead	1570	1554	death date: 1993
32	65.90	Pien	43.0	47.0	110	S			x	no curvature

APPENDIX A

CAML-T, Camp May Lower Transect, Trees, Jemez Mtn. , Aug., 1996										
tree no.	posn (at Meter)	Sp.	dbh cm	rch cm	core h cm	cover class	Field Comments	inner ring	est pith	Lab Comments
33	74.35	Pien	18.0	20.0	105	U		1886	1875	
34	74.83	Abco	71.0	82.5	cores	C	a=60,b=105		x	no curvature
35	77.55	Pien	6.0	7.5	19	dU	dead	1897	1897	
36	81.86	Pien	22.8	24.5	25	S		1899	1899	
37	82.90	Pien	39.5	42.3	50	S		1905	1900	
38	90.10	Pien	37.5	43.0	40	C		1898	1890	
39	92.18	Psme	33.0	39.9	x	d	no core: rotten		x	
40	99.45	Pien	69.0	77.0	50	C		1847	1831	
41	100.30	Psme	91.9	107.8	x	C	no core: rotten		x	
42	103.85	Pien	5.0	7.5	11	U			x	dating unreliable: no bark, suppressions
43	109.28	Potr	36.2	39.5	30	C			x	no curvature
44	109.77	Pien	29.0	31.8	39	S		1909	1903	
45	114.45	Pien	20.5	21.0	35	dU	dead	1886	1886	
46	112.10	Pipo	0.0	40.0	x	d	no core: root crown only		x	
47	115.00	Psme	74.4	79.9	85	C		1654	1654	suppressions
48	114.20	Pien	50.4	52.6	32	C				missing
49	118.20	Acgl	5.5	14.5	20	U			x	dating unreliable: no bark, suppressions
50	118.20	Acgl	8.9	14.5	40	U		1900	1900	
51	123.30	Pien	7.5	9.0	24	U		1912	1912	
52	127.20	Psme	76.0	91.0	85	C		1676	1641	
53	126.95	Pien	42.5	45.5	50	C		1892	1886	
54	125.60	Pipo	0.0	30.0	x	d	no core: root crown only		x	
55	134.35	Psme	10.0	11.5	53	U	dead	1897	1891	
56	135.84	Pien	46.0	47.0	60	C		1905	1895	
57	140.00	Psme	76.0	83.5	59	C		1696	1651	
58	137.90	Psme	35.0	60.0	x	dd	no core: rotten	x	x	
59	142.40	Psme	51.5	59.0	cores	C	a=55,b=120		x	no curvature
60	149.70	Psme	8.9	10.0	28	U		1890	1885	
61	150.50	Psme	12.5	15.0	32	U		1893	1889	
62	151.38	Psme	16.0	18.5	29	U		1886	1886	
63	143.00	Psme	72.2	86.0	cores	D	a=110,b=140	1759	1684	
64	151.30	Abco	69.5	73.3	cores	C	a=35,b=100	1888	1882	suppressions: 1950s and >1983

APPENDIX A

CAML-T, Camp May Lower Transect, Trees, Jemez Mtn. , Aug., 1996										
tree no.	posn (at Meter)	Sp.	dbh cm	rch cm	core h cm	cover class	Field Comments	inner ring	est pith	Lab Comments
65	151.40	Psme	10.2	13.9	31	U		1891	1887	
66	152.50	Psme	10.7	14.8	28	U		1898	1898	
67	152.70	Abco	18.0	20.0	20	dd	dead,down		x	dating unreliable: no bark, too few rings
68	160.75	Pied	5.2	7.0	32	U		1949	1949	
69	161.03	Pied	3.6	5.7	14	U		1974	1969	
70	161.84	Pied	9.6	12.2	35	U		1966	1962	
71	162.00	Pied	5.2	6.7	35	U		1969	1964	
72	162.80	Potr	12.2	13.7	45	U		1884	1880	
73	163.40	Pied	9.1	13.7	x	dU	no core	x	x	
74	162.90	Pied	3.2	4.0	19	U		1972	1967	
75	164.18	Psme	6.0	8.1	25	U		1952	1952	
76	165.50	Pied	9.5	13.0	70	U		1956	1950	
77	166.70	Pied	5.2	6.5	30	U		1968	1968	
78	167.62	Pied	8.5	11.5	37	U				missing
79	167.18	Psme	4.2	6.3	14	U		1947	1947	
80	169.21	Abco	4.8	6.2	13	U				missing
81	169.74	Pied	3.5	6.3	36	U		1961	1961	
82	173.12	Potr	21.5	22.5	40	S		1864	1864	
83	174.35	Potr	19.5	21.0	cores	S	a=33,b=94	1864	1864	
84	171.55	Psme	3.5	4.9	32	U		1903	1903	
85	175.23	Psme	79.9	101.6	cores	D	a=62,b=98	1771	1750	
86	175.40	Acgl	12.0	14.1	33	U		1883	1881	
87	175.40	Acgl	12.7	13.8	43	U			x	dating unreliable: no bark, erratic growth
88	176.78	Potr	30.1	32.9	47	C		1863	1862	
89	176.81	Potr	26.9	29.1	78.5	C		1867	1864	
90	180.70	Pien	4.0	7.5	29	U		1930	1930	suppressed: 1950s and >1983
91	181.22	Psme	8.7	12.3	28	U		1891	1891	
92	182.00	Potr	13.2	14.5	0	dd	no core		x	
93	185.03	Pien	10.4	12.8	33	U				missing
94	185.20	Potr	30.9	39.0	cores	C	a=44,b=121		x	no curvature
95	186.45	Potr	26.6	37.8	cores	C	a=87,b=106	1861	1861	
96	195.00	Pien	9.2	13.5	cores	U	a=63,b=109	1969	1969	

APPENDIX A

CAML-T, Camp May Lower Transect, Trees, Jemez Mtn. , Aug., 1996										
tree no.	posn (at Meter)	Sp.	dbh cm	rch cm	core h cm	cover class	Field Comments	inner ring	est pith	Lab Comments
97	196.50	Potr	25.3	29.5	cores	C	a=53,b=130	1895	1890	
98	196.90	Pien	2.5	4.6	17	U		1958	1953	
99	199.00	Pien	8.7	11.1	50	U		1947	1944	
100	200.00	Pien	17.8	23.0	x	U	no core: rotten	x	x	
101	199.50	Psme	3.5	5.7	24	dU	dead	1976	1973	
102	195.00	Pien	3.6	5.2	31	U		1972	1972	
103	195.00	Psme	4.6	5.7	7	U		1841	1841	
104	201.40	Pien	14.5	16.6	37	U				missing
105	202.00	Potr	18.4	20.9	29	S		1881	1881	
106	202.18	Psme	6.1	7.7	23	dU	dead	1946	1946	
107	201.25	Pien	4.9	7.4	38	U		unk	unk	
108	203.70	Pien	22.7	29.6	26	S		1925	1913	
109	204.20	Potr	27.6	31.1	48	C				missing
110	203.65	Psme	2.8	5.1	7	U		1946	1946	
111	203.20	Pien?	6.5	8.0	x	d	no core: rotten		x	
112	204.20	Pien	1.7	4.8	9	U		1976	1973	
113	206.94	Pien	5.3	7.1	35	U		1955	1955	tight and rx'n wood near pith
114	207.75	Pien	3.3	5.2	45	U		1951	1951	
115	209.25	Pien	16.3	21.0	3.7	D		1927	1926	
116	209.20	Pien	3.4	4.7	9	dU	dead		x	unreliable dating: too few rings, no bark, rx'n wood
117	209.50	Pien	6.0	6.6	4	U		1945	1945	tight on inside, ring count <1970
118	210.90	Pien	4.5	5.7	7	U		1958	1951	rx'n wood near pith
119	210.95	Pien	6.3	7.3	30	U		1967	1967	
120	210.60	Potr	25.1	28.5	36	D		1887	1875	
121	211.60	Pien	4.8	5.5	19	U		1959	1959	ring count
122	212.50	Pien	5.5	7.0	24	U		1969	1961	
123	212.35	Pien	6.9	8.4	20	U		1967	1961	
124	213.40	Pien	8.7	10.5	32	U		1969	1965	
125	214.50	Pien	3.4	4.7	7	U				missing
126	215.90	Acgl	9.8	11.9	cores	U	a=26,b=77	1891	1891	ring count
127	215.90	Acgl	3.5	4.6	cores	U	a=8,b=34	1954	1954	ring count
128	215.90	Acgl	9.5	10.5	15	U			x	dating unreliable: broken core, missing piece

APPENDIX A

CAML-T, Camp May Lower Transect, Trees, Jemez Mtn. , Aug., 1996										
tree no.	posn (at Meter)	Sp.	dbh cm	rch cm	core h cm	cover class	Field Comments	inner ring	est pith	Lab Comments
129	215.90	Acgl	10.6	11.2	31	U				missing
130	215.90	Acgl	8.2	9.2	26	U			1939	ring count
131	215.90	Acgl	5.9	7.6	26	U		1945	1943	
132	215.90	Psme	6.3	8.4	24	U		1911	1911	
133	215.30	Pien	3.0	5.1	18	U		1977	1977	
134	216.40	Pien	3.3	4.7	26	U		1962	1962	tight on outside, rx'n wood near pith, ring count
135	217.05	Pien	6.4	8.8	40	U		1963	1963	
136	218.00	Pien	3.8	5.0	28	U		1939	1939	very tight in 1950s
137	217.50	Pien	2.5	0.0	0	U				missing
138	218.30	Pien	3.8	5.0	38	U		1969	1969	
139	218.85	Pien	5.4	7.2	28	U		1949	1949	
140	219.00	Psme	3.0	4.5	41	U		1972	1972	ring count, very tight
141	219.40	Pien	5.8	7.6	22	U		1963	1963	
142	219.80	Pien	1.8	4.2	31	U		1974	1974	very tight on outside, ring count
143	220.90	Potr	12.9	15.4	35	dD	dead	1915	1915	
144	220.90	Pien	3.3	5.6	26	U		1970	1970	
145	222.50	Pien	4.4	5.9	25	U		1967	1964	
146	230.60	Pien	6.4	9.0	53	U		1962	1962	
147	234.70	Psme	74.2	85.7	68	D		1789	1784	
148	236.28	Pien	2.7	5.7	19.5	dU	dead		x	
149	238.75	Psme	10.1	11.7	42	U		1912	1912	
150	239.85	Pien	5.6	8.8	53	U	under a fallen tree	1970	1970	
151	247.80	Pien	66.8	77.4	63	C			x	no curvature
152	247.80	Pien	52.9	63.7	40	C		1897	1892	
153	253.45	Pien	20.6	24.9	39	S				missing
154	254.95	Pien	7.2	9.1	35	U		1934	1931	
155	257.20	Pien	5.5	7.5	9	U		1943	1941	
156	258.25	Pien	7.2	9.9	32	U		unk	unk	no bark, too short
157	259.80	?	0.0	0.0	x	dd	no core: decayed log	x	x	
158	260.93	Pien	12.1	14.8	31	U		1943	1937	
159	261.70	Pien	3.6	4.9	35	dU	dead	1949	1949	
160	262.30	Pien	13.3	15.5	31	U		1968	1964	

APPENDIX A

BON: Canada Bonito Tree Transect, Jemez Mtn., Aug., 1996										
Tree no.	**posn at Meter**	**Sp.**	**dbh cm**	**rch cm**	**core h cm**	**cover class**	**Field Comments**	**inner ring**	**est pith**	**Lab Comments**
1	1.2	Potr	18.5	20.3	cores	C	A-25,B-94	1902	1887	
2	2.8	Pien	15.1	18	32	dU	dead	x	x	
3	7.3	potr	14	16.4	27	S		1895	1892	
4	11.9	Abla	25.7	30.4	31	C		1933	1928	
5	16.1	Psme	21.2	27.4	26	S		1930	1924	
6	17.2	Potr	16.5	20.6	37	S		1893	1893	
7	20.3	Psme	18.7	20.2	75	S		1933	1929	
8	24.8	Potr	16.5	17.4	35	S		1897	1887	
9	27.1	Psme	44.4	48.3	38	C		1907	1900	
10	27.8	Potr	13.2	13.4	cores	S	A-72,B-124		x	no curvature
11	29.8	Pien	25.5	30.2	38	C		1903	1903	
12	34.1	Pien	19.1	23	37	S		1931	1927	
13	35.9	Potr	10.5	11.2	25	dd		1942	1940	
14	36.3	Potr	13	14.1	24	dd	top broken @ 1.5 m		x	no curvature
15	38.9	Psme	7	10.3	30	U		1920	1920	
16	39.8	Potr	16.6	18.1	cores	C	A-15,B-89			missing
17	40.9	Psme	4.1	6.1	14	U		1935	1935	
18	41.8	Pien	12.5	15.4	25	U		1919	1914	
19	42.2	Pien	x	49	x	dd	stump decayed, no core	x	x	
20	42.2	Potr	4.1	4.6	17	dU	dead	1966	1966	very tight in 1990s
21	43.8	Pien	38.9	46.8	41	C		1895	1895	
22	47.3	Pien	19.6	26.4	22	S	leaning on a tree	1917	1907	
22	49.8	Psme	na	37.8	x	dd	stump	x	x	
23	54.3	Psme	~60	20	x	dd	stump	1756	1742	
24	58.9	Abco	30	45	x	d	broken off @ 2m	x	x	
25	58.9	Pien	37.3	42.9	56	C		1880	1865	
26	61.1	Abco	42	57.9	x	d	decayed, broken @ 2.5 m	x	x	
27	64.2	psme	5.8	7.7	13	U	bowed base	1949	1936	
28	69.8	Pien	10.7	14.3	37	U		1911	1882	scar @ 1940
29	74.1	Psme	23.9	31.1	53	S		1857	1824	
30	75.9	Pien	89	114.5	82	D		1798	1792	
31	76.7	Pien	15.2	16.9	x	d	dead+rotten	x	x	

APPENDIX A

BON: Canada Bonito Tree Transect, Jemez Mtn., Aug., 1996										
Tree no.	posn at Meter	Sp.	dbh cm	rch cm	core h cm	cover class	Field Comments	inner ring	est pith	Lab Comments
32	78.9	Pien	9	12.3	33	dU	dead+rotten	1894	1870	
33	80.0	Potr	30.5	42.8	x	C	rotten	x	x	
34	82.0	Pien	4.8	6.9	22	U		1957	1947	label = '35'
35	87.2	Acgl	8.2	16.1	26	U		1909	1906	
36	87.2	Acgl	6.7	7.2	16	U		1900	1893	ring count
37	87.2	Acgl	11.4	12.6	33.5	U		1887	1887	
38	98.4	Pien	10.6	15.5	21	U		1924	1907	
39	93.0	Abco	68.4	88.2	62	D			x	no curvature
40	93.0	Psme	48.6	63.6	52.5	C				missing
41	94.5	Psme?	38	49		dd	dead,rotten,down	1771	x	no curvature
42	91.0	Abco	15	21	22	U		1902	1889	
43	98.0	Pien	25.9	30.9	27	S		1850	1841	
44	98.5	Abco	70	73.2	x	dd	dead,rotten,broken @ 2 m	x	x	
45	100.1	Pien	21.1	29.2	74	U		1880	1880	broken core
46	104.5	Pien	53.8	69.2	cores	C	A-82,B135	1945	x	no curvature
47	107.7	Pien	49.5	60.4	43	C				missing
48	108.9	Pien	25	30	x	dd	dead,down,decayed	x	x	
49	108.7	Abco	4.2	6.6	15	U	under a fallen log	x	x	broken in too many pieces
50	118.8	Psme	63.1	78.2	cores	C	A-90,B-121	1786	1771	
51	118.5	Psme	44.9	56.6	55	C				missing
52	118.8	Psme	36.8	48.4	cores	C	A-51,B109	1779	1770	
53	119.5	Psme	21.9	29.4	16	dS	dead	x	x	surgy, no bark
54	124.5	Pien	6.7	9.5	39	U		1876	1871	
55	126.3	Pien	25.6	33.5	97	S		1858	1858	
56	128.0	Pien	69.7	88.1	cores	D	A-102,B-144	1797	1795	
57	133.8	Abco		50	x		rotten	x	x	
59	134.5	Psme	62.1	87.5	159	C		1760	1752	
60	136.5	Pien	73.2	91.9	x	dD	snag,rotten,no core	x	x	
70	137.8	Psme	25	15	x	dd	down	x	x	
71	140.2	?	30	20	x	dd	down	x	x	
72	144.6	Abco	12.7	15.6	19	U		1890	1882	
73	144.7	Psme	69.7	84.5	117	D				missing

APPENDIX A

BON: Canada Bonito Tree Transect, Jemez Mtn., Aug., 1996										
Tree no.	**posn at Meter**	**Sp.**	**dbh cm**	**rch cm**	**core h cm**	**cover class**	**Field Comments**	**inner ring**	**est pith**	**Lab Comments**
74	146.4	Psme	30.8	51.1	x	dd	rotten no core	x	x	
75	152.9	Psme	59.8	79.1	x	dd	rotten	x	x	
76	148.9	Pien	16.9	18.1	x	dd	rotten	x	x	
77	155.2	Abco		80	x	dd	rotten	x	x	
78	153.4	Pien	24.2	36.4	cores	S	A-28,B-33	1886	1871	
79	154.8	Psme	75.6	89.9	cores	C	A-66,B-111	1747	1734	
80	160.0	Pien	45.1	55.4	48	C		1878	1869	
81	164.0	Abla	13.3	16	22	U		1915	1911	
82	165.3	Abco		30	x	dd	rotten root crown, mossy	x	x	
83	166.6	Psme	35.3	50.4	26	S		1749	1741	
84	167.3	Psme	66.1	74.8	55	C		1756	1745	
85	169.4	Psme	25	35	x	dd	rotten log	x	x	
86	170.6	Psme?	25	35	x	dd		x	x	
87	171.3	Pied	6.7	8.9	13	U		1937	1937	
88	171.3	Pied	6.9	8.7	28	U		1957	1945	
89	171.9	Pied	5.1	6.4	15	U		1934	1934	
90	174.3	Psme	70.9	82.6	80	D		1778	1771	
91	176.9	Pied	34.2	41.8	117	S		1916	1902	
92	185.0	Abla	30.5	37	50	S		1869	1860	
93	191.0	Acgl	9.2	10.6	20	U		x	x	no bark; erratic growth
94	191.0	Acgl	8	8.6	17	U			x	no curvature
95	191.0	Acgl	9.3	11.1	28	U		x	x	no bark; erratic growth
96	191.0	Acgl	9.4	10.1	27	U			x	no curvature
97	191.0	Acgl	11.3	12.7	34	U		1927	1910	
98	191.0	Acgl	9.4	10	16	U		1877	1874	
99	191.0	Acgl	9.9	11.5	20	U		1903	1903	ring count
100	191.0	Acgl	6.2	6.9	18	dU	dead	1921	1912	
101	191.0	Acgl	7	8.4	cores	U	A-22,B-28	x	x	no bark; erratic growth
102	191.0	Acgl	8.3	9.7	19	U		1902	1896	ring count
103	193.0	Pien	42.4	56.9	75	C		1918	1905	
104	196.0	Pien	5	8.6	cores	U	A-16,B-41	1926	1919	
105	197.0	Psme	52	70	x	dd	log	x	x	

APPENDIX A

BON: Canada Bonito Tree Transect, Jemez Mtn., Aug., 1996										
Tree no.	posn at Meter	Sp.	dbh cm	rch cm	core h cm	cover class	Field Comments	inner ring	est pith	Lab Comments
106	205.5	Psme	74.8	92.7	117	C		1753	1749	
107	208.0	Psme	x	~60	x	dd	rotten root	x	x	
108	210.2	Acgl	14.1	15	29	U		1885	1882	ring count
109	210.2	Acgl	9.8	13.6	26	U		1906	1900	
110	210.2	Acgl	16.1	17.7	32	U		1873	1864	
111	212.3	Abco	x	~40	x	dd	rotten log	x	x	
112	211.5	Psme	61.2	70.5	84	C		1734	1734	
113	221.8	Potr	46.1	51.4	91	dC	dead	1782	1751	
114	228.0	Psme	11.9	16.4	32	U		1894	1887	
115	233.8	Psme	51	61.5	75	C		1755	1743	
116	234.2	Pien	6.8	10	22	U		1900	1800	far from pith & very tight
117	235.4	Psme	37.3	52	49	S		1749	1744	
118	240.6	Potr	43.8	53.9	52	C		1732	1917	
119	247.7	Pien	40.4	50.5	60	S		1868	1851	
120	250.5	Psme	16.8	21.8	68	U		1762	1755	
121	252.5	Psme	66	86.9	120	C		1783	1769	
122	253.3	Abla	35.7	44.9	40	S		1855	x	no curvature
123	254.9	Psme	30	41.4	x	dd	rotten	x	x	
124	255.8	Abla	33.2	36.3	x	S	rotten	x	x	
125	257.1	Pien	18.2	24.7	32	U		1868	1858	
126	266.3	Abla	4.3	6.8	cores	U	A-30,B-32	x	x	complacent, too few rings
127	270.0	Pien	38.3	46.4	70	U		1861	1852	
128	269.6	Pien	37.9	46.7	121	C		1846	1832	
129	274.3	Psme	52	64	x	dd	down, rotten	x	x	
130	277.9	Abla	7.8	9.1	32	dd	under	x	x	many small pieces; no bark
131	282.4	Potr	37.7	46.8	85	dC	dead		x	no curvature
132	280.4	Abla	57.9	68.2	104	C		1884	x	no curvature
133	290.0	Psme	83.8	98.1	cores	D	A-75,B-101	1780	1766	

APPENDIX A

CAMU-S: Camp May Upper ,Seedling /Sapling Transect, Jemez Mtn., Aug. 1996						
plant no.	pos'n (at Meter)	Sp.	height (cm)	Field Comments	Pith	Lab Comments
1	25.80	Pien	60		1943	
2	33.98	Pien	148		1927	
3	34.88	Pien	120			missing
4	35.42	Pien	128		1930	
5	35.70	Pien	68		1940	
6	39.60	Pien	176	dead, down	1915	death=1992
7	58.40	Pien	170	dead,down,broken top	1933	death=1986
8	58.95	Pien	187		1937	
9	60.25	Pien	77		1929	
10	66.50	Pien	105			missing
11	72.80	Pien	132	dead,down,broken	1900	
12	80.20	Pien	250		1985	
13	67.29	Pien	25	seedling	1966	
14	67.15	Pien	15	seedling	1935	
15	59.18	Pien	375		1948	
16	36.40	Pien	54		1980	
17	103.30	Abco	32	all from	1985	
18	103.28	Abco	30	same root	1978	
19	103.30	Abco	26	17,18,19,20 +21	1979	
20	103.29	Abco	25		1971	very tight; lots o' r'xn wood
21	103.30	Abco	22			missing
22	103.30	Abco	70	17-21 cluster	1940	
23	113.60	Pien	60		1934	
24	118.70	Pien	89			missing
25	127.79	Potr	20		1990	too small
26	132.49	Potr	12		1948	
27	139.99	Pien	54	#27, 28 from same root		missing
28	139.98	Pien	58		1930	
29	164.40	Pien	68			missing
30	177.72	Pien	57		1956	
31	177.72	Pien	42			missing
32	178.40	Unkn	188	dead,down	1955	
33	162.40	Pien	76			missing
34	162.10	Acgl	50		1991	
35	160.80	Potr	19			missing
36	135.70	Acgl	23		x	ring bnd very light
37	135.40	Acgl	20		1978	ring bnd very light
38	134.50	Acgl	25		1988	light ring bnd
39	134.40	Acgl	16		1991	best guess
40	136.45	Acgl	20			missing
41	137.08	Acgl	19		1970	x-s too small
42	137.10	Acgl	13		1977	ring bnd very faint
43	124.10	Pien	17		x	lots o' rx'n wood
44	298.90	Potr	19	new shoot, not collected	x	

APPENDIX A

CAMU-S: Camp May Upper ,Seedling /Sapling Transect, Jemez Mtn., Aug. 1996						
plant	**pos'n**		**height**			
no.	**(at Meter)**	**Sp.**	**(cm)**	**Field Comments**	**Pith**	**Lab Comments**
45	285.50	Potr	22			missing
46	283.50	Potr	63		x	missing
47	279.10	Potr	16	new shoot, not collected	x	
48	278.00	Potr	10	new shoot, not collected	x	
49	266.00	Potr	28		x	too small
50	261.70	Potr	25	new shoot, not collected	x	

APPENDIX A

CAML-S: Camp May Lower Transect, Seedlings and Saplings, Jemez Mtn. , Aug., 1996						
plant no.	pos'n (at Meter)	Sp.	height (cm)	Field Comments	Pith	Lab Comments
1	0.4	Abco	35		1975	
2	0.3	Pien	188		1965	
3	0.3	Pien	75		1973	
4	0.1	Pien	88		1961	
5	0.5	Pien	180		1961	
6	0.8	Pien	173		1936	very tight in 1950's & 60's
7	0.8	Pien	50		1941	
8	0.9	Pien	118			missing
9	1.0	Pien	160		1948	
10	0.5	Pien	99		1963	
11	3.1	Pien	60	dead top	1962	
12	3.6	Psme	153		1930	
13	7.9	Abco	54		1978	
14	9.2	Acgl	50			missing
15	9.6	Pien	60			missing
16	9.7	Acgl	25			missing
17	9.3	Acgl	26			missing
18	9.8	Acgl	35			missing
19	9.7	Abco	27		1978	
20	10.2	Abco	67			missing
21	10.2	Pien	165	2 main stems	1966	
22	11.2	Abco	77		1977	
23	15.1	Pien	58		1943	
24	16.8	Abco	30		1981	very tight near pith
25	17.2	Pien	50		1955	rx'n wood
26	17.7	Pien	65		1957	
27	17.7	Pien	100		1962	
28	18.0	Abco	44			missing
29	18.4	Pien	45		1952	
30	18.9	Pien	45		1956	
31	20.0	Abco	36		1976	
32	17.8-18.7	Acgl	50	3 saplings		missing
32	17.8-18.7	Acgl	50			missing
32	17.8-18.7	Acgl	50			missing
33	17.0-19.8	Acgl	25	3 saplings		missing
33	17.0-19.8	Acgl	25			missing
33	17.0-19.8	Acgl	25			missing
34	22.0	Pien	88		1934	
35	23.3	Pien	110		1970	
36	23.5	Pien	29		1977	
37	24.7	Abco	132			missing
38	29.9	Pien	72		1968	
39	30.2	Pien	106		1953	
40	41.4	Pien	51			missing

APPENDIX A

CAML-S: Camp May Lower Transect, Seedlings and Saplings, Jemez Mtn. , Aug., 1996						
plant	pos'n		height			
no.	(at Meter)	Sp.	(cm)	Field Comments	Pith	Lab Comments
41	43.3	Pien	44		1968	
42	44.0	Pien	64		1962	
43	47.1	Pien	28		1953	difficult to see ring boundaries; rx'n wood
44	47.1	Acgl	32			missing
45	47.3	Acgl	25			missing
46	52.2-54.9	Acgl	20	6 saplings		missing
46	52.2-54.9	Acgl	20			missing
46	52.2-54.9	Acgl	20			missing
46	52.2-54.9	Acgl	20			missing
46	52.2-54.9	Acgl	20			missing
46	52.2-54.9	Acgl	20			missing
47	59.9	Potr	43		1995	no ring boundaries visible
48	64.3	Pien	19		1979	
49	65.1	Abco	19		1978	
50	66.2-67.2	Acgl	30	7 saplings		missing
50	66.2-67.2	Acgl	30			missing
50	66.2-67.2	Acgl	30			missing
50	66.2-67.2	Acgl	30			missing
50	66.2-67.2	Acgl	30			missing
50	66.2-67.2	Acgl	30			missing
50	66.2-67.2	Acgl	30			missing
51	76.1	Unkn.	70	dead	x	
52	82.0	Pien	25		1966	very tight
53	82.1	Pien	17			missing
54	82.5	Pien	30		1960	
55	83.3	Abco	170			missing
56	82.8	Pien	113		1909	~1939 scar
57	83.1	Pien	24		1960	very tight; lots of rx'n wood
58	83.1	Pien	24		1965	very tight; lots of rx'n wood
59	84.1	Pien	235		1886	very tight after 1946
60	86.3	Pien	150		1951	
61	88.2	Pien	66		1938	
62	90.8	Abco	45		1961	very tight near pith
63	90.7	Pien	160		1921	
64	91.7	Pien	97		1954	
65	91.8	Abco	90		1937	suppressed and rx'n wood
66	92.0	Pien	90			missing
67	92.9	Pien	20		1964	very tight
68	96.7	Pien	14		1984	difficult to see ring boundaries
69	131.1	Abco	60		1948	very, very tight in 1960's and 70's
70	131.4	Abco	36			missing
71	134.2	Pien	110		1932	
72	135.1	Pien	113		1941	
73	135.6	Pien	163		1924	

APPENDIX A

CAML-S: Camp May Lower Transect, Seedlings and Saplings, Jemez Mtn. , Aug., 1996						
plant	pos'n		height			
no.	(at Meter)	Sp.	(cm)	Field Comments	Pith	Lab Comments
74	136.3	Pien	56			missing
75	136.4	Unkn.	58	dead	x	
76	136.6	Pien	50		1938	
77	136.7	Unkn.	65	dead	x	
78	136.5	Unkn.	40	dead	x	
79	147.4	Pien	130		1925	
80	150.0	Unkn.	300	dead	1884	very suppressed >1930
81	150.0	Pien	58		1956	very tight
82	150.0	Pien	68		1941	
83	150-151	Acgl	35	6 saplings		missing
83	150-151	Acgl	35			missing
83	150-151	Acgl	35			missing
83	150-151	Acgl	35			missing
83	150-151	Acgl	35			missing
83	150-151	Acgl	35			missing
84	151.1	Unkn.	200	dead snag, broken top	x	unreliable dating: very suppressed
85	151.5	Psme	300		1883	very tight >1925
86	156.7	Pien	35			missing
87	157.6	Pien	46			missing
88	161.9	Pien	175		1945	
89	162.2	Unkn.	145	dead	x	43 rings; lots of rx'n wood
90	162.8	Pien	140		1964	
91	162.9	Pien	250		1955	
92	163.2	Psme	145		1959	
93	164.9	Pien	200		1946	~1964 scar
94	165.1	Pien	160		1952	~1963 scar
95	165.1	Pien	90		1957	
96	168.2	Psme	100	scars		missing
97	169.4	Unkn.	180	dead, has firescars	x	suppressions
98	171.7	Pien	137		1946	
99	173.5	Psme	100		1935	
100	173.7	Acgl	20		1988	difficult to see ring boundaries; rx'n wood
101	179.1	Pien	130			missing
102	181.3	Unkn.	30	dead	x	
103	183.1	Pien	58		1946	~1970 scar
104	184.0	Pien	48		1981	
105	187.2	Potr	50		1989	
106	188.6	Pien	30		1984	
107	192.5	Abco	65			missing
108	193.5	Pien	136		1957	~1968 scar
109	199.0	Pien	150		1943	
110	198.5	Pien	225		1943	
111	198.5	Pien	64			missing
112	198.5	Pien	140			missing

APPENDIX A

CAML-S: Camp May Lower Transect, Seedlings and Saplings, Jemez Mtn. , Aug., 1996						
plant	pos'n		height			
no.	(at Meter)	Sp.	(cm)	Field Comments	Pith	Lab Comments
113	199.0	Pien	60		1965	
114	203.9	Unkn.	76			missing
115	203.9	Unkn.	130			missing
116	204.6	Unkn.	130		1936	other 116 inner=1969
117	205.3	Unkn.	100			missing
118	207.0	Unkn.	85		1943	
119	207.1	Unkn.	53			missing
120	208.0	Unkn.	200		1946	
121	208.7	Pien	75		1958	~1967 scar
122	208.9	Unkn.	75			missing
123	208.5	Unkn.	100		1965	
124	210.7	Unkn.	225		1957	
125	211.7	Unkn.	240		1962	
126	211.1	Unkn.	185			missing
127	211.2	Unkn.	90			missing
128	213.2	Unkn.	220			missing
129	213.2	Psme	199		1938	
130	213.5	Unkn.	125		1966	
131	214.3	Pien	95		1957	
132	214.3	Pien	133		1954	
133	214.6	Pien	300		1938	1989 Do scar; early 1960's tight
134	214.7	Unkn.	73	broken top	1965	
135	215.0	Pien	225		1946	
136	215.1	Pien	155		1949	
137	216.9	Pien	200		1960	very tight on outside
138	217.4	Unkn.	200		1945	PSME?
139	217.7	Pien	300		1934	
140	218.2	Pien	137		1947	
141	218.1	Pien	305		1939	~1948 Do scar
142	218.4	Psme	188		1942	
143	217.5	Unkn.	300		1937	
144	217.8	Unkn.	220		1951	
145	218.0	Unkn.	115			missing
146	218.5	Pien	50		1972	
147	218.5	Unkn.	35		1981	
148	218.5	pien	185		1949	
149	219.1	Pien	78			missing
150	221.1	Psme?	108		1955	
151	221.1	Pien	78		1955	
152	222.0	Pien	105		1957	
500	100	Potr	400	dead	x	
501	99.7	Pien	26	dead	1973	
502	97.5	Pien	22		1981	very tight near pith
503	91	Potr	38		1995	no ring boundaries visible

APPENDIX A

CAML-S: Camp May Lower Transect, Seedlings and Saplings, Jemez Mtn. , Aug., 1996						
plant no.	pos'n (at Meter)	Sp.	height (cm)	Field Comments	Pith	Lab Comments
504	76.6	Pien	46		1984	
505	75.4	Pien	115		1943	
506	74.9	Pien	130		1948	
507	72.4	Pien	170		1937	lots of rx'n wood
508	72.4	Pien	95			missing
509	71.6	Pien	70		1961	
106	71.9	Pien	130			missing
510	71.5	Pien	131		1935	
511	71.3	Pien	92			missing
512	71	Pien	78			missing
513	71	Pien	116			missing
514	63.8	Pien	79	dead	x	suppression; rx'n wood
515	63.4	Pien	130		1953	
516	62.7	Pien	58		~1950	pith rotted out
517	62.1	Pien	155		1948	
518	61.9	Pien	157		1948	
519	61	Pien	278		1963	
520	60.6	Pien	370		1927	
521	59.6	Pien	172		1950	~1970 scar
522	59.5	Pien	98		1956	
523	59.2	Pien	212			missing
524	58.7	Pien	355		1950	
525	59	Pien	48		1981	difficult to see ring boundaries
526	58.1	Pien	188	dead	x	
527	57.9	Pien	124	dead	1953	
528	57.8	Pien	171		1942	
529	57.7	Pien	177		1943	
530	57.8	Pien	49	dead/rotten	x	
531	55.15	Pien	83		1943	
532	54.7	Pien	36	dead	x	
533	54.2	Pien	246			missing
534	51.8	Pien	83		1946	
535	44.8	Acgl	100			missing
536	39.8	Acgl	27			missing
537	38.6	Acgl	80		1978	
538	38.4	Acgl	38			missing
539	30.8	Pien	208		1957	

APPENDIX A

BON, Canada Bonito Seedling/Sapling Transect, Jemez Mtn., Aug.1996						
plant	**pos'n**		**height**			
no.	**(at Meter)**	**Sp.**	**(cm)**	**Field Comments**	**Pith**	**Lab Comments**
id #'s: 1-15 were Ninebark misidentified as Maple						
16	33.28	Psme	125		1934	
17	47.5	Psme	197			missing
18	37.8	Psme	89		1938	tight thru-out
19	38.8	Potr	65	dead	x	
20	40.8	Potr	54		1927	very open inside; very tight > 1980
21	40.9	Pien	120	dead	1930	death date 1992; very tight thru-out
22	41.3	Pien	69		1934	very tight thru-out
23	41.8	Psme	284		1924	suppressed after 1980
24	50.8	Pien	64		1963	inj @ 1979
25	54.9	Potr	34	this years growth	1996	
26	63.9	Abco	251		1882	scar @1985; very tight <1985
27	75.1	Psme	16			missing
28	89.6	Pien	235	dead	1932	dd 1995; inj @1983Do
29	102.8	Psme	22			missing
30	107.9	Pien	14			missing
31	117.5	Pien	98		1932	inj @1938; lots o' rx'n wood
32	139.6	Pien	129		1950	very tight < 1960
33	159.5	Abco	110		1933	2 piths
34	176.6	Pien	116		1955	poor ring bound.; rx'n wood < 1960
35	186	abco	24		1975	
36	215.9	Pien	40		1974	
37	239.1	Abla	94		1961	regular growth thru-out
38	240.1	Abla	51		1963	inj @1973Do
39	246.1	Abla	97		1936	<1940 open; tight during 1950s
40	248.3	Abla	106	dead	x	
41	259.4	Pien	51		1971	
42	261.6	Abla	17		1974	
43	263.4	Abla	61		1966	
44	266	Abla	139		1961	fairly open
45	268.8	Abla	136		1963	good
46	269.3	Abla	25		1979	lots o' rx'n wood
47	270.7	Abla	11		1979	
48	272.2	Abla	25		1973	
49	272.9	Psme	28		1982	
50	273.1	Abla	30		1982	
51	273.5	Abla	9		1985	
52	273.6	Abla	21		1966	
53	273.7	Abla	10		1975	
54	274.3	Abla	92		1970	rx'n wood
55	274.4	Abla	20		1981	
56	274.4	Abla	22			missing
57	274.4	Psme	27		1978	
58	275	Abla	19		1978	
59	275.2	Pien	30		1979	

APPENDIX A

BON, Canada Bonito Seedling/Sapling Transect, Jemez Mtn., Aug.1996						
plant no.	pos'n (at Meter)	Sp.	height (cm)	Field Comments	Pith	Lab Comments
60	275.5	Abla	16		1977	
61	275.9	Abla	34		1972	
62	276.2	Abla	147		1944	2 piths
63	278.2	Abla	15		1976	
64	278.5	Abla	26		1974	
65	278.8	Abla	21		1979	
66	279	Abla	25		1970	
67	279.04	Pien	24		1979	
68	280	Abla	33		1978	
69	280	Pien	17		1987	
70	280	Abla	24		1976	
80	280	Abla	16		1980	
81	280.6	Abla	14		1985	
82	280.7	Pien	42		1973	
83	281.2	Abla	35		1971	
84	281.2	Abla	30		1973	
85	281.4	Abla	13		1980	
86	281.7	Abla	20		1975	
87	281.7	Abla	29		1989	
88	281.9	Pien	27		1981	
89	281.9	Acgl	80			missing
90	281.9	Abla	21		1979	
91	282.2	Abla	12		1983	
92	267.9	Abla	225		1936	tight inside < 1960
93	282.3	Pien	69		1936	
94	282.3	Pien	36		1979	
95	282.3	Abla	29		1976	
96	282.7	Abla	25		1979	
97	282.8	Pien	44		1976	high rx'n wood
98	283.2	Pien	66			missing
99	283.1	Abla	24		1982	
100	283.6	Abla	179		1938	very tight < 1960; inj @ 1962Do
101	283.1	Abla	7		1979	
102	283.8	Abla	28		1983	
103	285.4	Abla	39		1962	
104	285.5	Abla	140		1954	
105	286.5	Abco	50		1970	

APPENDIX A

BACA fence line aspen stand cored in summer 1996			
id	**est pith**	**inner ring**	**comments**
BACA fence line aspen stand cored in summer 1996			
id	**est pith**	**inner ring**	**comments**
1	1863	1876	
2	1879	1885	
3	x	x	no curve
4	1861	1862	
5			missing
6	1856	1870	
7	1863	1869	
8	1870	1871	
9	1867	1873	
10	1860	1869	
11	1859	1863	
12	1863	1868	
13	1861	1864	

APPENDIX A

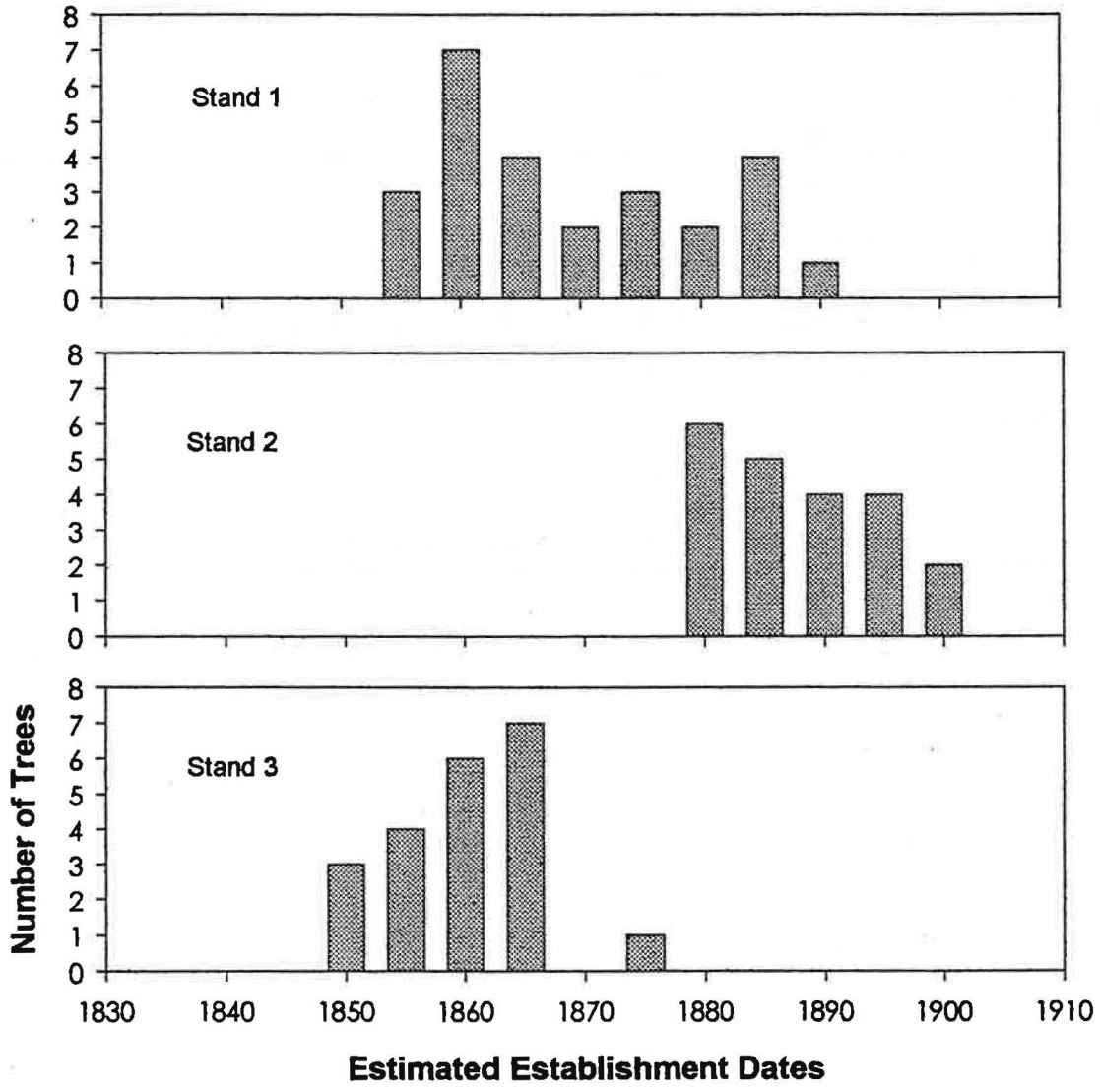
CMN aspen stands cored in fall 1995					
	id	est pith	inner	outer	dbh
CMN aspen stands cored in fall 1995					
	id	est pith	inner	outer	dbh
Site 1	100	-	-	1995	
	101	1858	1863	1995	34.5
	102	1863	1870	1995	31.5
	103	1890	1897	1995	30.6
	104	-	-	1995	35.7
	105	-	-	1995	32.3
	106	1860	1872	1995	35.6
	107	1883	1892	1990	27.2
	109	1859	1878	1995	32.9
	110	1881	1885	1995	31
	111	1872	1894	1995	32.2
	112	1883	1893	1995	30.6
	113	1857	1862	1995	30.5
	114	1858	1863	1995	27.5
	114	1875	1889	1995	33.3
	115	1862	1886	1995	28
	116	1865	1876	1995	38.9
	117	1858	1865	1995	25.9
	118	1880	1880	1995	28.3
	120	18885	1893	1995	29.5
	121	1852	1861	1995	28.9
	122	1855	1860	1995	28.7
	123	1859	1862	1995	27
	124	1876	1882	1995	27.6
	150	-	-	1995	3704
	151	1866	1871	1995	37.7
	152	1875	1883	1995	33.1
	153a	1854	1869	1995	
	153b	-	-	1995	
	153c	1879	1884	1995	40.2
	154	1865	1886	1995	37.8
	155	1867	1880	1995	39.2
Site 2	200	1876	1894	1995	35.3
	201	1898	1917	1995	29
	202	1889	1900	1995	30
	203a	1883	1897	1995	
	203b	1882	1898	1995	37.8
	204	1880	1880	1995	37.1
	205	-	-	1995	30
	206	1895	1907	1995	34
	207	1885	1901	1995	43.2
	208	1880	1889	1995	26.8

APPENDIX A

CMN aspen stands cored in fall 1995					
	id	est pith	inner	outer	dbh
	209	-	-	1995	39.3
	210a	1892	1898	1995	
	210b	1898	1907	1995	
	211	1880	1889	1995	42.9
	212	1887	1899	1995	40.5
	213	1879	1890	1995	34.1
	214	1890	1900	1995	40.5
	215	1894	1906	1995	42.9
	217	1892	1900	1995	
	218	1883	1888	1995	29.4
	219	1878	1880	1995	39.2
	220	1887	1890	1995	32.8
	221	-	-	1995	42.8
	222	1885	1894	1995	40.5
	223	1898	1908	1995	
	224	1882	1888	1995	28.1
Site 3	300	-	-	1995	35.2
	301	1865	1873	1995	35.6
	302	1861	1869	1995	38.6
	303	1851	1854	1995	30.1
	305	1848	1850	1995	35.4
	306	1850	1858	1995	27.1
	307	1858	1862	1995	31.4
	308	1859	1867	1995	25.5
	309	1874	1886	1995	29.4
	310	1864	1874	1995	34.7
	312	1851	1860	1995	33
	313b	1861	1865	1995	37.3
	314	1864	1872	1995	35.2
	316	1859	1859	1995	36.3
	317	1850	1852	1995	33.3
	318	1852	1864	1995	38.7
	319	1859	1866	1995	39.2
	320	1860	1863	1995	31.6
	321	1862	1877	1995	30.2
	323	1860	1872	1995	28
	324	1862	1870	1995	37.7
	325	1854	1859	1995	30

APPENDIX A

Aspen Stands near and at Camp May North fire history site.



APPENDIX A – Individual Summaries for Camp May/Cañada Bonito aspen cross-sections
file: anh.wpd

"Aspen Natural History"

Cañada Bonito Aspen X-Sections

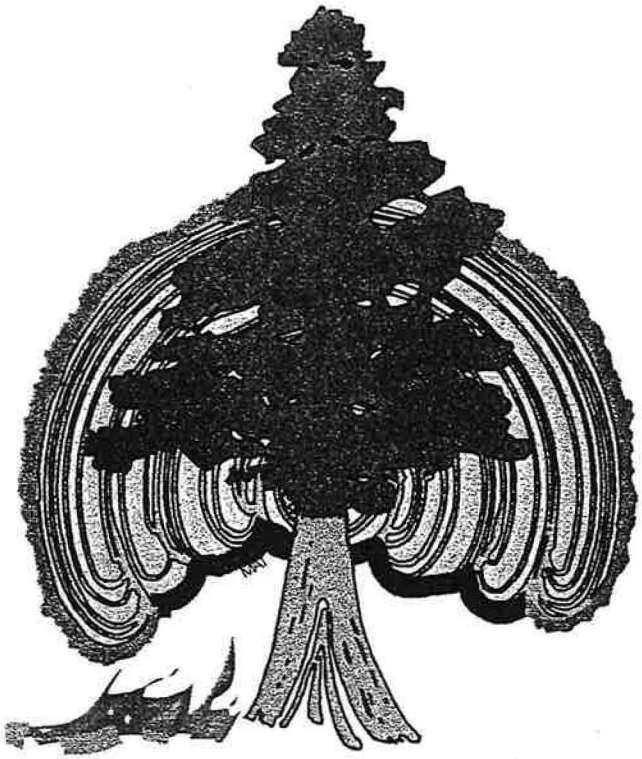
ID	Pith Date	Bark Date	Age (yrs)	Comments
CAN46	±1719	±1991	~272	
CAN47	?	?	~221	most decayed of all aspen x-sections
CAN48	±1718	±1974	~256	
CAN49	±1714	±1992	~278	
CAN50	±1721	±1985	~264	

Camp May North Aspen X-sections

ID	Pith Date	Bark Date	Age (yrs)	Comments
CMN54	±1854	±1974	~120	
CMN55	±1818	±1971	~153	
CMN56	±1812	±1977	~165	
CMN57	±1853	±1980	~127	fire scar at 1847

APPENDIX B

Expanded Fire Regime Studies in the Jemez Mountains, New Mexico:
A Preliminary Report on the Fire history of an Historically
Grazed Site - Cerro Balitas



First Progress Report
Spring 1996

To:
Craig D. Allen
National Biological Service/USGS
Bandelier National Monument

From:
Kiyomi A. Morino
Christopher H. Baisan
Thomas W. Swetnam
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The University of Arizona
Tucson Arizona, 85721

Progress Report #1: *Jemez Mountains Extended Fire Regime Study*

INTRODUCTION

Fire is an ecological process that has played an important role in regulating ecosystem dynamics and influencing species evolution. It is not surprising that land managers, whose interests include guiding ecosystem change, seek a better understanding of this phenomenon. During recent decades, land managers have focused increasingly on understanding how to re-introduce and apply fire to ecosystems. The implications of using fire as a management tool can be dramatic from both ecologic and societal perspectives and therefore requires a solid knowledge base.

Fire histories provide a starting point for understanding fire and subsequently developing fire management programs. Spatial and temporal patterns of past fire occurrence can be reconstructed using dendrochronological techniques (Swetnam and Baisan *in press*). Information about historical fire frequency, extent, seasonality, and severity, can be used as a template by managers to construct fire management strategies (Allen 1994). Also, examining past fire occurrence patterns can provide unique insights about potential environmental controls over fire regimes for a particular site.

The ponderosa pine forests of the Jemez Mountains, in north-central New Mexico, are relatively well described in terms of historic fire regimes (Allen 1989; Touchan *et al.* 1995). Previous fire history studies have yielded information that serves as a solid knowledge base. However, these studies have also been a source of new questions and hypotheses about past variations in fire regimes, the environmental controls of these fire regimes, and their effects on ecosystem structures. To this end, an expanded fire regime study of the Jemez Mountains was proposed (Swetnam and Allen 1995).

One area of interest in the proposed in the new study was the association of land-use patterns and fire regime responses. Among land-use patterns, grazing was targeted because it appeared to have an effect on fire regimes in previous fire history studies (Touchan *et al.* 1995; Allen 1989). Generally in ponderosa pine forests of the Southwest, grazing is thought to have a notable impact on fire regimes because grasses are a primary fuel regulating fire spread. A grazing effect is assumed when an abrupt decline in fire frequency and intensive livestock grazing co-occur. In the proposed new study, it was hypothesized that, "pre-settlement fire regimes were interrupted within Hispanic land grant areas, or traditional Native American lands, where early livestock grazing took place" (Swetnam and Allen 1995). The purpose of this paper is to present the preliminary analysis of data collected (in Fall 1995) to test this hypothesis.

SITE DESCRIPTION

The Cerro Balitas site (BAL) is located in the southern portion of the Jemez Mountains. It is situated on a northwest-southeast trending corridor of relatively gentle topography sandwiched between two topographically extreme features: to the northeast is Sanchez Canyon and to the southwest is Cochiti Canyon. Cerro Balitas pertains to the Santa Fe National Forest, established in 1905. The fire history site lies adjacent to the Dome Wilderness, established *ca.* 1976, and approximately three kilometers north of the Cañada de Cochiti land grant, established in 1740.

It was believed, based on its topographical and geographical positions, that the Cerro Balitas site may be located on or near a historical route used in the seasonal movement of livestock,

i.e., to the higher elevations during the summer months and to the lower elevations during the winter months. The use of this area for livestock at least in recent history was confirmed by an old Forest Service sign indicating "Center Stock Driveway" (Figure 1).

Presently, the vegetation in this area is ponderosa pine forest comprised of apparently even-aged, widely-spaced trees. While ponderosa pine predominates the overstory, the understory includes a few widely dispersed patches of ponderosa pine and Douglas-fir regeneration (Figure 2). Ground cover is dominated by needle cast (up to 10 cm deep in some portions of the site); grass cover was observed to be very low.

METHODS

Two groups of trees were collected from predominantly northeast-facing slopes between an elevation of 2160 and 2260 m (Figure 3). Standard fire history collection methods were used to collect specimens from this site (Arno and Sneck 1977; Swetnam and Baisan *in press*). A chainsaw was used to collect whole or partial cross sections from both live and dead trees. Full cross sections were taken from dead trees and partial cross-sections were taken from live trees. Samples were thoroughly labelled and securely wrapped in the field to reduce the probability of breakage and lost pieces during transport.

In the laboratory all samples were re-assembled, cut to manageable sizes, and sanded. Progressively finer grits were used (down to 320 grit) so that the cellular structure on a transverse section could be discerned using a dissecting scope (20-30x magnification). Each cross-section was examined and crossdated. The dates of the 1) inner-most ring, 2) the outer-most ring, 3) fire scars, and 4) unspecified injuries were then

recorded.

For fire scars and unspecified injuries the position of the scar within the tree-ring was also described (Dieterich and Swetnam 1984; Baisan and Swetnam 1990). Scar position illustrates the timing of fires with respect to the growing season of the tree, enabling us to infer the approximate timing of fires at an intra-annual scale. Scar position was described based on the location of the scar relative to ring morphology. Our current knowledge about tree-growth phenology in the Southwest (Fritts *et al.* 1965; Fritts 1976; Baisan and Swetnam 1994) allows us to identify windows of time (multi-month periods) when the fire event most likely occurred. The following describes how scar position is evaluated and the probable time period represented.

- *Dormant (D)*: Scar is positioned between the latewood of the previous year and the earlywood of the current year. Dormant-position scars represent fires occurring during the dormant season of the tree, *i.e.*, from fall to spring, which spans two calendar years. In the Southwest, fires tend to be more common in the spring compared to the fall so these fire scars are assumed to be spring fires and are thus dated to the ring following the scar (Baisan and Swetnam 1990). It is most likely that these fires occur before May.
- *Early Earlywood (EE)*: Scar is positioned in the first one-third of the earlywood. It is most likely that these fires occur between early May and mid-June.
- *Middle Earlywood (ME)*: Scar is positioned in the second third of the earlywood. It is most likely that these fires occurred between early June and late July.
- *Late Earlywood (LE)*: Scar is positioned in the last third of the earlywood. It is most likely that these fires occurred

between mid-July and late August.

- *Latewood (La)*: Scar is positioned in the latewood. It is most likely that these fires occurred between early August and September.
- *Unknown (Un)*: Scar position is undeterminable because of growth suppression and/or scar erosion.

RESULTS and DISCUSSION

This preliminary analysis is based on the examination of 32 out of a total of 35 trees. The inner-most date of the material collected is 1494. The first fire recorded occurred in 1714. A total of 235 fire scars and 6 unspecified injuries were dated comprising 36 different fire years. The Mean Fire Interval (MFI) for all fires recorded by more than one tree for the period 1695-1995 was 13.6 years (Table 1).

Two long fire-free intervals ($p<.05$) were identified in the Cerro Balitas fire history (Table 2). The first occurred between 1773 and 1801; however, due to low sample size of recorder trees[1] it is not possible to conclude whether this is a real pattern or an artifact of sample depth. The second gap occurred between 1883 and 1918. This gap in fire occurrence was likely a real phenomenon as this portion of the fire history is represented by several samples. A third gap which was not identified in the analysis but that undeniably exists occurred between 1918 and 1995.

Closer examination of the fire-free interval at the end of the 1700s shows spatial differences. While the beginning of the

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[1]A tree becomes a "recorder tree" after surviving its first fire. The absence of bark and the presence of resin at the point of injury make the tree more suscetible to scarring by subsequent fires.

interval is 1773, the end of the interval depends on the sub-site. In Group A, the interval ends in 1814, while in Group B, the interval ends in 1801, yielding a 41 and 28 year intervals for each group, respectively (Figure 4).

The late 1700s, in addition to potentially being a period of low fire occurrence, is also characterized by other features. First, establishment dates of many of the sampled trees, including pith dates and estimated pith dates, appear to be clustered in between 1740 and 1780 (Figure 4). Second, trees that established in the late 1700s have ring-widths around the pith that tend to be relatively wide, suggesting conditions were highly favorable for tree growth during this period. The combination of clustered establishment dates and wide ring-widths near the pith suggests the occurrence of some event and/or some set of conditions that created ideal conditions for the establishment and growth of a new stand.

During the 1800s fires occurred every 10 years (Table 1), exhibiting a high synchroneity (Figure 4). Fires were recorded consistently by the majority of trees sampled with the percentage of trees recording any given event ranging from 54% to 93%. The occurrence of the 1801 fire only in Group B and the high synchroneity of fire in both groups after the 1801 fire suggests a change in fire spread potential within the site. Possible factors that may have influenced fire spread include grazing, fire and climate. For example, increased fire spread potentials (*i.e.*, greater tendencies for widespread fires) may have resulted from decreases in grazing intensity and/or fire occurrence, and/or changes in climate affecting fuel accumulation rates.

Scar positions were assigned to 94.9% of all scars dated. The majority of these scars (78.4%) were identified either as Dormant season, Early Earlywood, or Middle Earlywood scars,

suggesting that historically most fires tended to occur between early May and late July. Each fire is represented by a range of scar positions (Figure 5); however, generally one dominant scar position characterizes each event. Moreover, the range of scar positions that characterize each fire year tends not to include both Dormant and Latewood position scars. The 1814 fire which includes scars in both Dormant and Latewood positions is an exception. Only one tree (BAL 19) records an 1814 scar in the Latewood position; nonetheless it is still intriguing especially considering that two trees (BAL 15 and 17) sampled only 20 m upslope record the 1814 fire as Dormant and Early earlywood scars. The most parsimonious explanation of this scar distribution is that two separate events occurred; perhaps one early in the growing season on the upper slope and another later in the growing season on the lower slope.

This study provides a unique opportunity to refine our interpretations of scar position data for two reasons. First, the presence of a false ring allows a more detailed description of scar position. False rings are a band of latewood-type cells (*i.e.*, narrow diameter and thick cell walls) that occur within the earlywood and represent a period of reduced growth (Fritts 1976). In the Southwest, false rings are a response to the dry conditions that occur just before the onset of the summer rains (Fritts 1976; Baisan and Swetnam 1992). Because false rings are a response to a particular set of climatic conditions and tend to occur at a particular time of the year, false rings provide a useful benchmark to evaluate the timing of historical fires.

The second reason why our interpretation of scar position data may be improved by this study relates to a verification of the date of the 1918 fire: June 26 (Allen pers. comm.). The dominant scar position of this fire, *i.e.*, Dormant season,

suggests that this fire occurred sometime between early May and early June. This fire was much later than we would predict based on tree growth phenology. One possible explanation is related to the basipetal migration (from shoots to roots) of growth initiation in trees. In suppressed or old trees, or during drought years, growth iniation may proceed down the stem slower than usual; thus, growth at or near the base of the tree (where fire scars occur) may not begin until June (Fritts 1976). The year 1918 is a relatively narrow ring indicating a drought year; therefore it is not surprising that the 1918 fire dates to June 26 even with Dormant-season position scars. Further analyses and interpretation of scar position will aim to incorporate 1) the scar position with respect to the false ring and 2) relative tree-ring width.

Table 1. Descriptive statistics for fire intervals of the Cerro Balitas fire history site.

	Period	
Statistic	***1694-1995***	***1800-1900***
Mean fire Interval (yrs)	13.6	10.3
Median Fire Interval (yrs)	11.0	10.0
Weibull Median fire Interval[1] (yrs)	13.2	10.4
Minimum Fire Interval (yrs)	8.0	8.0
Maximum Fire Interval (yrs)	35.0	14.0
95% Exceedance Interval[2] (yrs)	5.5	6.7
5% Exceedance Interval[3] (yrs)	21.6	13.4
Standard Deviation	7.7	2.3
Coefficient of Variation	0.6	0.2
Skewness	1.86	0.46
Kurtosis	2.14	-1.35

[1] Median interval based on a Weibull distribution fitted to the fire-interval data (Grissino-Mayer 1995).

[2] Interval exceeded by 95% of all other intervals based on the Weibull fitted distribution.

[3] Interval exceeded by 5% of all other intervals based on the Weibull fitted distribution.

Table 2. Fire intervals and associated probabilities based on the fitted Weibull distribution.

Fire Year	Fire Interval		prob>fi
1714	.		.
1725	11		0.665
1737	12		0.590
1748	11		0.665
1757	9		0.798
1773	16		0.290
1801	28	>	0.002
1814	13		0.512
1822	8		0.853
1830	8		0.853
1841	11		0.665
1851	10		0.735
1861	10		0.735
1875	14		0.435
1883	8		0.853
1918	35	>	0.000

> : p < 0.05 level (significantly large interval)
< : p > 0.95 level (significantly small interval)



Figure 1. Forest Service sign advertising livestock driveway land in Cerro Balitas fire history site.



Figure 2. One of the few patches of regeneration found at the Cerro Balitas fire history site. Note that while most of the overstory trees are ponderosa pine, this patch of regeneration consists mostly of Douglas-fir.

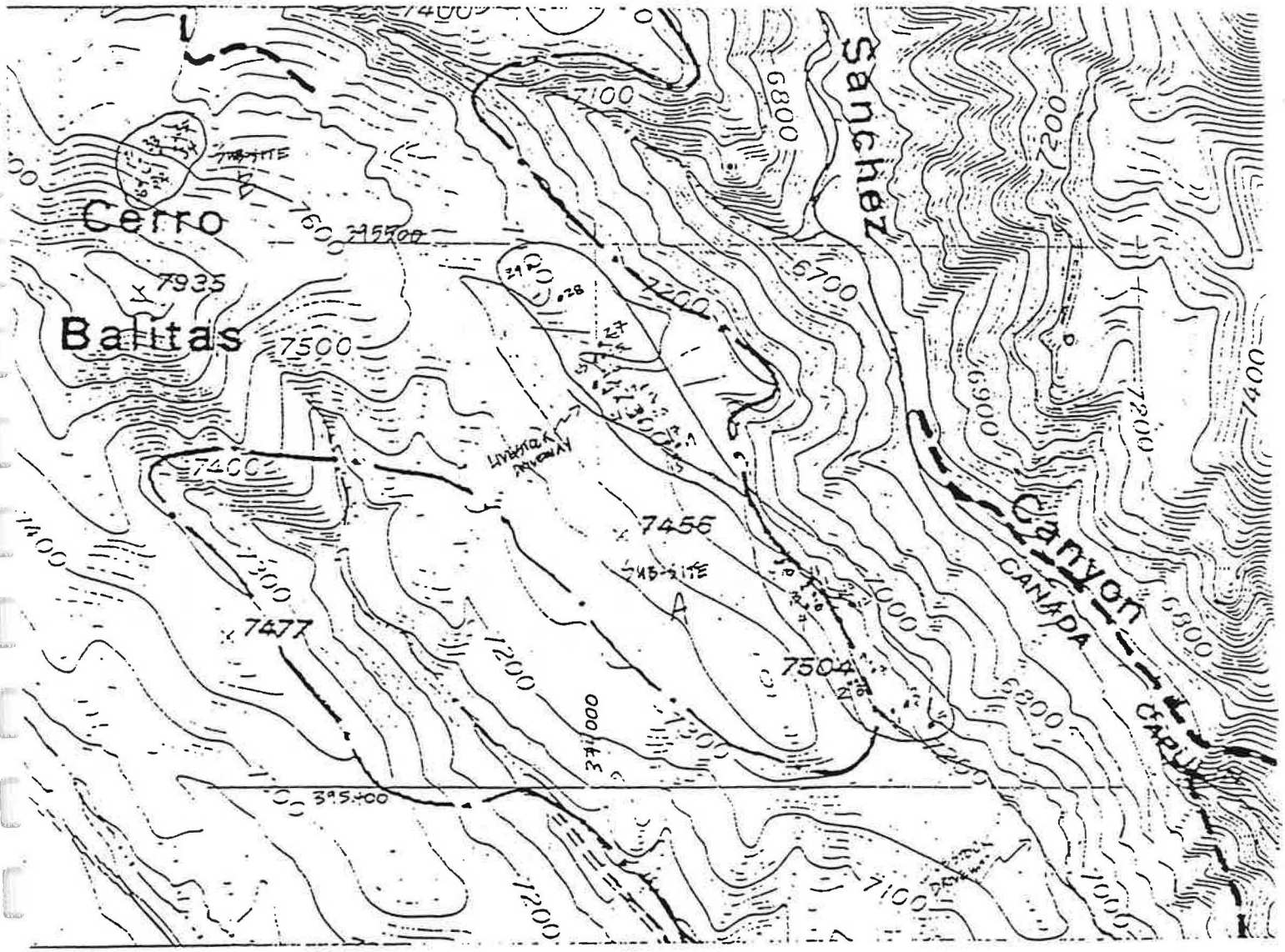


Figure 3. Map of specimen locations in the Cerro Balitas fire history site.

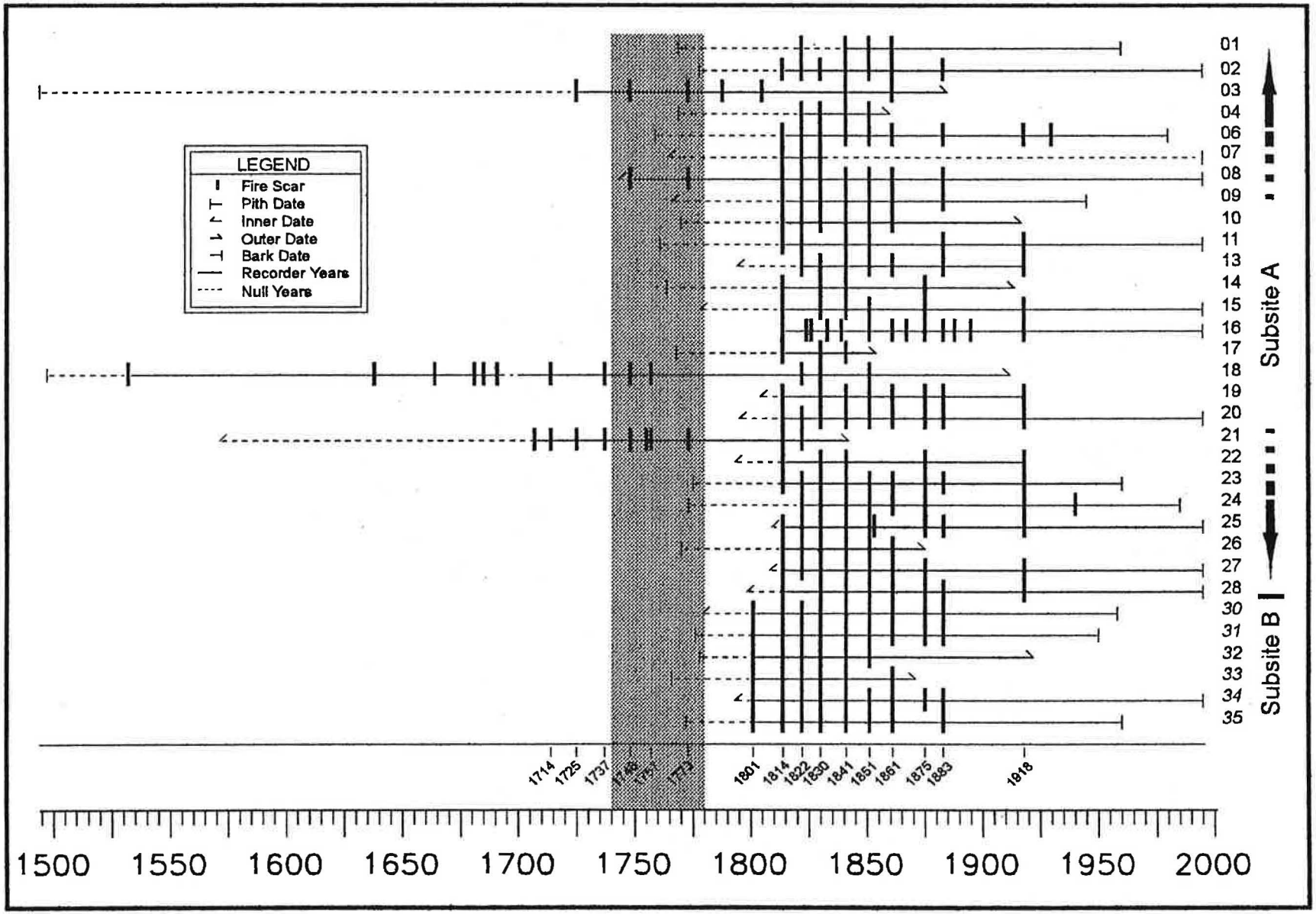


Figure 4. Fire history chart for Cerro Balitas. Dates at the base of the chart represent fires recorded by greater than one tree. Shaded rectangle highlights the period, 1740-1780, when numerous sampled trees established.

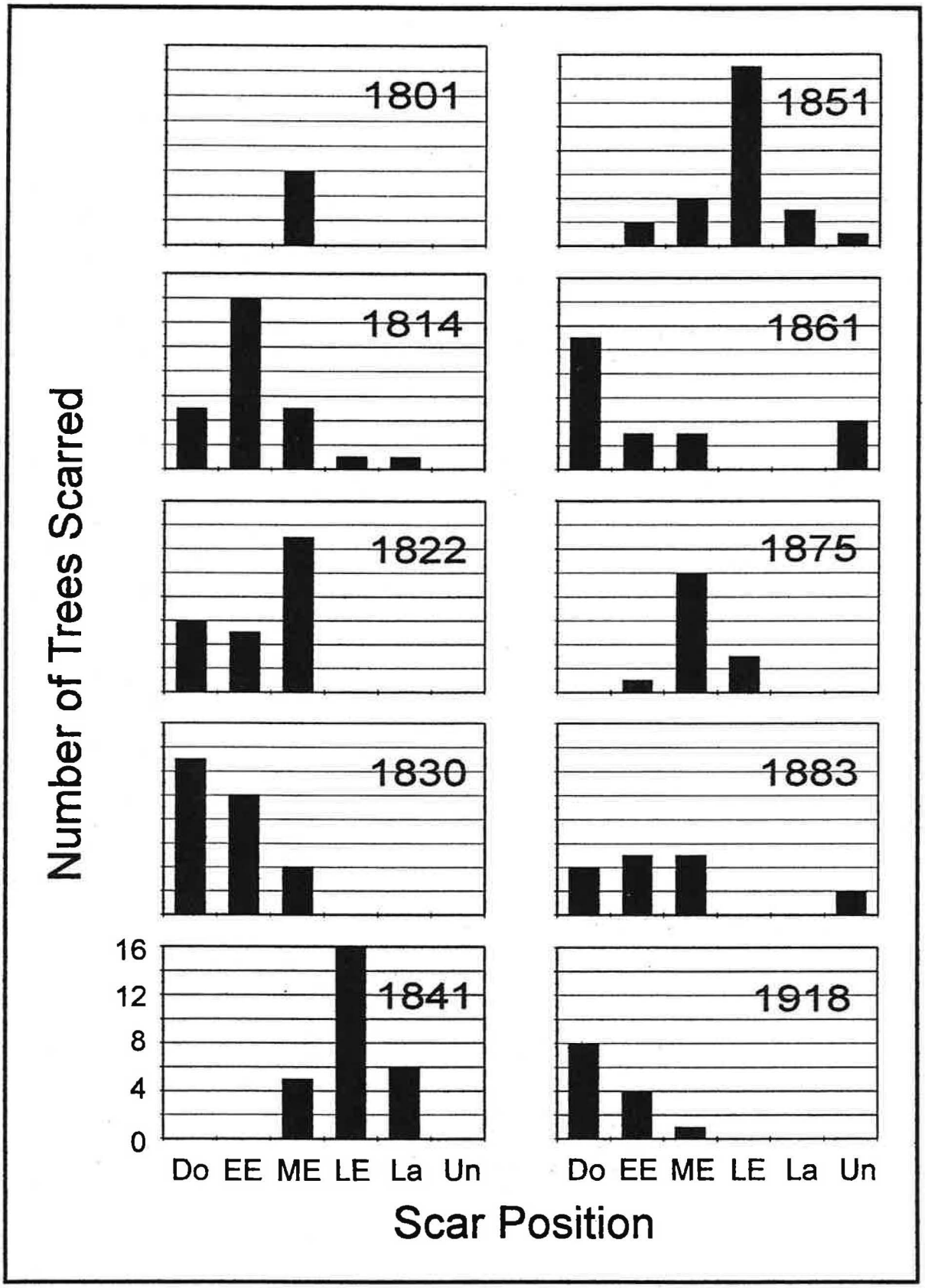


Figure 5. Distribution of scar positions for fires after 1800 recorded on more than one tree. Do=Dormant; EE=Early Earlywood; ME=Middle Earlywood; LE=Late Earlywood; La=Latewood; and Un=Unknown. See text for more details.

LITERATURE CITED

Allen, CD. 1989. Changes in the landscape of the Jemez Mountains, New Mexico. Ph.D. Dissertation, University of California, Berkley. 346 pp.

Allen, CD. 1994. Ecological perspective: Linking ecology, GIS, and remote sensing to ecosystem management. IN: Sample, VA, ed., Remote Sensing and GIS in Ecosystem Management. Island Press Covelo, CA:111-139.

Arno, SF and KM Sneck. 1977. A method for determining fire history in coniferous forests of the mountain west. USDA For. Serv. *GTR INT-42.* 28 pp.

Baisan, CH and TW Swetnam. 1990. Fire history on a desert mountain range: Rincon Mountain Wilderness, Arizona, USA. *Canadian Journal of Forest Research* 20:1559-1569.

Baisan, CH and TW Swetnam. 1994. Assessment of phenological growth patterns in four coniferous species, Rhyolite Canyon, Chiricahua National Monument. Final Report, SPMA, Tucson. 35 pp.

Dieterich, JH and TW Swetnam. 1984. Dendrochronology of a fire-scarred ponderosa pine. *Forest Science* 30:238-247.

Fritts, HC. 1976. *Tree Rings and Climate.* Academic Press, New York, NY. 567 pp.

Fritts, HC, DG Smith and MA Stokes. 1965. The biological model for paleoclimatic interpretation of Mesa Verde tree-ring series. *American Antiquity* 31:101-121.

Grissino-Mayer HD. 1995. Tree-ring reconstructions of climate and fire history at El Malpais National Monument. Ph. D. dissertation, The University of Arizona, Tucson, AZ. 407 pp.

Swetnam TW, and CD Allen. 1995. Study Proposal: Expanded fire regime studies in the Jemez Mountains, New Mexico. Cooperative Agreement by The University of Arizona and the National Biological Service.

Swetnam, TW and CH Baisan. 1996. Historical fire regime patterns in the Southwestern United States since AD 1700. In Allen, CD, ed., Proceedings, 2nd La Mesa Fire Symposium, March 29-31, 1994, Los Alamos, New Mexico. USDA For. Serv. RM-GTR-286:11-32.

Touchan, R, TW Swetnam and HD Grissino-Mayer. 1995. Effects of livestock grazing on pre-settlement fire regimes in New Mexico. In JK Brown, RW Mutch, CW Spoon and RH Wakimoto, eds., *Proceedings: Symposium on Fire in Wilderness and Park Management, 1993 March 30 - April 1, Missoula, Montana.* Ogden UT: USDA For, Serv., INT-GTR-320:268-272.

Appendix A - Fire-scar data for each sample

Series 1 : **BAL01**
Pith Date : 1769
Bark Date : 1960
Length of sample : 192
Number in final analysis : 121
Information on fire history :
1822 D fire scar
1841 M fire scar
1851 M fire scar FI = 10
1861 D fire scar FI = 10
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 30.3
Sample mean fire interval : 10.0

Series 2 : **BAL02**
Pith Date : 1778
Bark Date : 1995
Length of sample : 218
Number in final analysis : 182
Information on fire history :
1814 M fire scar
1822 M fire scar FI = 8
1830 E fire scar FI = 8
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1861 D fire scar FI = 10
1883 D fire scar FI = 22
Total number of fire scars : 7
Total number all indicators : 7
Average number years per fire : 26.0
Sample mean fire interval : 11.5

Series 3 : **BAL03**
Pith Date : 1494
Outer Ring : 1885
Length of sample : 392
Number in final analysis : 161
Information on fire history :
1725 M fire scar
1748 U fire scar FI = 23
1773 D fire scar FI = 25
1788 D fire scar FI = 15
1805 A fire scar FI = 17
1841 A fire scar FI = 36
1861 U fire scar FI = 20
Total number of fire scars : 7
Total number all indicators : 7
Average number years per fire : 23.0
Sample mean fire interval : 22.7

Series 4 : **BAL04**
Pith Date : 1769
Outer Ring : 1860
Length of sample : 92
Number in final analysis : 39
Information on fire history :
1822 D fire scar
1830 D fire scar FI = 8
1841 M fire scar FI = 11
1851 U fire scar FI = 10
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 9.8
Sample mean fire interval : 9.7

Series 5 : **BAL06**
Pith Date : 1759
Bark Date : 1980
Length of sample : 222
Number in final analysis : 167
Information on fire history :
1814 E fire scar
1822 D fire scar FI = 8
1830 D fire scar FI = 8
1832 U injury
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1861 D fire scar FI = 10
1883 M fire scar FI = 22
1918 D fire scar FI = 35
1930 M fire scar FI = 12
Total number of fire scars : 9
Total number all indicators : 10
Average number years per fire : 18.6
Sample mean fire interval : 14.5

Series 6 : **BAL07**
Inner Ring : 1764
Bark Date : 1995
Length of sample : 232
Number in final analysis : 17
Information on fire history :
1814 D fire scar
1822 M fire scar FI = 8
1830 E fire scar FI = 8
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 5.7
Sample mean fire interval : 8.0

Series 7 : **BAL08**
Inner Ring : 1743
Bark Date : 1995
Length of sample : 253
Number in final analysis : 248
Information on fire history :
1748 D fire scar
1773 D fire scar FI = 25
1814 D fire scar FI = 41
1822 M fire scar FI = 8
1830 E fire scar FI = 8
1841 L fire scar FI = 11
1851 M fire scar FI = 10

Appendix A - Fire-scar data for each sample

1861 D fire scar FI = 10
1883 M fire scar FI = 22
Total number of fire scars : 9
Total number all indicators : 9
Average number years per fire : 27.6
Sample mean fire interval : 16.9

Series 8 : **BAL09**
Inner Ring : 1766
Bark Date : 1945
Length of sample : 180
Number in final analysis : 132
Information on fire history :
1814 E fire scar
1822 M fire scar FI = 8
1830 D fire scar FI = 8
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1861 D fire scar FI = 10
1883 U fire scar FI = 22
Total number of fire scars : 7
Total number all indicators : 7
Average number years per fire : 18.9
Sample mean fire interval : 11.5

Series 9 : **BAL10**
Pith Date : 1770
Outer Ring : 1917
Length of sample : 148
Number in final analysis : 104
Information on fire history :
1814 E fire scar
1822 D fire scar FI = 8
1830 D fire scar FI = 8
1841 A fire scar FI = 11
1851 L fire scar FI = 10
1861 D fire scar FI = 10
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 17.3
Sample mean fire interval : 9.4

Series 10 : **BAL11**
Pith Date : 1761
Bark Date : 1995
Length of sample : 235
Number in final analysis : 182
Information on fire history :
1814 M fire scar
1822 D fire scar FI = 8
1841 L fire scar FI = 19
1851 L fire scar FI = 10
1883 E fire scar FI = 32
1918 E fire scar FI = 35
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 30.3
Sample mean fire interval : 20.8

Series 11 : **BAL13**
Inner Ring : 1794
Outer Ring :1918
Length of sample : 125
Number in final analysis : 97
Information on fire history :
1822 M fire scar
1830 E fire scar FI = 8
1841 L fire scar FI = 11
1851 M fire scar FI = 10
1861 E fire scar FI = 10
1883 E fire scar FI = 22
1918 E fire scar FI = 35
Total number of fire scars : 7
Total number all indicators : 7
Average number years per fire : 13.9
Sample mean fire interval : 16.0

Series 12 : **BAL14**
Pith Date : 1764
Outer Ring : 1914
Length of sample : 151
Number in final analysis : 101
Information on fire history :
1814 E fire scar
1830 D fire scar FI = 16
1841 M fire scar FI = 11
1875 M fire scar FI = 34
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 25.3
Sample mean fire interval : 20.3

Series 13 : **BAL15**
Inner Ring : 1778
Bark Date : 1995
Length of sample : 218
Number in final analysis : 182
Information on fire history :
1814 D fire scar
1830 E fire scar FI = 16
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1875 M fire scar FI = 24
1918 D fire scar FI = 43
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 30.3
Sample mean fire interval : 20.8

Series 14 : **BAL16**
Inner Ring : 1814
Bark Date : 1995
Length of sample : 182
Number in final analysis : 182

Appendix A - Fire-scar data for each sample

Information on fire history :
1814 U fire scar
1824 E fire scar FI = 10
1826 D fire scar FI = 2
1833 D fire scar FI = 7
1839 D fire scar FI = 6
1851 A fire scar FI = 12
1861 D fire scar FI = 10
1867 E fire scar FI = 6
1875 M fire scar FI = 8
1883 M fire scar FI = 8
1888 L fire scar FI = 5
1895 E fire scar FI = 7
1918 D fire scar FI = 23
1987 D injury
1989 D injury
Total number of fire scars : 13
Total number all indicators : 15
Average number years per fire : 14.0
Sample mean fire interval : 8.7

Series 15 : **BAL17**
Pith Date : 1768
Outer Ring : 1854
Length of sample : 87
Number in final analysis : 41
Information on fire history :
1814 D fire scar
1830 D fire scar FI = 16
1841 L fire scar FI = 11
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 13.7
Sample mean fire interval : 13.5

Series 16 : **BAL18**
Pith Date : 1497
Outer Ring : 1912
Length of sample : 416
Number in final analysis : 373
Information on fire history :
1532 M fire scar
1638 D fire scar FI = 106
1664 D fire scar FI = 26
1681 D fire scar FI = 17
1685 D fire scar FI = 4
1691 D fire scar FI = 6
1714 D fire scar FI = 14
1737 E fire scar FI = 23
1748 M fire scar FI = 11
1757 D fire scar FI = 9
1822 E fire scar FI = 65
1830 D fire scar FI = 8
1851 E fire scar FI = 21
Total number of fire scars : 13
Total number all indicators : 13
Average number years per fire : 28.7
Sample mean fire interval : 25.8

Series 17 : **BAL19**
Inner Ring : 1804
Outer Ring :1918
Length of sample : 115
Number in final analysis : 105
Information on fire history :
1814 A fire scar
1830 M fire scar FI = 16
1841 A fire scar FI = 11
1851 L fire scar FI = 10
1861 U fire scar FI = 10
1875 E fire scar FI = 14
1883 M fire scar FI = 8
1918 D fire scar FI = 35
Total number of fire scars : 8
Total number all indicators : 8
Average number years per fire : 13.1
Sample mean fire interval : 14.9

Series 18 : **BAL20**
Inner Ring : 1795
Bark Date : 1995
Length of sample : 201
Number in final analysis : 182
Information on fire history :
1814 M fire scar
1822 M fire scar FI = 8
1830 E fire scar FI = 8
1841 A fire scar FI = 11
1851 L fire scar FI = 10
1861 M fire scar FI = 10
1875 M fire scar FI = 14
1883 E fire scar FI = 8
1918 E fire scar FI = 35
Total number of fire scars : 9
Total number all indicators : 9
Average number years per fire : 20.2
Sample mean fire interval : 13.0

Series 19 : **BAL21**
Inner Ring : 1571
Outer Ring : 1842
Length of sample : 272
Number in final analysis : 136
Information on fire history :
1707 U fire scar
1714 U fire scar FI = 7
1725 M fire scar FI = 11
1737 L fire scar FI = 12
1748 L fire scar FI = 11
1755 M fire scar FI = 7
1757 D fire scar FI = 2
1773 D fire scar FI = 16
1814 E fire scar FI = 41
1822 E fire scar FI = 8

Appendix A - Fire-scar data for each sample

Total number of fire scars : 10
Total number all indicators : 10
Average number years per fire : 13.6
Sample mean fire interval : 12.8

Series 20 : **BAL22**
Inner Ring : 1793
Outer Ring :1918
Length of sample : 126
Number in final analysis : 105
Information on fire history :
1814 M fire scar
1830 E fire scar FI = 16
1841 A fire scar FI = 11
1875 M fire scar FI = 34
1918 D fire scar FI = 43
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 21.0
Sample mean fire interval : 26.0

Series 21 : **BAL23**
Pith Date : 1775
Bark Date : 1960
Length of sample : 186
Number in final analysis : 147
Information on fire history :
1814 D fire scar
1822 M fire scar FI = 8
1830 M fire scar FI = 8
1841 M fire scar FI = 11
1851 L fire scar FI = 10
1861 E fire scar FI = 10
1875 M fire scar FI = 14
1883 M fire scar FI = 8
1918 D fire scar FI = 35
Total number of fire scars : 9
Total number all indicators : 9
Average number years per fire : 16.3
Sample mean fire interval : 13.0

Series 22 : **BAL24**
Pith Date : 1773
Bark Date : 1985
Length of sample : 213
Number in final analysis : 164
Information on fire history :
1822 E fire scar
1830 E fire scar FI = 8
1841 L fire scar FI = 11
1851 E fire scar FI = 10
1861 U fire scar FI = 10
1875 M fire scar FI = 14
1918 D fire scar FI = 43
1940 D fire scar FI = 22
Total number of fire scars : 8
Total number all indicators : 8
Average number years per fire : 20.5
Sample mean fire interval : 16.9

Series 23 : **BAL25**
Inner Ring : 1809
Bark Date : 1995
Length of sample : 187
Number in final analysis : 182
Information on fire history :
1814 E fire scar
1822 M fire scar FI = 8
1830 M fire scar FI = 8
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1853 D fire scar FI = 2
1875 L fire scar FI = 22
1883 D fire scar FI = 8
1918 D fire scar FI = 35
Total number of fire scars : 9
Total number all indicators : 9
Average number years per fire : 20.2
Sample mean fire interval : 13.0

Series 24 : **BAL26**
Pith Date : 1770
Outer Ring : 1875
Length of sample : 106
Number in final analysis : 62
Information on fire history :
1814 E fire scar
1822 M fire scar FI = 8
1830 M fire scar FI = 8
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1861 D fire scar FI = 10
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 10.3
Sample mean fire interval : 9.4

Series 25 : **BAL27**
Inner Ring : 1808
Bark Date : 1995
Length of sample : 188
Number in final analysis : 182
Information on fire history :
1814 E fire scar
1822 M fire scar FI = 8
1830 D fire scar FI = 8
1841 M fire scar FI = 11
1851 M fire scar FI = 10
1861 M fire scar FI = 10
1875 M fire scar FI = 14
1918 M fire scar FI = 43
Total number of fire scars : 8
Total number all indicators : 8
Average number years per fire : 22.8

Appendix A - Fire-scar data for each sample

Sample mean fire interval : 14.9

Series 26 : **BAL28**
Inner Ring : 1798
Bark Date : 1995
Length of sample : 198
Number in final analysis : 182
Information on fire history :
1814 E fire scar
1830 E fire scar FI = 16
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1861 D fire scar FI = 10
1875 M fire scar FI = 14
1883 E fire scar FI = 8
1918 E fire scar FI = 35
Total number of fire scars : 8
Total number all indicators : 8
Average number years per fire : 22.8
Sample mean fire interval : 14.9

Series 27 : **BAL30**
Inner Ring : 1779
Bark Date : 1958
Length of sample : 180
Number in final analysis : 158
Information on fire history :
1801 M fire scar
1814 E fire scar FI = 13
1822 M fire scar FI = 8
1830 E fire scar FI = 8
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1861 E fire scar FI = 10
1875 L fire scar FI = 14
1883 E fire scar FI = 8
Total number of fire scars : 9
Total number all indicators : 9
Average number years per fire : 17.6
Sample mean fire interval : 10.2

Series 28 : **BAL31**
Pith Date : 1776
Bark Date : 1950
Length of sample : 175
Number in final analysis : 150
Information on fire history :
1801 M fire scar
1814 E fire scar FI = 13
1817 D injury
1822 M fire scar FI = 8
1830 D fire scar FI = 8
1841 L fire scar FI = 11
1851 A fire scar FI = 10
1861 D fire scar FI = 10
1875 M fire scar FI = 14
1883 D fire scar FI = 8
Total number of fire scars : 9
Total number all indicators : 10
Average number years per fire : 16.7
Sample mean fire interval : 10.2

Series 29 : **BAL32**
Pith Date : 1778
Outer Ring : 1922
Length of sample : 145
Number in final analysis : 122
Information on fire history :
1801 M fire scar
1814 E fire scar FI = 13
1822 D fire scar FI = 8
1830 D fire scar FI = 8
1841 A fire scar FI = 11
1851 L fire scar FI = 10
1854 M injury
Total number of fire scars : 6
Total number all indicators : 7
Average number years per fire : 20.3
Sample mean fire interval : 10.0

Series 30 : **BAL33**
Pith Date : 1766
Outer Ring : 1871
Length of sample : 106
Number in final analysis : 71
Information on fire history :
1801 M fire scar
1814 E fire scar FI = 13
1822 E fire scar FI = 8
1830 D fire scar FI = 8
1841 L fire scar FI = 11
1861 M fire scar FI = 20
Total number of fire scars : 6
Total number all indicators : 6
Average number years per fire : 11.8
Sample mean fire interval : 12.0

Series 31 : **BAL34**
Inner Ring : 1793
Bark Date : 1995
Length of sample : 203
Number in final analysis : 195
Information on fire history :
1801 M fire scar
1814 M fire scar FI = 13
1822 E fire scar FI = 8
1830 D fire scar FI = 8
1841 U fire scar FI = 11
1851 A fire scar FI = 10
1852 A injury
1861 D fire scar FI = 10
1875 L fire scar FI = 14
1883 D fire scar FI = 8
Total number of fire scars : 9

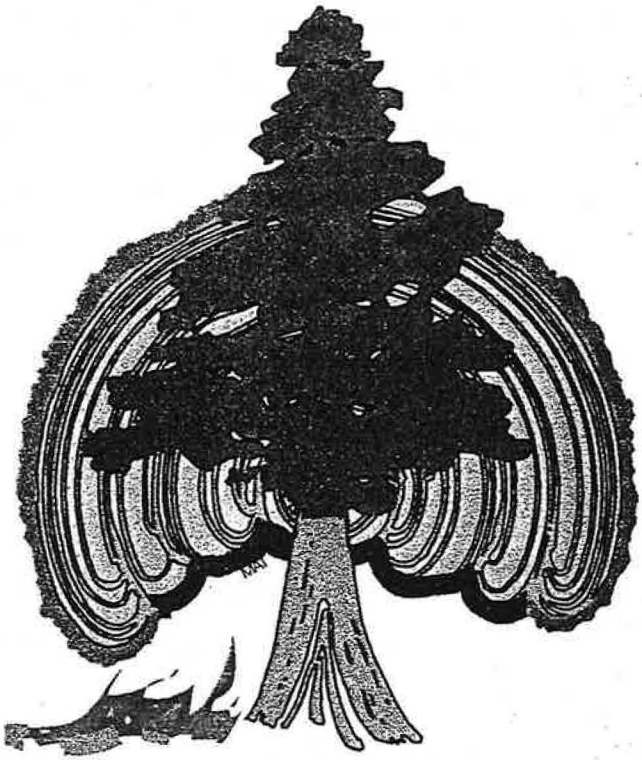
Appendix A - Fire-scar data for each sample

Total number all indicators : 10
Average number years per fire : 21.7
Sample mean fire interval : 10.2

Series 32 : **BAL35**
Pith Date : 1772
Bark Date : 1960
Length of sample : 189
Number in final analysis : 160
Information on fire history :
1801 M fire scar
1814 E fire scar FI = 13
1822 M fire scar FI = 8
1830 D fire scar FI = 8
1841 L fire scar FI = 11
1851 L fire scar FI = 10
1861 U fire scar FI = 10
1883 U fire scar FI = 22
Total number of fire scars : 8
Total number all indicators : 8
Average number years per fire : 20.0
Sample mean fire interval : 11.7

APPENDIX C

Expanded Fire Regime Studies in the Jemez Mountains, New Mexico



Second Progress Report
Spring 1997

To:
Craig D. Allen
National Biological Service/USGS
Bandelier National Monument

From:
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INTRODUCTION

This project is a continuation of studies designed to examine the interaction between fires and humans and landscapes. This project has three main research objectives: (1) to expand fire regime studies in mixed conifer and aspen stands; (2) to reconstruct fire chronologies in areas impacted by early livestock grazing; and (3) to examine fire regimes of the piñon-juniper vegetation zone at the ponderosa pine ecotone (Swetnam and Allen 1995). During the summer of 1996, field work for this study was completed. In addition to collecting material in compliance to the above objectives, we also had the unique opportunity to sample culturally modified trees (CMT's) in El Valle, New Mexico. This material will further improve our understanding of fire/human/landscape interactions. This report summarizes the sampling and collection effort and the status of laboratory analysis. We will also present and discuss preliminary aspects of fire chronology reconstructions in the piñon-juniper/ponderosa pine ecotone.

FIELD METHODS

A variety of sampling techniques were used during the summer 1996 trip. All sites were selected to satisfy the project objectives (see above); however, specific criteria for selecting site locations varied. In some cases, locations were selected to collect data to augment previous or ongoing studies (*e.g.*, fire history studies in mixed-conifer stands [Touchan *et al.* 1996] and erosion watershed studies in piñon-juniper stands [C. Allen pers. comm.]). In other cases, locations were selected to obtain new fire history information (*e.g.* Baca location) and inofrmation on CMT's (*e.g.*, peeled ponderosa pines in El Valle, NM). In all sites, precise specimen locations were determined by David Snyderman, ecologist at the Bandelier National Monument, using a GPS (Global Positioning System) unit. For fire history and peel trees sampled, the coordinates of each tree were recorded; for age/stand structure trees, the coordinates of the center line of the transect were recorded.

I. Fire History

Standard fire history collection methods were used to collect specimens from this site (Arno and Sneck 1977; Swetnam and Baisan 1996). A chainsaw was used to collect whole or

partial cross sections from both live and dead trees. Full cross sections were taken from dead trees and partial cross-sections were taken from live trees. Samples were labelled and securely wrapped in the field to reduce breakage and loss during transport

II. CMT's - Culturally Modified Trees: Peeled Trees

Peeled trees were sampled in a fashion similar to fire-scar collection methods (see previous section).

III. Age/Stand Structure Study

Data collection for age/stand structure in the mixed conifer was assessed using transects. Following a reconnaisance of the stand, transects were located subjectively in areas deemed to be representative of the whole stand based on overstory/understory composition and structure.

Trees were sampled using a 'nested belt transect' strategy to obtain adequate representation of all size classes (Abolt 1997). Using this strategy, larger areas were sampled for larger diameter trees because larger (older) trees occur at lower densities. Transects were 300 m long. Within one meter on each side of the center line, data was recorded for seedlings and saplings less than 2.5 cm dbh. These data included species, linear position along the transect and height. For the smaller seedings, the whole plant was harvested; for larger seedlings/saplings, cross-sections were taken from the base of the plant using either garden sheers or a small hand saw. When cross-sections were collected, the top and bottom of the sections were labelled on the specimen.

All trees with a dbh greater than 2.5 cm were cored using the following criteria: for distances greater than one meter from the center line only trees with a dbh greater than 30 cm were cored and for distances greater than two meters from the center line only trees with a dbh greater than 60 cm were cored. The maximum distance from the center line for sampling was three meters, producing a belt six meters wide. One exception to this sampling startegy was the CAM-U plot. Due to the overall low density of trees in this stand, the transect was widened; trees at least 30 cm dbh were cored between one and three meters on each side of the center line and trees at least 60 cm dbh were cored between three and four meters of each side of the center line.

Trees were cored as close to the ground as possible. Data recorded for each tree consisted of (1) position along the transect; (2) species; (3) dbh; (4) drc (diameter at root crown); (5) coring height; and (6) crown class. Four categories were used for crown class based on the amount of sunlight recieved by the tree. *Dominant* trees recieved direct sunlight on all sides and top of the crown; *co-dominant* trees recieved direct sunlight on the some sides and the top of the crown; *sub-dominant* trees recieved direct sunlight only on the top of the crown; and *understory* trees did not receive any direct sunlight. Cores were inserted in paper straws, sealed by crimping in the ends of the straws and labelled using numbers cross-referenced with the data recorded for each tree.

IV. Site Description for Pinon-Juniper Fire History Sites : FWH & FRM

Fire-scarred material was collected on a mesa on the east side of Frijoles Canyon in the Bandelier National Monument. The current vegetation is dominated by pinon-juniper; a few live ponderosa pine also occur as well as a higher density of ponderosa pine logs and snags. All fire-scarred material was ponderosa pine. Ground cover is extremely low (less than 5%; C. Allen, personal comm). Shallow drainages have a primarily north-south orientation (Figure 1).

Two sites were collected on the mesa: a northern site, Frijolito Watershed Hydrology Study Area (FWH) and a southern site, separated by a major drainage and a distance of approximately 500 meters, Frijoles Mesa (FRM; Figure 1). A gradual decrease in elevation occurs from FWH to FRM; elevation in FWH ranges from 6520 to 6440 and in FRM from 6440 to 6320. The FWH site has an area of approximately 420,000 m^2 (0.42 ha) and is roughly square-shaped; 20 samples were collected, located primarily to the south and east of the Frijolito Watershed Hydrology Study Area. FWH was bounded on the east by a major drainage and the west by steep slopes or cliffs descending into the Frijoles Canyon. The FRM site is approximately 345,000 m^2 (0.35 ha) and is rectangular in shape; 29 trees were sampled, many of them were located in or on the edge of a wash.

LABORATORY METHODS (for piñon-juniper/ponderosa pine ecotone fire history studies only)

In the laboratory, all samples were re-assembled, re-sectioned on a band saw to manageable sizes, and sanded. Progressively finer grits were used (down to 320 grit) so that the cellular structure on a transverse section could be discerned using a dissecting scope (20-30x magnification). Each cross-section was examined and crossdated. The dates of the 1) inner-most ring, 2) the outer-most ring, 3) fire scars, and 4) unspecified injuries were then recorded.

The position of the scar within the tree-ring was also described (Dieterich and Swetnam 1984; Baisan and Swetnam 1990; Ortloff 1996). Scar position illustrates the timing of fires with respect to the growing season of the tree, enabling us to infer the approximate timing of fires at an intra-annual scale. Scar position was described based on the location of the scar relative to ring morphology. Our current knowledge about tree-growth phenology in the Southwest (Fritts 1976; Baisan and Swetnam 1994) allows us to estimate windows of time (3-6 week periods in the growing season) when the fire event most likely occurred. The following describes how scar position is evaluated and the probable time period represented.

- *Dormant (D)*: Scar is positioned between the latewood of the previous year and the earlywood of the current year. Dormant-position scars represent fires occurring during the dormant season of the tree, *i.e.*, from fall to spring, which spans two calendar years. In the Southwest, fires tend to be more common in the spring compared to the fall so these fire scars are assumed to be spring fires and are thus dated to the ring following the scar (Baisan and Swetnam 1990). It is most likely that these fires occur before May.
- *Early Earlywood (EE)*: Scar is positioned in the first one-third of the earlywood. It is most likely that these fires occur between early May and mid-June.
- *Middle Earlywood (ME)*: Scar is positioned in the second third of the earlywood. It is most likely that these fires occurred between early June and late July.
- *Late Earlywood (LE)*: Scar is positioned in the last third of the earlywood. It is most likely that these fires occurred between mid-July and late August.
- *Latewood (La)*: Scar is positioned in the latewood. It is most likely that these fires

occurred between early August and September.

- *Unknown (Un)*: Scar position is undeterminable because of growth suppression and/or scar erosion.

PRELIMINARY RESULTS and DISCUSSION

I. 1996 Summer Collection

In total, 917 trees were sampled during the 1996 summer collection trip. Sets of collections are currently in different stages of processing (Table 1). The two fire history sites in the pinon-juniper/ponderosa pine ecotone (FRM and FWH) are the most complete. The samples from these sites have been dated and checked. For the other fire history and CMT sites, we have examined a subset of the samples and have a set of dates but these have not yet been checked (Table 1). For the age/stand structure sites, BON, CAM-L and CAM-U, the data recorded in the field has been compiled.

II. Pinon-Juniper/ Ponderosa Pine Ecotone Fire Histories

Fire scars from 19 and 26 trees were dated for the FWH and FRM sites, respectively. The FRM fire history was slightly longer than that of FWH. The earliest fire scar in FRM is 1605 while in FWH, it is 1664; by that year, already seven trees in FRM are recording fires (Figure 2). For both sites, there is a cluster of death dates around the 1950s. This is probably related to the severe drought that occurred during this decade.

Fire Frequency

Considering all fires recorded, FRM recorded approximately twice as many fires as FWH; 25 versus 12 fires, yielding Mean Fire Intervals (MFI's) of 12.5 and 18.5 years for FRM and FWH, respectively. The higher fire frequency in FRM might be an artifact of its greater sample depth. If we assume that fire dates recorded on fewer trees represent smaller fires, then for sites having approximately equal areas, the site with the larger number of trees sampled is more likely to detect smaller fires. Similiarly, if fire intensity is low resulting in a reduced number of trees scarred, then a higher density of fire history samples will increase the probability of sampling at least one tree that was scarred.

Upon closer examination of the FRM fire history, it appears that the higher fire frequency is largely attributable to one tree. Between 1725 and 1996, 12 fires were recorded on only one tree and 4 fires on only 2 trees (Figure 2). Of the 12 fire events recorded on a single tree, 9 of these occurred in FRM (the site with a greater number of samples). Interestingly, of these 9 fires, 6 were recorded on a single tree. The tree, FRM06, accounts for half of the fires detected only by one tree. This tree was located on the edge of a wash. Near the base of the bole, the tree was bent over such that the bole was approximately parellel with the slope. Depending on when the tree became non-vertical, this growth form may have increased the tree's susceptibility to scarring, for example, by creating an environment that was conducive to pre-heating.

Between 1725 and 1996, four fires were recorded on only 2 trees (Figure 2). Three of these fires were recorded only in FRM; the other fire was recorded on one tree each in FRM and FWH. For fires recorded by more than two trees, the MFI computes to 44.3 and 41.8 years for FWH and FRM, respectively, demonstrating that fire frequency patterns for 'larger' fires in both sites is quite similiar.

After 1842, there appears to be a change in the character of fire occurrence. Only two fires occur that scar more than three trees. One in FWH in 1858 and the other in FRM in 1892. Both events were relatively local in extent. The most prevalent feature of the post-1842 fire regime on the mesa, however, is the virtual absence of fire after 1892 (Figure 2), resulting in the longest fire-free interval of 104 years at the time of our collection effort.

Fire Extent

Comparison of the fire dates from each site offers insight to fire extent patterns on the Frijoles Mesa. Four and five 'large' (recorded by more than three trees) fires have occurred in FWH and FRM, respectively, since 1725. Three of these fires are in common for the two sites: 1725, 1773 and 1842. Both the 1725 and 1842 fires appear to have spread throughout both sites, suggesting that during these years, there was a high degree of homogeneity in fuel distribution and perhaps a high fuel load. In particular, the 1842 fire was recorded on all but one tree. In contrast, the 1773 fire is recorded throughout FWH but not FRM. Specifically, only trees from the southern group of FRM show a 1773 scar. This pattern is intriguing because it indicates that

fire occurred on both sides of but not within the northern group of FRM trees. A large fire in 1795 was recorded only in the northern group of FRM trees, perhaps confirming that this area was not burned in 1773 and suggesting that 22 years was not sufficient time for fuels to accumulate enough for fire spread throughout the whole area. However, a closer look at scarring patterns on individual trees suggest that 22 years was in many cases enough time for fuels to accumulate and the resulting fire to scar a tree. Within the Frijoles Mesa fire chronology, there are 22 cases when fires were recorded on the same tree at intervals less than 22 years. Two trees (in FRM: 04 and 06) each record an interval of two years and five trees (in FWH: 05,08,10,11, and 12) record both the 1842 and 1858 fires (Figure 2); the latter indicating that 16 years was sufficient time not only for fuels to accumulate at the base of individual trees but also between trees. The observed variability in interval length is probably indicative of variability in climate conditions that are conducive to fuel accumulation and ignition.

Fire Seasonality

A total of 123 scars were found between the two sites; for 89.4% of these (n=110), scar positions were determined. Over half of the scar positions (56.4%) were observed to be 'Dormant' (D). D-position scars were observed for all but two of the larger fires, *i.e.*, recorded by more than two trees (1657, 1665, 1704, 1725, 1773, 1795, 1842, 1858, 1892; Figure 3), suggesting that, in the past, fires tended to ignite at or near the beginning of the growing season, from mid-April to early June. In many cases, single fire dates show a range of scar positions (Figure 3), suggesting, for example, the possibility of multiple ignitions and/or long-lasting, creeping fires.

SUMMARY

Our work in this area highlights important differences between the pre-20th century and contemporary Frijoles Mesa landscape. In the past, fire occurred periodically on Frijoles Mesa, acting as an important ecological force. This is not obvious based on the current appearance and structure of the landscape: percent ground cover is extremely low and the vegetation is primarily comprised of species not considered to be well-adapted to episodic surface fire, *i.e.*, piñon and

juniper. Using dendrochronological techniques, it was determined that fire occurred on the landscape approximately once every 40 years; however, currently, this area is experiencing an absence of fire that has so far lasted 104 years. Other historical differences probably also included vegetation composition. It is likely that a markedly higher component of ponderosa pine comprised the vegetation in this area based on field observations of several dead and comparatively few live ponderosa pines.

Table 1. Description and Status of 1996 Summer Collections.

Collection Site (Code)	Location	Study Objective	n	Sample Preparation	Data Status	Comments
Frijoles Experimental Watershed (**FWH**)	Bandelier Nat'l Monument	PJ-Ponderosa Pine Fire History	20	Complete	Final	one tree not dated; very buggy
Frijoles Mesa South (**FRM**)	Bandelier Nat'l Monument	PJ-Ponderosa Pine Fire History	29	Complete	Final	very buggy
Baca Headquarters (**BAC**)	Baca Land Grant	Grazing and Fire History	4	Incomplete	Preliminary	>50% samples sanded; <50% samples with preliminary dates
Alamo Bog (**ALA**)	Baca Land Grant	Grazing and Fire History	25	Complete*	Preliminary	some fairly old material but surgy; all but 2 trees with final dates; *one sample from one tree unaccounted for
North of Alamo Bog (**NAB**)	Baca Land Grant	Grazing and Fire History	8	Incomplete	Preliminary	>50% samples sanded; <50% samples with preliminary dates
Canada Bonito North (**CAN**)	Canada Bonito	Mixed Conifer Fire History	7	Incomplete	No Data	samples have not yet been transported from storage
Camp May North (**CMN**)	Camp May	Mixed Conifer Fire History	15	Incomplete	No Data	samples have not yet been transprted from storage
Bonito Canyon (**BON**)	Canada Bonito	Mixed Conifer Age/Stand Struct.	t-133 s-105	Incomplete	Preliminary	cores mounted and surfaced; cross-sections not surfaced; field data entered; no age data
Camp May Lower (**CAM-L**)	Camp May	Mixed Conifer Age/Stand Struct.	t-172 s-191	Incomplete	Preliminary	cores mounted, not surfaced; cross-sections not surfaced; field data entered; no age data
Camp May Upper (**CAM-U**)	Camp May	Mixed Conifer Age/Stand Sruct.	t-124 s-52	Incomplete	Preliminary	cores mounted and surfaced; cross-sections not surfaced; field data entered; no age data
El Valle (**EVF**)	Santa Fe National Forest	People and Fire History	14	Incomplete	Preliminary	buggy material; very good crossdating; >50% samples sanded; >50% samples with preliminary dates
El Valle (**EVP**)	Santa Fe National Forest	Culturally Modified Trees	18	Incomplete	Preliminary	buggy material; very good crossdating; >50% samples sanded; <50% samples with preliminary dates

All Fire Scarred Trees near the FWHS

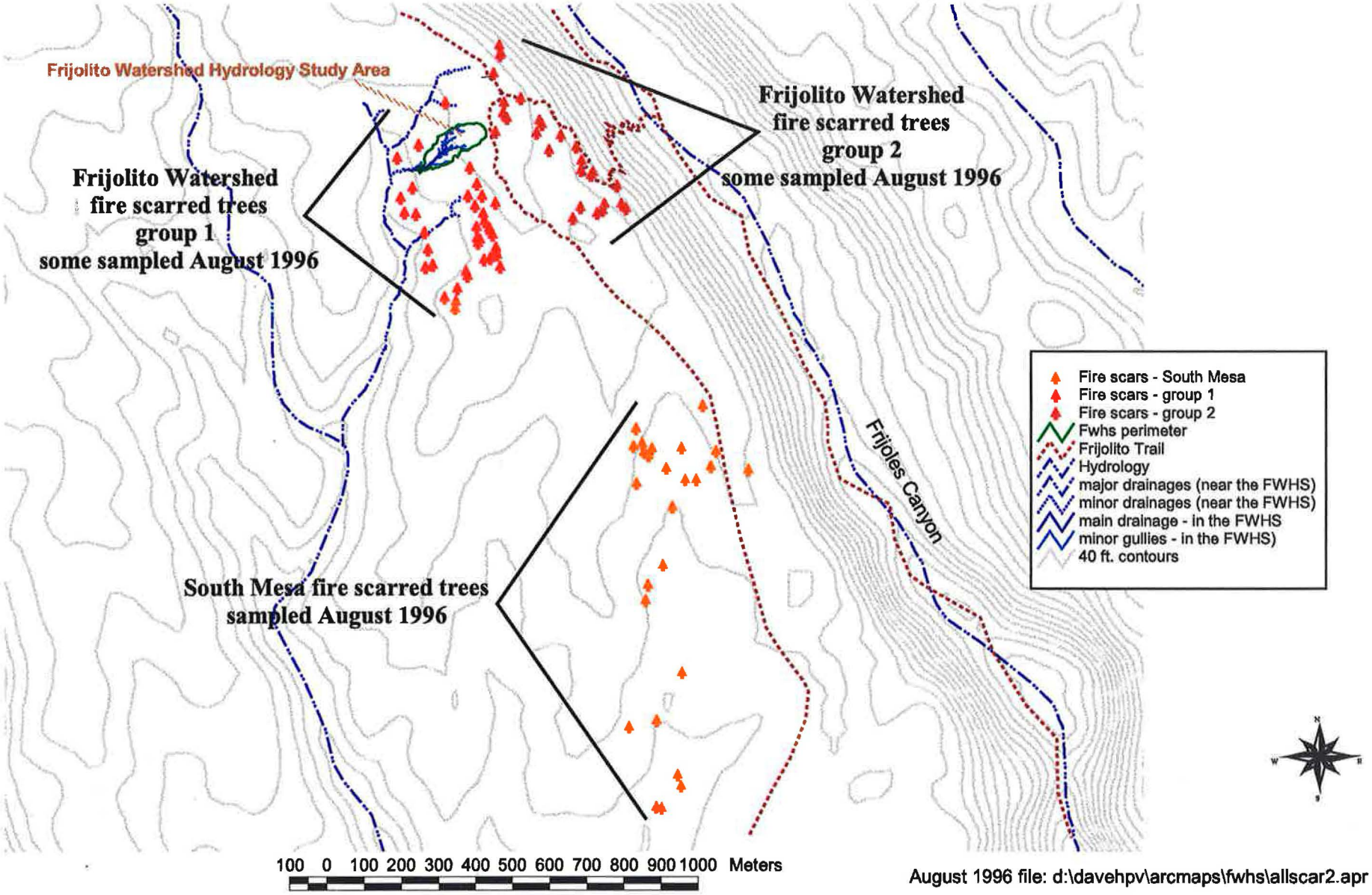


Figure 1. Map showing locations of FWHS (in red) and FRM (in orange) on Frijoles Mesa.

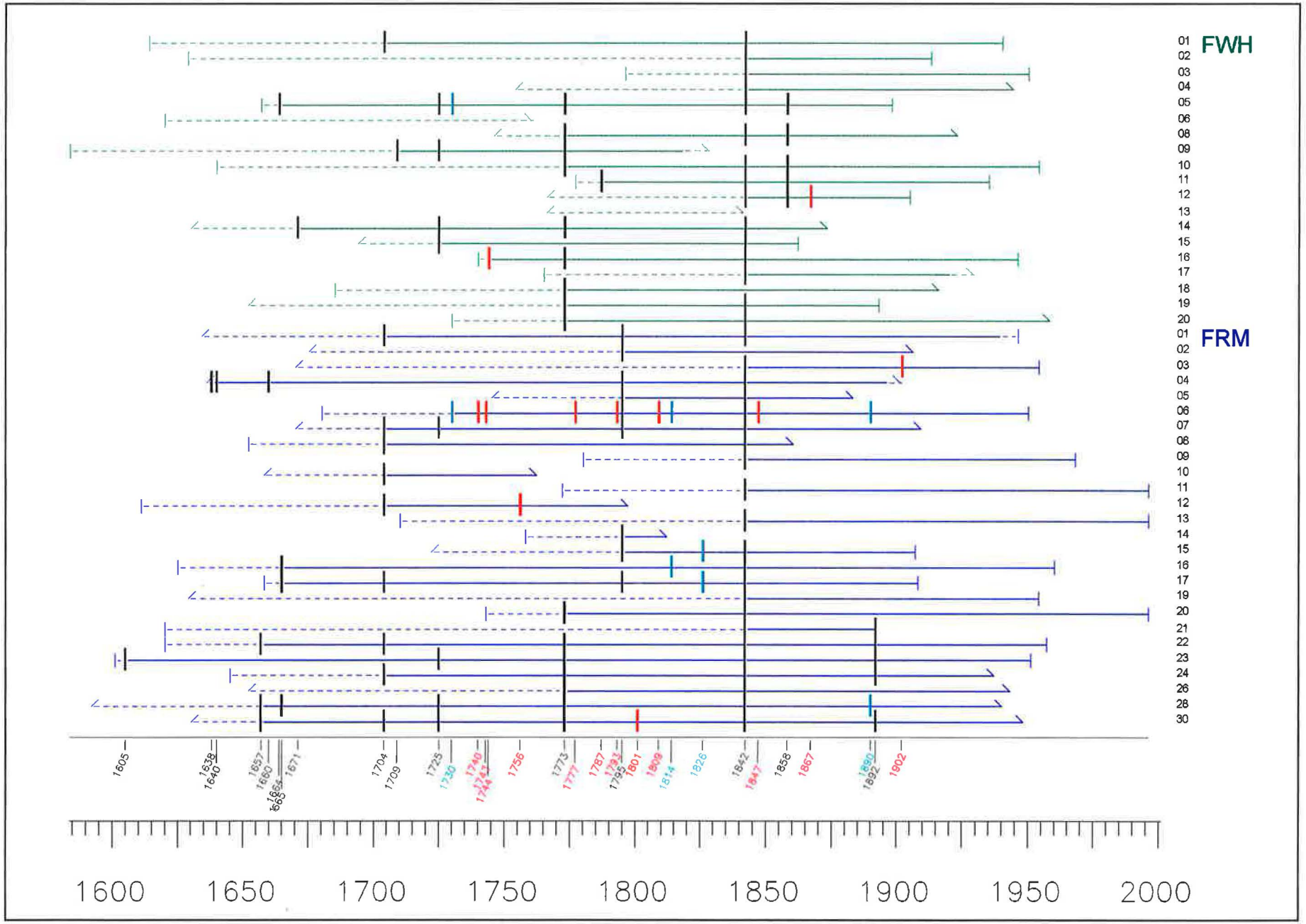


Figure 2. Fire history chart of FWH and FRM. Red dates and bars represent fires recorded on only one tree; blue dates and bars represent fires recorded only on two trees.

1605 D---
1638 E]--
1640 A]--
1657 LAA]]-------------------------------------
1660 D]]]]-------------------------------------
1664 M]]]]]-------------------------------------
1665 DMM]]]]]-------------------------------------
1671 E]]]]]]]----------------------------------
1704 DDDDDMLAAA]]]]]]---------------------------
1709 D]]]]]]]]]]]]]]]]--------------------------
1725 DEEEMMML]]]]]]]]]]--------------------------
1730 MU]]]]]]]]]]]]]]]]]-------------------------
1740 D]]]]]]]]]]]]]]]]]]-------------------------
1743 M]]]]]]]]]]]]]]]]]]-------------------------
1744 M]]]]]]]]]]]]]]]]]]]------------------------
1756 E]]]]]]]]]]]]]]]]]]]------------------------
1773 DDDDDDDDDMMMAUU]]]]]]]]]]------------------
1777 M]]]]]]]]]]]]]]]]]]]]]]]]]]------------------
1787 D]]]]]]]]]]]]]]]]]]]]]]]]]]-----------------
1793 L]]]]]]]]]]]]]]]]]]]]]]]]]]----------------
1795 EMMMMLAAU]]]]]]]]]]]]]]]]]]]]]-------------
1801 D]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]--------------
1809 M]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]--------------
1814 AU]]]]]]]D]]]]]]]]]]]]]]]]]]]]---------------
1826 AA]]]]]]]]]]]]]]]]]]]]]]]]]]]----------------
1842 DDDDDDDDDDDDDDDDDDDDDDDDDDDDDDUUUUUU]]------
1847 D]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]------
1858 DDEMM]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]------
1867 M]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]--------
1890 MU]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]----------
1892 DDDDU]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]----------
1902 D]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]]--------------

Figure 3. Scar position data for fires recorded at FWH and FRM. D=dormant; E=Early Earlywood; M=Middle Earlywood; L=Late Earlywood; A=Latewood; U=Unknown. See text for details.

LITERATURE CITED

Abolt, R. 1997. Fire history along an elevational gradient in the Mogollon Mountains, New Mexico. M.S. Thesis, University of Arizona, Tucson, AZ.

Arno, SF and KM Sneck. 1977. A method for determining fire history in coniferous forests of the mountain west. USDA For. Serv. *GTR INT-42.* 28 pp.

Baisan, CH and TW Swetnam. 1990. Fire history on a desert mountain range: Rincon Mountain Wilderness, Arizona, USA. *Canadian Journal of Forest Research* 20:1559-1569.

Baisan, CH and TW Swetnam. 1994. Assessment of phenological growth patterns in four coniferous species, Rhyolite Canyon, Chiricahua National Monument. Final Report, SPMA, Tucson. 35 pp.

Dieterich, JH and TW Swetnam. 1984. Dendrochronology of a fire-scarred ponderosa pine. *Forest Science* 30:238-247.

Fritts, HC. 1976. *Tree Rings and Climate*. Academic Press, New York, NY. 567 pp.

Ortloff, W. 1996. Wood-anatomical evidence of fire seasonality. In Dean JS, DM Meko and TW Swetnam, eds., Tree Rings, Environment, and Humanity: Proceedings of the International Conference, Tucson, AZ, 17-21 May 1994:89-93.

Swetnam TW, and CD Allen. 1995. Study Proposal: Expanded fire regime studies in the Jemez Mountains, New Mexico. Cooperative Agreement by The University of Arizona and the National Biological Service.

Swetnam, TW and CH Baisan. 1996. Historical fire regime patterns in the Southwestern United States since AD 1700. In Allen, CD, ed., Proceedings, 2nd La Mesa Fire Symposium, March 29-31, 1994, Los Alamos, New Mexico. USDA For. Serv. RM-GTR-286:11-32.

Touchan, R, CD Allen and TW Swetnam. 1996. Fire history and climatic patterns in ponderosa pine and mixed conifer forest of the Jemez Mountains, northern New Mexico. In Allen, CD, ed., Proceedings, 2nd La Mesa Fire Symposium, March 29-31, 1994, Los Alamos, New Mexico. USDA For. Serv. RM-GTR-286:33-46.

Fire-scar data for Frijoles Mesa Samples

Series 1 : FRM01
Inner Ring : 1634
Bark Date : 1946
Length of sample : 313
Number in final analysis : 236
Information on fire history :
1704 D fire scar
1795 A fire scar FI = 91
1842 D fire scar FI = 47
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 78.7
Sample mean fire interval : 69.0

Series 2 : FRM02
Inner Ring : 1675
Outer Ring : 1906
Length of sample : 232
Number in final analysis : 112
Information on fire history :
1795 M fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 112.0

Series 3 : FRM03
Inner Ring : 1670
Bark Date : 1954
Length of sample : 285
Number in final analysis : 113
Information on fire history :
1842 D fire scar
1902 D fire scar FI = 60
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 56.5
Sample mean fire interval : 60.0

Series 4 : FRM04
Inner Ring : 1636
Outer Ring : 1901
Length of sample : 266
Number in final analysis : 259
Information on fire history :
1638 E fire scar
1640 A fire scar FI = 2
1649 D injury
1660 D fire scar FI = 20
1779 M injury
1795 A fire scar FI = 135
1842 D fire scar FI = 47
Total number of fire scars : 5
Total number all indicators : 7
Average number years per fire : 51.8
Sample mean fire interval : 51.0

Series 5 : FRM05
Inner Ring : 1745
Outer Ring : 1883
Length of sample : 139
Number in final analysis : 89
Information on fire history :
1795 U fire scar
1842 U fire scar FI = 47
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 44.5
Sample mean fire interval : 47.0

Series 6 : FRM06
Pith Date : 1680
Bark Date : 1950
Length of sample : 271
Number in final analysis : 221
Information on fire history :
1730 M fire scar
1740 D fire scar FI = 10
1743 M fire scar FI = 3
1752 U injury
1774 M injury
1777 M fire scar FI = 34
1793 L fire scar FI = 16
1795 M fire scar FI = 2
1809 M fire scar FI = 14

1814 A fire scar FI = 5
1842 D fire scar FI = 28
1847 D fire scar FI = 5
1866 D injury
1890 M fire scar FI = 43
1902 U injury
Total number of fire scars : 11
Total number all indicators : 15
Average number years per fire : 20.1
Sample mean fire interval : 16.0

Series 7 : FRM07
Inner Ring : 1670
Outer Ring : 1909
Length of sample : 240
Number in final analysis : 206
Information on fire history :
1704 A fire scar
1725 M fire scar FI = 21
1795 M fire scar FI = 70
1842 U fire scar FI = 47
Total number of fire scars : 4
Total number all indicators : 4
Average number years per fire : 51.5
Sample mean fire interval : 46.0

Series 8 : FRM08
Pith Date : 1652
Outer Ring : 1860
Length of sample : 209
Number in final analysis : 157
Information on fire history :
1704 A fire scar
1842 U fire scar FI = 138
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 78.5
Sample mean fire interval : 138.0

Series 9 : FRM09
Pith Date : 1780
Bark Date : 1968
Length of sample : 189
Number in final analysis : 127
Information on fire history :
1842 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 127.0

Series 10 : FRM10
Inner Ring : 1658
Outer Ring : 1762
Length of sample : 105
Number in final analysis : 59
Information on fire history :
1704 L fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 59.0

Series 11 : FRM11
Pith Date : 1772
Bark Date : 1996
Length of sample : 225
Number in final analysis : 155
Information on fire history :
1842 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 155.0

Series 12 : FRM12
Pith Date : 1611
Outer Ring : 1797
Length of sample : 187
Number in final analysis : 94
Information on fire history :
1704 D fire scar
1756 E fire scar FI = 52
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 47.0
Sample mean fire interval : 52.0

Fire-scar data for Frijoles Mesa Samples

Series 13 : FRM13
Pith Date : 1710
Bark Date : 1996
Length of sample : 287
Number in final analysis : 155
Information on fire history :
1842 D fire scar
1983 D injury
Total number of fire scars : 1
Total number all indicators : 2
Average number years per fire : 155.0

Series 14 : FRM14
Pith Date : 1758
Outer Ring : 1812
Length of sample : 55
Number in final analysis : 18
Information on fire history :
1795 L fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 18.0

Series 15 : FRM15
Inner Ring : 1722
Bark Date : 1907
Length of sample : 186
Number in final analysis : 113
Information on fire history :
1795 E fire scar
1826 A fire scar FI = 31
1842 U fire scar FI = 16
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 37.7
Sample mean fire interval : 23.5

Series 16 : FRM16
Pith Date : 1625
Bark Date : 1960
Length of sample : 336
Number in final analysis : 296
Information on fire history :
1665 M fire scar
1814 U fire scar FI = 149
1842 U fire scar FI = 28
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 98.7
Sample mean fire interval : 88.5

Series 17 : FRM17
Pith Date : 1658
Bark Date : 1908
Length of sample : 251
Number in final analysis : 244
Information on fire history :
1665 D fire scar
1704 M fire scar FI = 39
1795 M fire scar FI = 91
1826 A fire scar FI = 31
1842 D fire scar FI = 16
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 48.8
Sample mean fire interval : 44.3

Series 18 : FRM19
Inner Ring : 1629
Bark Date : 1954
Length of sample : 326
Number in final analysis : 113
Information on fire history :
1842 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 113.0

Series 19 : FRM20
Pith Date : 1743
Bark Date : 1996
Length of sample : 254
Number in final analysis : 224
Information on fire history :

Fire-scar data for Frijoles Mesa Samples

1773 D fire scar
1842 D fire scar FI = 69
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 112.0
Sample mean fire interval : 69.0

Series 20 : FRM21
Pith Date : 1620
Outer Ring :1892
Length of sample : 273
Number in final analysis : 51
Information on fire history :
1842 D fire scar
1892 D fire scar FI = 50
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 25.5
Sample mean fire interval : 50.0

Series 21 : FRM22
Pith Date : 1620
Bark Date : 1957
Length of sample : 338
Number in final analysis : 301
Information on fire history :
1657 A fire scar
1704 D fire scar FI = 47
1773 D fire scar FI = 69
1842 D fire scar FI = 69
1892 U fire scar FI = 50
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 60.2
Sample mean fire interval : 58.8

Series 22 : FRM23
Pith Date : 1601
Bark Date : 1951
Length of sample : 351
Number in final analysis : 347
Information on fire history :
1605 D fire scar
1725 L fire scar FI = 120
1773 D fire scar FI = 48
1842 D fire scar FI = 69
1892 D fire scar FI = 50
Total number of fire scars : 5
Total number all indicators : 5
Average number years per fire : 69.4
Sample mean fire interval : 71.7

Series 23 : FRM24
Pith Date : 1645
Outer Ring : 1937
Length of sample : 293
Number in final analysis : 235
Information on fire history :
1686 D injury
1704 A fire scar
1773 A fire scar FI = 69
1842 D fire scar FI = 69
1892 D fire scar FI = 50
Total number of fire scars : 4
Total number all indicators : 5
Average number years per fire : 58.8
Sample mean fire interval : 62.7

Series 24 : FRM26
Inner Ring : 1652
Outer Ring : 1943
Length of sample : 292
Number in final analysis : 171
Information on fire history :
1773 D fire scar
1842 D fire scar FI = 69
1880 M injury
1911 D injury
Total number of fire scars : 2
Total number all indicators : 4
Average number years per fire : 85.5
Sample mean fire interval : 69.0

Series 25 : FRM28

Fire-scar data for Frijoles Mesa Samples

Inner Ring : 1592
Outer Ring : 1940
Length of sample : 349
Number in final analysis : 287
Information on fire history :
1612 D injury
1625 D injury
1648 D injury
1657 L fire scar
1665 M fire scar FI = 8
1725 E fire scar FI = 60
1773 D fire scar FI = 48
1842 D fire scar FI = 69
1890 U fire scar FI = 48
Total number of fire scars : 6
Total number all indicators : 9
Average number years per fire : 47.8
Sample mean fire interval : 46.6

Series 26 : FRM30
Inner Ring : 1630
Outer Ring : 1948
Length of sample : 319
Number in final analysis : 292
Information on fire history :
1657 A fire scar
1704 D fire scar FI = 47
1725 M fire scar FI = 21
1773 D fire scar FI = 48
1801 D fire scar FI = 28
1842 D fire scar FI = 41
1892 D fire scar FI = 50
Total number of fire scars : 7
Total number all indicators : 7
Average number years per fire : 41.7
Sample mean fire interval : 39.2

Fire-scar data for Frijoles Experimental Watershed Samples

Series 1 : FWH01
Pith Date : 1614
Bark Date : 1940
Length of sample : 327
Number in final analysis : 237
Information on fire history :
1704 D fire scar
1842 D fire scar FI = 138
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 118.5
Sample mean fire interval : 138.0

Series 2 : FWH02
Pith Date : 1629
Bark Date : 1913
Length of sample : 285
Number in final analysis : 72
Information on fire history :
1842 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 72.0

Series 3 : FWH03
Pith Date : 1796
Bark Date : 1950
Length of sample : 155
Number in final analysis : 109
Information on fire history :
1842 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 109.0

Series 4 : FWH04
Inner Ring : 1754
Outer Ring : 1944
Length of sample : 191
Number in final analysis : 105
Information on fire history :
1814 D injury
1816 D injury
1842 D fire scar
Total number of fire scars : 1
Total number all indicators : 3
Average number years per fire : 105.0

Series 5 : FWH05
Pith Date : 1657
Bark Date : 1898
Length of sample : 242
Number in final analysis : 235
Information on fire history :
1664 M fire scar
1709 D injury
1725 E fire scar FI = 61
1730 U fire scar FI = 5
1773 D fire scar FI = 43
1810 D injury
1842 D fire scar FI = 69
1858 D fire scar FI = 16
Total number of fire scars : 6
Total number all indicators : 8
Average number years per fire : 39.2
Sample mean fire interval : 38.8

Series 6 : FWH06
Pith Date : 1620
Outer Ring : 1760
Length of sample : 141
Number in final analysis : 0
Information on fire history :
No information in this range.

Series 7 : FWH08
Inner Ring : 1746
Outer Ring : 1923
Length of sample : 178
Number in final analysis : 151
Information on fire history :
1773 M fire scar
1842 D fire scar FI = 69
1858 E fire scar FI = 16

Fire-scar data for Frijoles Experimental Watershed Samples

Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 50.3
Sample mean fire interval : 42.5

Series 8 : FWH09
Pith Date : 1584
Outer Ring : 1828
Length of sample : 245
Number in final analysis : 110
Information on fire history :
1709 D fire scar
1725 E fire scar FI = 16
1773 D fire scar FI = 48
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 36.7
Sample mean fire interval : 32.0

Series 9 : FWH10
Pith Date : 1640
Bark Date : 1954
Length of sample : 315
Number in final analysis : 182
Information on fire history :
1773 U fire scar
1842 D fire scar FI = 69
1858 M fire scar FI = 16
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 60.7
Sample mean fire interval : 42.5

Series 10 : FWH11
Pith Date : 1777
Bark Date : 1935
Length of sample : 159
Number in final analysis : 149
Information on fire history :
1787 D fire scar
1842 D fire scar FI = 55
1858 D fire scar FI = 16
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 49.7
Sample mean fire interval : 35.5

Series 11 : FWH12
Inner Ring : 1766
Bark Date : 1905
Length of sample : 140
Number in final analysis : 64
Information on fire history :
1842 D fire scar
1858 M fire scar FI = 16
1867 M fire scar FI = 9
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 21.3
Sample mean fire interval : 12.5

Series 12 : FWH13
Inner Ring : 1766
Outer Ring : 1841
Length of sample : 76
Number in final analysis : 0
Information on fire history :
No information in this range.

Series 13 : FWH14
Inner Ring : 1630
Outer Ring : 1873
Length of sample : 244
Number in final analysis : 205
Information on fire history :
1638 L injury
1651 A injury
1671 E fire scar
1725 M fire scar FI = 54
1773 D fire scar FI = 48
1842 D fire scar FI = 69
Total number of fire scars : 4
Total number all indicators : 6
Average number years per fire : 51.3

Fire-scar data for Frijoles Experimental Watershed Samples

Sample mean fire interval : 57.0

Series 14 : FWH15
Inner Ring : 1694
Bark Date : 1862
Length of sample : 169
Number in final analysis : 138
Information on fire history :
1725 D fire scar
1842 D fire scar FI = 117
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 69.0
Sample mean fire interval : 117.0

Series 15 : FWH16
Pith Date : 1740
Bark Date : 1946
Length of sample : 207
Number in final analysis : 203
Information on fire history :
1744 M fire scar
1773 M fire scar FI = 29
1842 D fire scar FI = 69
Total number of fire scars : 3
Total number all indicators : 3
Average number years per fire : 67.7
Sample mean fire interval : 49.0

Series 16 : FWH17
Pith Date : 1765
Outer Ring : 1929
Length of sample : 165
Number in final analysis : 79
Information on fire history :
1842 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 79.0

Series 17 : FWH18
Pith Date : 1685
Outer Ring : 1916
Length of sample : 232
Number in final analysis : 144
Information on fire history :
1773 D fire scar
Total number of fire scars : 1
Total number all indicators : 1
Average number years per fire : 144.0

Series 18 : FWH19
Inner Ring : 1652
Bark Date : 1893
Length of sample : 242
Number in final analysis : 121
Information on fire history :
1773 M fire scar
1842 D fire scar FI = 69
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 60.5
Sample mean fire interval : 69.0

Series 19 : FWH20
Pith Date : 1730
Outer Ring : 1958
Length of sample : 229
Number in final analysis : 186
Information on fire history :
1773 U fire scar
1842 U fire scar FI = 69
Total number of fire scars : 2
Total number all indicators : 2
Average number years per fire : 93.0
Sample mean fire interval : 69.0