

Historical and current landscape-scale ponderosa pine and mixed conifer forest structure in the Southern Sierra Nevada

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Abstract. Many managers today are tasked with restoring forests to mitigate the potential for uncharacteristically severe fire. One challenge to this mandate is the lack of large-scale reference information on forest structure prior to impacts from Euro-American settlement. We used a robust 1911 historical dataset that covers a large geographic extent (>10,000 ha) and has unbiased sampling locations to compare past and current forest conditions for ponderosa pine and mixed conifer forests in the southern Sierra Nevada. The 1911 dataset contained records from 18,052 trees in 378 sampled transects, totaling just over 300 ha in transect area. Forest structure was highly variable in 1911 and shrubs were found in 54% of transects. Total tree basal area ranged from 1 to 60 m² ha⁻¹ and tree density from 2 to 170 ha⁻¹ (based on trees >30 cm dbh). K-means cluster analysis divided transects into four groups: mixed conifer-high basal area (MC High BA), mixed conifer-average basal area (MC Ave BA), mixed conifer-average basal area-high shrubs (MC Ave BA Shrubs), and ponderosa pine (Pond Pine). The percentage of this 1911 landscape that experienced high severity fire was low and varied from 1–3% in mixed conifer forests and 4–6% in ponderosa pine forests. Comparing forest inventory data from 1911 to the present indicates that current forests have changed drastically, particularly in tree density, canopy cover, the density of large trees, dominance of white fir in mixed conifer forests, and the similarity of tree basal area in contemporary ponderosa pine and mixed conifer forests. Average forest canopy cover increased from 25–49% in mixed conifer forests, and from 12–49% in ponderosa pine forests from 1911 to the present; canopy cover in current forest types is similar but in 1911 mixed conifer forests had twice the canopy cover as ponderosa pine forests. Current forest restoration goals in the southern Sierra Nevada are often skewed toward the higher range of these historical values, which will limit the effectiveness of these treatments if the objective is to produce resilient forest ecosystems into the future.

Key words: fire ecology; fire management; fire severity; forest ecology; forest resiliency; reference conditions; restoration.

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INTRODUCTION

Throughout much of the drier, low- to mid-elevation coniferous forests in western North America fires historically burned at intensities that often left mature trees unaffected or scarred by fire, but seldom killed (Allen et al. 2002, Collins and Stephens 2007) even when preceded by multi-year drought (Stephens et al. 2008). Mid-elevation forests in the Sierra Nevada, such as those historically dominated by ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*P. jeffreyi*), and other mixed conifer species commonly burned many times per century (Van de Water and Safford 2011) and this produced generally open stand structures (Figs. 1 and 2). These low to moderate intensity fires burned for months at a time and collectively covered very large areas (Skinner and Chang 1996).

While it is clear that fires historically had a strong influence on forest structure at the stand-scale and vegetation patterns at the landscape scale, there are topographic controls on vegetation, which can operate independent of fire (Show and Kotok 1929, Rundel et al. 1977). These topographic controls affect available moisture and temperature patterns, which in combination influence vegetation composition and structure. Elevation has long been noted as a driver of vegetation composition, which in the Sierra Nevada results in greater *Pinus* dominance in lower elevations of the montane zone and greater *Abies* dominance in the mid-to upper montane zone (Show and Kotok 1929). However what is actually a stronger predictor of forest composition in the Sierra Nevada is the trade-off between evaporative demand, which is affected by slope aspect and elevation, and water supply, which is affected by soil properties and precipitation patterns (Stephenson 1998).

In the late 19th and early 20th centuries, policies of fire exclusion, introduction of livestock grazing, and elimination of Native American ignitions greatly reduced fire frequencies in ponderosa pine and mixed conifer forests (Stephens et al. 2007a). With these changes many contemporary forests have substantially increased in their vulnerability to uncharacteristically severe fire (Agee and Skinner 2005), exhibited primarily through the creation of large high severity patches. These large patches, where

most if not all of the trees are dead, can impede conifer tree regeneration (Barton 2002, Goforth and Minnich 2008, Roccaforte et al. 2012, Collins and Roller 2013, Crotteau et al. 2013, Crotteau et al. 2014) and predispose them for repeated high severity fire and potentially, type conversion (Van Wagtenonk et al. 2012, Collins and Skinner 2014). As a result, many forest managers today are tasked with mitigating the potential for uncharacteristic severe fire (North et al. 2009, Stephens et al. 2013).

The methods used by managers to reduce fire hazards and restore US coniferous forests are prescribed fire, mechanical treatments, and managed wildfire (Stephens et al. 2009). US National Park Service policy mandates incorporation of natural disturbances into management plans to maintain parks in an unimpaired state (van Wagtenonk 2012). One obvious challenge to this mandate is the lack of large-scale reference information on forest structure prior to the impacts from Euro-American settlement. Where feasible, fire history data provides historical reference information in the context of the natural range of variability of disturbance regimes (Allen et al. 2002, Reynolds et al. 2013). Based on the records preserved in trees rings (fire scars and tree ages) researchers have reconstructed fire regimes (Kilgore and Taylor 1979, Caprio and Swetnam 1995, Swetnam et al. 2009) and past forest structure (North et al. 2007, Hurteau and North 2010) from forests in the southern Sierra Nevada. Additionally, there is one study in giant sequoia (*Sequoiadendron giganteum*)-mixed conifer forests that reported forest structure based on a set of plots measured in 1900–1901 (Stephens and Elliott-Fisk 1998); however, plot locations used in this study were biased and are not representative of southern Sierra Nevada mixed conifer forest as a whole. In many cases these studies were intended to inform managers and policy makers of the historical or natural range of variability operating on the landscape which can assist in the development of restoration plans.

One of the biggest limitations of forest structure reconstructions based on dendrochronology is their limited spatial extents. In addition, tree-ring based reconstructions are subject to an inherent limitation brought about by only using extant data. When there is a considerable amount



Fig. 1. Mixed conifer forest from Chiquito Basin on the Sierra National Forest. Photo taken in 1914 by E. G. Dudley (USFS Bass Lake Ranger District historic photo archives; photo no. HP00971). Original caption read, “Typed-Sugar Pine killed by *Dendroctonus monticolae*, Chiquito Basin. Taken by Dudley, 1914.”

of time between the reconstruction period and data collection, as there is with most historical forest reconstructions in the western US (>100 years), uncertainty increases owing to sample losses from fire, insects, disease, and decomposition (Collins et al. 2011).

Large historical datasets, collected from the field and archived, are an alternative source of information used in forest reconstructions (e.g., Leiberger 1902, Wieslander et al. 1933). These datasets sometimes allow for detailed quantitative comparisons of current versus historical forest structure and composition (Lutz et al. 2009). However, there are a number of concerns associated with historical datasets: (1) limited geographic extent, (2) unknown or unrepeatable study site selection and inventory methodolo-

gies, and (3) limited temporal depth. Finding a historical dataset that addresses all of these concerns would be extremely difficult, if not impossible (Collins et al. 2011, Haggmann et al. 2013). That stated, we have identified a historical dataset that covers a large geographic extent (>10,000 ha) and has unbiased sampling locations. This particular dataset consists of early timber inventories conducted by the US Forest Service (USFS) and includes robust tree measurements over large areas, which contrasts with the reconstruction of forest structure from very low density tree measurements from General Land Office records (e.g., Baker 2014). In California, these inventories were conducted ca. 1910 and were part of the first organized assessment of all timber resources within the then, new agency



Fig. 2. Historic conditions in a ponderosa pine stand on the Sierra National Forest (ca. 1917; Sierra National Forest Photo HP03137).

(Collins et al. 2011).

In this study we take advantage of a portion of these early USFS timber inventories that were conducted on what was then the Kern National Forest (now part of the Sequoia National Forest). A comparison of current forest conditions to those based on the early inventories can provide information on potential changes driven primarily by 20th century fire exclusion policies and harvesting. Such comparisons can provide information to managers on how close current forest structure and composition is to a time when natural processes operated on the landscape. Our objectives were to: (1) summarize historical timber inventory records, (2) identify distinct forest types based on forest structure and species composition, and (3) compare past and current forest conditions for ponderosa pine and mixed conifer forests at the landscape scale in the southern Sierra Nevada.

STUDY AREA

The forest sampled in 1911 was in the Greenhorn Mountains of the southern Sierra

Nevada. This area is characterized as west-slope Sierra Nevada ponderosa pine and mixed conifer forests (Figs. 1 and 2) consisting of ponderosa pine, sugar pine (*Pinus lambertiana*), white fir (*Abies concolor*), incense-cedar (*Calocedrus decurrens*), California black oak (*Quercus kelloggii*), and canyon live oak (*Q. chrysolepis*). The climate is Mediterranean with cool, wet winters and hot, dry summers. Annual precipitation ranges from 9 to 74 cm year⁻¹, with an average of 32 cm year⁻¹; mean monthly temperatures range from 0.9°C in January to 20.3°C in July (data from the Piutes Remote Automated Weather Station, 2005–2011).

The study site covers 11,500 ha and topography varies within this area. Elevation in the study area ranges between 1430 and 2270 m. The southern portion of the area is of lower elevation (1430–1980) while the northern area is higher (1560–2270). Soils in this area are predominately coarse-loamy well-drained dystric xerochrepts (under taxonomic order of inceptosols). Prior to the late 1800s fire was common in this region, with a mean point fire return interval of approximately 5–20 years (Kilgore and Taylor

1979, Caprio and Swetnam 1995). With the onset of fire exclusion fire was largely removed from the study area.

Early land use information from the Greenhorn Mountains is provided by records from the Sequoia National Forest (USDA 2013; Jim Whitfield, Ecosystem Staff Officer, Sequoia National Forest, *personal communication*, 2014). Small portions of the Greenhorn Mountains were logged using only wagons and horses in the late 19th and early 20th centuries. There was no railroad logging in this area. The nearest record of railroad logging is on the Hume Lake Ranger District which is approximately 75 km northwest of the study site (Otter 1963, Johnston 1997). Most of the earliest logged areas in the Greenhorn Mountains were located near mining camps around Lake Isabella that are not included in the 1911 transects. Other areas logged prior to 1911 were located at lower elevations that were more accessible by early roads and were used to construct houses in the growing town of Bakersfield, California. The historic inventory records collected for this study included 15 survey transects that mentioned prior cutting; these were excluded from the study.

METHODS

Historical forest inventory data

All of the historical forest inventories within our study area were conducted in 1911. The inventories were conducted by two-person crews, with one person compass and distancing and the other assessing the forest. Their assessments involved recording all live conifer trees ≥ 30.5 cm (12 inches) in diameter at breast height (dbh) within belt transects that were 20.1 m (66 feet or 1 chain) wide and 402 m (1320 feet or 20 chains) long. Trees were tallied by species into dbh classes of 5.1 cm (2 inches). Recording of smaller trees (< 30.5 cm dbh) was inconsistent across transects. In addition to inventorying trees the following observations were made in each transect: rock type and exposure, soil texture, ground cover, and shrub cover. General notes on forest condition, including insect depredation, fire damage, stand development stage, and the spatial distribution of the trees were also recorded.

Transect locations were based systematically

on the Public Land Survey System (PLSS), which was the primary method used to survey rural or undeveloped land in the western US. Transects started and ended at the mid-points of quarter-quarter sections, which we refer to as lots, with one belt transect sampled in each 15.7 ha (40 acres) lot for the area surveyed. Transects were placed as strips across a section (an area comprised of 16 lots) and generally oriented either N-S or E-W, against dominant contour within a section. Some transects were placed for 10 chains in a N-S direction followed by 10 chains in an E-W direction allowing surveyors to connect strips within a section. Each transect covered 0.9 ha (2 acres).

We assembled a suite of variables to characterize forest structure and composition using tree lists generated from the 1911 belt transect data. The tree lists were standardized for area sampled such that outputs represented per hectare values. The constructed variables were: tree density for all trees and partitioned into three dbh classes, proportion of stand basal area by three species groups, and total basal area. Basal area is the total cross-sectional area of all live tree stems in a stand (similar basal area can be produced by a few large trees or many small trees). The three dbh classes used to report partitioned tree density were: 30.5–61.0 cm, 61.1–91.4 cm, > 91.4 cm, and were based on a stand classification scheme used in forest management throughout the Sierra Nevada (USDA 2004) and in previous work (Lutz et al. 2009, Collins et al. 2011). The species groups that we investigated for potential changes in proportion of stand basal area were: (1) pine—ponderosa pine and sugar pine, (2) true fir—white fir and red fir (*Abies magnifica*), and (3) incense-cedar.

In addition to recording information on forest structure and site characteristics, during the surveys the field crew took detailed notes on vegetation conditions along transects (see Appendix for a copy of all notes recorded during this inventory); these records were used to estimate the incidence of high severity fire. Surveyors typically noted where they entered and exited patches of contrasting vegetation, such as chaparral or dense “immature” timber, but did not record explicit descriptions of fire severity in terms of damage to timber; we assumed these areas were burned by high

severity fire. We used the length of these discrete forest patches along survey transects to estimate the proportion of high severity fire on the landscape (average proportion of transect in high severity patch multiplied by percentage of total transects with evidence suggesting high severity fire).

The presence of chaparral in these forests can be both a successional change brought about by high severity fire (Kauffman and Martin 1991) or it can be a product of edaphic conditions that limit tree establishment/growth (e.g., dry sites with shallow soils) (Nagel and Taylor 2005). Given the uncertainty as to what was driving the observed chaparral, we bracketed our estimates of high severity fire. We noted transects in which observed chaparral may have been environmentally and/or edaphically controlled (see Appendix). These included transects at the edge of the timber survey area, which corresponded with the extent of the timber belt, as well as transects that had distinct topographic features, such as a ridge tops or steep canyons. Our bracketed high severity fire estimates included and excluded these potentially environmentally and/or edaphically controlled transects. In all cases the high severity patches were smaller than the length of the transect, or did not result in complete mortality across a transect, because all transects contained trees >61 cm dbh.

Current forest inventory data

The Forest Inventory and Analysis (FIA) program provides a nationwide inventory of forestlands in the US and is executed by the USFS. The FIA program delivers inventory and monitoring data related to forest structure, composition, and health, based on a set of systematically randomized plots across the country. Standard FIA plot densities are one plot per 2428 ha (6000 ac). FIA plots (673 m²) are divided into four 7.3 m (24 ft) radius circular subplots, with one central subplot and three peripheral subplots arranged at 120-degree angles from plot center. Peripheral subplots are situated at a distance of 36.6 m (120 ft) from the subplot center to the plot center. For all subplots, every tree >12.7 cm (5 in) is measured (dbh, height) and identified to species. Each subplot also contains a 2.1 m (6.8 ft) radius circular microplot for the measurement of tree regeneration (all

trees <12.7 cm dbh, seedlings and saplings). More information pertaining to FIA protocol can be found in Bechtold and Patterson (2005), Woudenberg et al. (2011), and the FIA program website (<http://www.fia.fs.fed.us/>). All FIA plot data used here was based on the most recent FIA protocol.

Data analysis

Vegetation in the 1911 transects was summarized by basal area, stem density of tallied trees, and shrub cover. Shrubs, as they were denoted by 1911 surveyors, included mountain misery (*Chamaebatia foliolosa*), manzanita (*Arctostaphylos* spp.), black oak, canyon live oak, scrub oak (*Q. berberidifolia*, or shrubby form of *Q. kelloggii* or *Q. chrysolepis*), chaparral, chinquapin (*Chrysolepis sempervirens*), willow (*Salix* spp.), mountain mahogany (*Cercocarpus betuloides*), wild plum (*Prunus* spp.), and Sierra gooseberry (*Ribes roezlii*). We converted qualitative assessments of cover, assigning a cover of 10%, 20%, 50% or 90% for each species based on the description provided by the surveyor (e.g., sparse, scattered, moderate, and dense, respectively). It is worth noting that for the entire 1911 area included in our analysis there were only two sets of observers; therefore, a reasonable assumption of consistency in the written descriptions across the survey area.

Topographic variables were derived using a digital elevation model (Gesch et al. 2002, Gesch 2007). Raster datasets for slope, aspect, and curvature were generated using Spatial Analyst tools in ArcMap 10.1. Aspect was classified so that values ranged from 0 (xeric) to 20 (mesic) (Parker 1982). Pixels were categorized by four topographic position index (TPI) classes (valley bottom, gentle slope, steep slope, ridgetop) using the CorridorDesigner toolbox (Majka et al. 2007). The default settings of the “create topographic position raster” tool were used so that pixel elevation was assessed relative to neighboring pixels within 200 m, with those being lower or higher by 12 m compared to the neighborhood average classified as valley bottom or ridgetop, respectively. The cutoff point for gentle versus steep slope was 6° (10.5%).

A raster of topographic relative moisture index (TRMI) was calculated using TPI, aspect, slope, and curvature following the method of Parker

(1982). Actual evapotranspiration (AET) and annual climatic water deficit were calculated using soil water holding potential, temperature, and precipitation (Churchill et al. 2013). We used the soil water holding capacity in the top 150 cm of the soil (Soil Survey Staff 2013) and weather data from the period 1901–1910, obtained from Climate WNA (Wang et al. 2011). All topographic variables were calculated at a 10 m resolution except AET and water deficit, which were calculated at a 30 m resolution then resampled to a 10 m pixel size to match that of the other variables. Mean transect values for continuous topographic variables were extracted from 10-m raster layers using zonal statistics. For TPI, proportion of transect area in each class was calculated, and a TPI class was assigned to each transect based on the majority area in each class.

Transects were classified into groups using k-means cluster analysis (Hartigan and Wong 1979). Clustering was based on the following overstory and understory structure variables: cover of mountain misery, total cover of all other shrub species, basal area by tree species (yellow pine [ponderosa and Jeffrey pine], sugar pine, incense-cedar, white fir, and total), and stem density by size class (30.4–61, 61.1–91.4, >91.4 cm dbh and total). Variables were z-score standardized prior to clustering to account for differences in scale (McCune and Grace 2002). To select the optimum number of clusters we compared results for up to a 12 cluster solution to 250 runs done using randomized input data. Graphs of the within-group sum of squared error (SSE) and the absolute difference in SSE from the average SSE of the randomized data were examined. The cluster solution that maximized the difference between sum of squared error for the chosen cluster solution and the average of the randomized runs was selected (Peeples 2011).

To investigate whether identified vegetation groups were associated with different topographic characteristics we used a two-stage analysis. First, we used a random forest analysis to identify which, if any, of the constructed topographic variables explained the occurrence of the vegetation groups. This was performed in R version 3.0.2, using the conditional inference method “cforest” (Hothorn et al. 2006). This method constructs a suite of conditional inference trees, using a randomly selected subset of

predictor variables and a random subsample of plots for each tree. Examining a large number of trees allows for identification and ranking of influential variables, and averages out the instability of individual regression trees that can exhibit large changes in structure due to random variation in the data (Strobl et al. 2009). Variable importance was assessed using the conditional method developed by Strobl et al. (2008). The second part of this analysis was to compare values for the top three topographic variables, as indicated by the variable importance rankings from the random forest analysis, among the vegetation groups using an ANOVA model that accounted for unequal variances. When ANOVA models were significant ($\alpha = 0.05$) a Games-Howell comparison was used to compare means among vegetation group (Games and Howell 1976). This was performed using “proc MIXED” in SAS version 9.4.

Following the cluster analysis, the Forest Vegetation Simulator (FVS; Dixon 2002) was used to estimate canopy cover for the historical inventory transects. FVS uses tree species and size to generate crown radii for all trees in a given belt transect. FVS then calculates the percentage of ground area directly covered with tree crowns, correcting for canopy overlap (Dixon 2002). To investigate how well FVS canopy cover estimates approximate field-based observations in old-growth forests, we compared field-measured canopy cover from an intact Jeffrey pine-mixed forest in the Sierra San Pedro Mártir, Mexico (Stephens and Gill 2005), to FVS-estimated canopy cover for the same plots. This was done for 25 0.1-ha circular plots, which were established on a regular 125-m grid. Within each plot the following information was collected for each tree >1 cm dbh: status (live/dead), species, and dbh (to nearest 0.1 cm). Canopy cover was assessed with GRS densitometer based on a 5×5 grid, with approximately 3 m between grid points. The number of points that intersected tree crowns was multiplied by four to obtain percent canopy cover. The trees recorded on each plot were entered into FVS to generate modeled estimates of canopy cover for comparison to field based measurements.

FIA plot data was obtained from all west-side mixed conifer and ponderosa pine forests on the Sequoia and Sierra National Forests (data col-

Table 1. Forest structure (means $\pm$ SD) in each K-means group for the 1911 Kern National Forest data. MC, mixed conifer; BA, basal area; Pond Pine, Ponderosa pine; dbh, diameter at breast height.

Characteristic	K-means group				Total
	MC High BA	MC Ave BA	MC Ave BA Shrubs	Pond Pine	
N	55	127	39	157	378
Understory (% cover)					
Mountain misery	0.0 $\pm$ 0.0	5.4 $\pm$ 13.7	61.8 $\pm$ 29.1	1.4 $\pm$ 6.7	8.8 $\pm$ 22.2
All shrubs	20.0 $\pm$ 24.4	25.7 $\pm$ 29.8	75.6 $\pm$ 54.4	13.8 $\pm$ 29.1	25.0 $\pm$ 36.7
Basal area (m ² ha ⁻¹)					
White fir	21.6 $\pm$ 8.8	6.8 $\pm$ 4.6	5.2 $\pm$ 4.1	2.0 $\pm$ 3.4	6.8 $\pm$ 8.2
Incense-cedar	13.7 $\pm$ 7.9	10.2 $\pm$ 5.6	8.3 $\pm$ 3.0	2.1 $\pm$ 2.8	7.1 $\pm$ 6.6
Sugar pine	4.0 $\pm$ 4.1	2.4 $\pm$ 2.6	5.0 $\pm$ 3.2	0.6 $\pm$ 1.1	2.2 $\pm$ 2.9
Ponderosa pine	2.4 $\pm$ 3.2	5.3 $\pm$ 4.3	9.6 $\pm$ 4.7	6.5 $\pm$ 4.5	5.8 $\pm$ 4.7
Total basal area	41.8 $\pm$ 7.0	24.6 $\pm$ 5.7	28.0 $\pm$ 9.5	11.2 $\pm$ 5.1	21.9 $\pm$ 12.2
Tree density (ha ⁻¹)					
30.4–61 cm dbh	49.6 $\pm$ 20.8	30.8 $\pm$ 13.9	62.3 $\pm$ 24.2	11.8 $\pm$ 8.9	29.0 $\pm$ 22.8
61.1–91.4 cm dbh	20.9 $\pm$ 6.7	14.1 $\pm$ 6.0	22.8 $\pm$ 11.2	6.6 $\pm$ 4.4	12.9 $\pm$ 8.7
> 91.4 cm dbh	26.9 $\pm$ 8.7	14.6 $\pm$ 6.3	9.0 $\pm$ 4.7	6.9 $\pm$ 4.1	12.6 $\pm$ 8.9
Total	97.5 $\pm$ 19.6	59.4 $\pm$ 14.6	94.1 $\pm$ 32.2	25.2 $\pm$ 12.1	54.5 $\pm$ 33.0

lected from 2001 to 2008) to compare to the 1911 forest structure data. The same forest structure variables were computed for the FIA data as described above for the 1911 historical data. Note that we only included trees >30.5 cm dbh from the FIA data to match the minimum diameter used for the 1911 data. We tested for differences in forest structure variables among time periods (1911 against recent FIA) using Welch's variance-weighted one-way ANOVA, which does not require an underlying assumption of homogeneity of variances (Welch 1951). This analysis was done with Proc GLM in SAS version 9.4.

RESULTS

Overall the 1911 dataset contained 18,052 trees in 378 transects, totaling just over 300 ha in transect area. Forest structure was highly variable in this forest. Total tree basal area ranged from 1 to 60 m² ha⁻¹ and tree density ranged from 2 to 170 ha⁻¹ (based on trees >30 cm dbh). On average the basal area was comprised of 25% white fir, 29% incense-cedar, 8% sugar pine, and 38% ponderosa pine. For each species, the proportion of transects in which it was absent were: 18% (white fir), 19% (incense-cedar), 35% (sugar pine) and 8% (ponderosa pine). Stems 30–60 cm dbh were about twice as abundant on average as those in the 60–90 and >90 cm size classes (Table 1). Shrubs (all species including mountain misery) were found in 54.4% of transects.

K-means cluster analysis divided transects into four groups (Table 1). The first group, mixed conifer-high basal area (MC High BA) was characterized by high total tree basal area and stem density, with high basal area of white fir, incense-cedar, and sugar pine but low ponderosa pine basal area and density. This group accounted for 15% of the total survey area. White fir and incense-cedar were the dominant species in this group and mountain misery was entirely absent. The second group was mixed conifer-average basal area (MC Ave BA) and had values close to the overall averages for all forest structure variables in the sampled landscape, and accounted for 34% of the total area. Incense-cedar had the highest tree basal area, but white fir and ponderosa pine were also co-dominant (based on tree basal area). The third group, mixed conifer-average basal area-high shrubs (MC Ave BA Shrubs) had very high cover of mountain misery and other shrubs, above average density of trees <91.4 cm dbh, and high basal area of pine species, particularly ponderosa pine. This group accounted for 10% of the 1911 survey area. The two species with the greatest overall tree basal area in this group were ponderosa pine and incense-cedar. The last group, which accounted for the largest percentage of area (41%), was dominated by ponderosa pine (Pond Pine) and had low conifer density, and tended to have lower than average tree basal area of all species except ponderosa pine. K-means groups tended to be spatially clustered within the study area

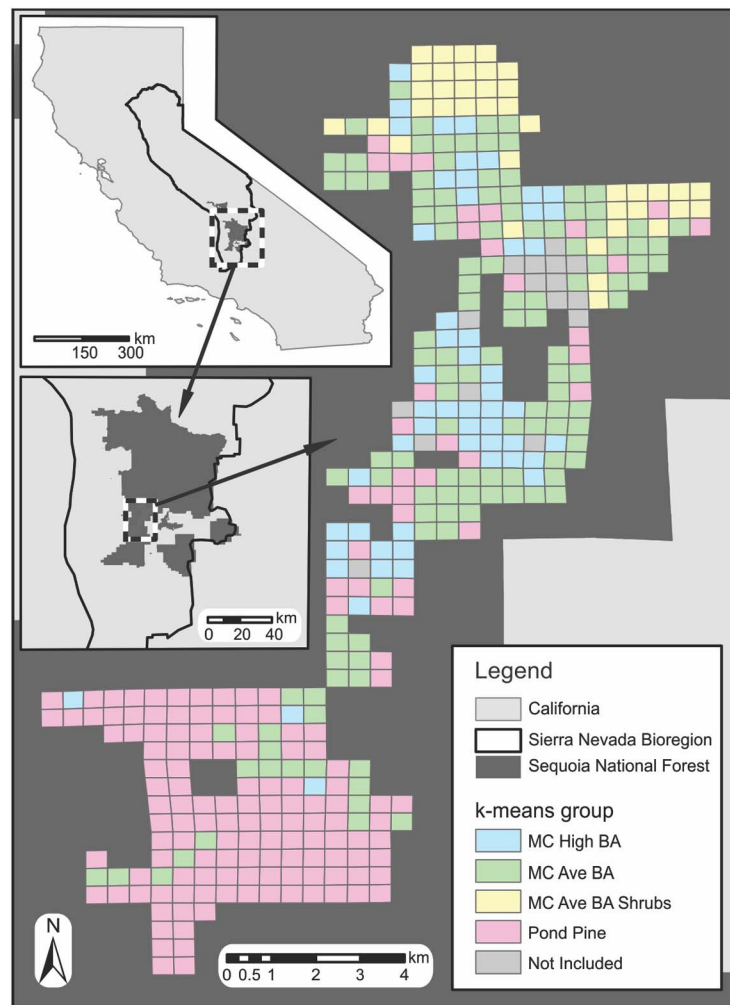


Fig. 3. Map showing location of 1911 survey area within California (top left inset) and Sequoia National Forest (lower left inset). Black and white dashed squares show the area represented in the second inset and the main map. Colors on main map depict K-means clusters in ponderosa pine (PP) and mixed conifer (MC) forests. BA, basal area.

(Fig. 3); the southwestern portion of the study area was predominantly in the Pond Pine group.

Density of trees >91 cm dbh was the highest in MC High BA and basal area was approximately $42 \text{ m}^2 \text{ ha}^{-1}$. The two MC classes with average basal areas (MC Ave BA, MC Ave BA Shrubs) differed by understory shrub cover (26% versus 76%) and the dominance of mountain misery (5% versus 62%), respectively. Interestingly the average mixed conifer areas with high shrubs were primarily located in the northern and northeastern portions of the study area (Fig. 3). The shrub dominated areas had a higher proportion

of ponderosa pine that was co-dominated by incense-cedar; the areas with lower shrub cover were dominated incense-cedar with a co-dominance of white fir (Table 1). Tree density in the 30–61 cm dbh class was twice as large in the MC Ave BA Shrub group when compared to the MC Ave BA group even though average total basal areas were very similar.

The three highest ranking variables from the random forest analysis were AET, Elevation, and Aspect (Appendix: Fig. A1). ANOVA results indicated significant differences among groups for all three variables (Table 2). For all three

Table 2. Topographic conditions (means $\pm$ SD) in each K-means group for the 1911 Kern National Forest data. Letters denote Games-Howell significance groupings between K-means groups ($P < 0.05$). AET, actual evapotranspiration.

K-means group	AET (mm)	Elevation (m)	Aspect ($^{\circ}$) [†]
Pond Pine	357.9 ^A $\pm$ 34.3	1753 ^A $\pm$ 122.4	140, 267 ^A $\pm$ 31
MC Ave BA	307.1 ^B $\pm$ 24.9	1866 ^B $\pm$ 107.1	125, 288 ^B $\pm$ 38
MC Ave BA Shrubs	294.1 ^C $\pm$ 17.6	1906 ^{BC} $\pm$ 88.9	115, 296 ^{BC} $\pm$ 41
MC High BA	305.3 ^{BC} $\pm$ 50.5	1935 ^C $\pm$ 128.8	106, 305 ^C $\pm$ 33

[†] Statistical comparisons for aspect were done prior to back-transforming values. Transformed values were 7.6 ± 3.4 , 9.9 ± 4.2 , 108 ± 4.5 , and 11.8 ± 3.7 for Pond Pine, MC Ave, MC Shrubs, and MC High, respectively.

topographic variables, Pond Pine was different from the other three groups, having higher AET, lower elevation, and more southwesterly aspects (average transformed value of 7.6, corresponding to 140° and 267°) (Table 2). MC High BA occurred on higher elevations and northeasterly aspects (average transformed value of 11.8, corresponding to 106° and 305°). MC Ave BA Shrubs occurred on sites with the lowest AET, but had similar elevations and aspects to those for the other two MC groups (Table 2).

The 1911 surveyor's notes indicated that low

fire damage was the most common observation in these forests followed by moderate fire damage (Table 3). Collectively these two categories covered approximately 92% of all three mixed conifer structural groups and 76% of the Pond Pine structural group (Pond Pine also had 17% of plots with no recent fire recorded) (Table 3). High fire damage, including that inferred by the presence of chaparral or immature timber, was recorded on very few transects (Table 3). The percentage of this landscape that experienced high severity fire in the last decade or two (or

Table 3. Forest structural group surveyor notes (% reported in each category) on the condition of timber from the Kern National Forest in 1911 as recorded on the United States Department of Agriculture Forest Service Form 321A. Complete surveyor notes are in the Appendix. MC, mixed conifer; BA, tree basal area; Ave, average; Pond Pine, ponderosa pine.

Type	Condition	K-means group			
		MC High BA	MC Ave BA	MC Ave BA Shrubs	Pond Pine
Fire damage	none	1.9	4.9	5.1	16.7
	low	55.6	54.1	69.2	61.5
	moderate	37.0	38.5	17.9	14.7
	high	5.6	2.5	7.7	7.1
Oak	none	45.5	22.1	38.5	25.5
	low	36.4	34.6	25.6	24.8
	moderate	15.9	23.1	25.6	22.9
	high	2.3	20.2	10.3	26.8
Pest/pathogen	none	20.0	25.5	12.8	43.1
	moss	55.6	28.3	0.0	25.5
	mistletoe	0.0	3.8	0.0	10.5
	fungus	8.9	22.6	2.6	22.2
Regeneration	insects	26.7	45.3	87.2	31.4
	none	9.3	16.0	43.6	5.1
	scarce	11.1	8.0	38.5	4.5
	low	18.5	20.0	10.3	31.4
Tree distribution	moderate	51.9	37.6	7.7	39.7
	high	9.3	18.4	0.0	19.2
	scattered	13.2	37.5	36.8	31.0
	open	2.6	10.2	18.4	31.0
	groups	2.6	12.5	26.3	6.2
	fairly dense	23.7	8.0	0.0	6.2
	dense	15.8	0.0	0.0	0.9
	patchy	18.4	22.7	5.3	23.0
	uniform	23.7	5.7	13.2	0.0

Table 4. High severity fire percentage in historical ponderosa pine and mixed conifer forests in the southern Sierra Nevada. The lower estimate includes transects that had immature timber without fire damage as well as transects with patches of chaparral and reproduction but soils were not described as rocky. The high range estimate also includes transects where chaparral was on the edge of the study area or occurred on a ridge or slope that the surveyor noted was rocky. Complete surveyor notes are included in the Appendix. MC, mixed conifer; BA, tree basal area; Pond Pine, ponderosa pine; Ave, average.

Characteristic	K-means group			
	MC High BA	MC Ave BA	MC Ave BA Shrubs	Pond Pine
Transects with a high severity patch (%)	5.6–7.4	2.5–3.3	7.7	7.1–13.5
Average proportion of transect in high severity	0.25, 0.33	0.28, 0.38	0.13	0.47, 0.58
Landscape area in high severity (%)	1.8	2.3–3.4	1	4.1–6.3

longer in the case of transects consisting of immature timber) was low and varied from 1% to 3% in mixed conifer forests and from 4% to 6% in ponderosa pine forests (Table 4). Insects that were causing some tree mortality were recorded in 30–45% of Pond Pine, MC High BA, and MC Ave BA structural groups; this increased to 87% in the MC Ave BA Shrubs group (Table 3).

Tree regeneration was recorded as “none”, “scarce”, or “low” in approximately 40% of the Pond Pine, MC High BA, and MC Ave BA structural groups; this increased to 92% in the MC Ave BA Shrubs group. Conversely, approximately 20% of the MC Ave BA and Pond Pine groups had “high” conifer tree regeneration (Table 3). Oaks were present in many plots, with fewer in the MC Ave BA Shrubs and MC High BA structural groups (Table 3). Tree distributions within the belt transects were diverse with approximately one-third of MC Ave BA, MC Ave BA Shrubs, and Pond Pine structural groups having a “scattered” distribution (Table 3). Pond Pine forests were noted for their openness and MC High BA areas for their high density (41% of transects). Trees were recorded as “distributed in groups” in 26% of the MC Ave BA Shrubs structural group with MC High BA having the fewest groups (2.6%) (Table 3). Approximately 20% of the transects in MC High BA, MC Ave

BA, and Pond Pine structural groups had a “patchy” forest distribution with “uniform” forests most common in the MC High BA group (23%); in the other forests groups “uniform” forests were relatively rare (Table 3).

The average difference between SSPM plot-measured and FVS-estimated canopy cover is reported in Table 5. Both the average overall difference, which includes positive and negative values, and the average absolute difference, which only includes absolute values of the differences are reported. Average canopy cover estimates projected by FVS were slightly below that measured in reference forests (24.8% vs. 26.1%, Table 5). However, a paired t-test on the two canopy cover estimates indicated no significant difference ($P = 0.57$) suggesting that our FVS estimates of canopy cover are accurate. It is worth noting that both the plot-based and FVS-projected canopy cover estimates agree with a previously reported canopy cover estimate (25.3%) from a larger sampling area in the same forest of northern Baja California, Mexico, which was based on ten 100 m canopy line intercept transects (Stephens and Gill 2005).

Tree density increased markedly between 1911 and the recent sampling effort (FIA plots), especially in ponderosa pine forests (430% increase) (Table 6). This increase was highly

Table 5. Comparison of measured percent canopy cover (CC) to that projected by the forest vegetation simulator (FVS) for a Jeffrey pine-mixed conifer forest in the Sierra San Pedro Martir, Baja California, Mexico.

Statistic	Field-measured CC	FVS-projected CC	Difference (field–FVS)	Absolute difference (field–FVS)
Average	26.1	24.8	1.3	8.6
SD	14.1	8.3	11.1	6.9

Table 6. Historical and contemporary forest structure for two major forest types in Kern National Forest study area. Historical forest structure is based on historical systematic timber survey transects conducted in 1911; contemporary structure is based on Forest Inventory and Analysis (FIA) plots measured between 2001 and 2008. Asterisks indicate statistical significance by forest type between 1911 and FIA (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$). Values are presented as mean $\pm$ SD.

Characteristic	Mixed conifer		Ponderosa pine	
	1911	FIA	1911	FIA
N (plots)	221	270	157	124
Basal area ($\text{m}^2 \text{ha}^{-1}$)				
Fir	10.2 $\pm$ 8.8	16.1*** $\pm$ 22.3	2.0 $\pm$ 3.4	2.8 $\pm$ 8.3
Incense-cedar	10.7 $\pm$ 6.2	5.1*** $\pm$ 9.0	2.1 $\pm$ 2.8	3.0 $\pm$ 6.2
Sugar pine	3.2 $\pm$ 3.3	2.9 $\pm$ 5.2	0.6 $\pm$ 1.1	1.0 $\pm$ 4.8
Ponderosa pine	5.3 $\pm$ 4.7	6.6* $\pm$ 9.5	6.5 $\pm$ 4.5	8.7* $\pm$ 9.8
Other	NA	4.1 $\pm$ 8.7	NA	3.7 $\pm$ 7.4
Total†	29.5 $\pm$ 9.9	30.8 $\pm$ 24.0	11.2 $\pm$ 5.1	15.6** $\pm$ 13.8
Tree density (ha^{-1})				
30.4–61.0 cm dbh	41.0 $\pm$ 21.8	103.9*** $\pm$ 79.1	11.8 $\pm$ 8.9	95.3*** $\pm$ 86.3
61.1–91.4 cm dbh	17.3 $\pm$ 8.2	20.7* $\pm$ 18.9	6.6 $\pm$ 4.4	11.2*** $\pm$ 12.5
> 91.4 cm dbh	16.7 $\pm$ 9.2	8.7*** $\pm$ 10.9	6.9 $\pm$ 4.1	2.2*** $\pm$ 5.0
Total	75.0 $\pm$ 26.9	133.3*** $\pm$ 85.0	25.2 $\pm$ 12.1	108.6*** $\pm$ 88.0
Canopy cover (%)	25.2 $\pm$ 7.1	49.1* $\pm$ 19.9	12.1 $\pm$ 5.1	49.2* $\pm$ 22.5

† Does not include other species to maintain consistency with 1911 inventory.

significant ($P < 0.0001$) for the smallest tree size class (30.5–61.0 cm dbh) in both mixed conifer and ponderosa pine forests. Large trees (>91.4 cm) decreased by 50% in mixed conifer forests and by 70% in ponderosa pine forests when comparing current structure to that in 1911 (Table 6). Total tree basal area in mixed conifer forests was unchanged between 1911 and the present (approximately $30 \text{ m}^2 \text{ha}^{-1}$) but increased by approximately 50% in ponderosa pine forests (Table 6). Sugar pine basal area remained relatively constant in mixed conifer forests whereas incense-cedar basal area was two times greater in 1911 as compared to today. White fir basal area in mixed conifer forests increased greatly in the recent measurement versus 1911. Average forest canopy cover increased from 25% to 49% in mixed conifer forests and from 12% to 49% in ponderosa pine forests; canopy cover in current forests is similar between types versus in 1911 when mixed conifer forests had twice the canopy cover as ponderosa pine forests.

DISCUSSION

The southern Sierra Nevada ponderosa pine and mixed conifer forests sampled in 1911 had low tree densities but there was important variation by structural groups (Table 1). The Pond Pine forest group tended to be located in

the lower elevation portion of the study area and had the lowest tree densities and basal areas (25 trees ha^{-1} and $11 \text{ m}^2 \text{ha}^{-1}$, respectively). Ponderosa pine made up 58% of tree basal area in 1911 followed by approximately equal amounts of white fir and incense-cedar (18% each). Shrub cover was important in this group and averaged 14% with less than one-tenth being mountain misery.

In Jeffrey pine dominated mixed conifer forests in the Sierra San Pedro Mártir, Mexico, which have not experienced wide-spread fire suppression or harvesting, average tree basal area was $20 \text{ m}^2 \text{ha}^{-1}$ (Stephens and Gill 2005) and this is larger than that found in 1911 ponderosa pine forests in the southern Sierra Nevada. Jeffrey pine dominated the SSPM forests contributing 67% of basal area followed by smaller amounts of white fir and sugar pine (23% and 8% of basal area, respectively). In ponderosa pine forests in northern Arizona, Fulé et al. (2009) found that ponderosa pine dominated stand basal area (64%) in 1870 but contributed only 36% in the same forest in 2003 after fire exclusion and harvesting.

Stoddard (2011) did an extensive review of historical forest information from the Southwestern US (Arizona, New Mexico, and small portions of Utah and Colorado). Information is given on pre Euro-American forest conditions

from ponderosa pine and mixed conifer forests from studies that varied in spatial scale (1–1000 ha) and reference date (1860–1952). Selecting ponderosa pine studies that provided information from larger areas (>80 ha) and estimated structural characteristics before the major impacts of Euro-Americans (before 1880) resulted in a basal area $10.4 \text{ m}^2 \text{ ha}^{-1}$ which is similar to the southern Sierra Nevada forests studied here. Stoddard (2011) also summarized pre Euro-American mixed conifer forest basal area of $16.2 \text{ m}^2 \text{ ha}^{-1}$, which is lower than all three mixed conifer structural groups in the southern Sierra Nevada (Table 1), probably reflecting lower ecosystem productivity in the Southwestern US. Reynolds et al. (2013) provided another recent review of historical forest conditions from the Southwestern US and report ponderosa pine and mixed conifer tree density and basal area of 30–315 trees ha^{-1} and $5\text{--}20 \text{ m}^2 \text{ ha}^{-1}$, and 53–251 trees ha^{-1} and $9\text{--}28 \text{ m}^2 \text{ ha}^{-1}$, respectively. The values from Reynolds et al. (2013) overlap those found in our 1911 data, but the basal areas from our 1911 estimates in the southern Sierra Nevada are at the high end of their distributions, especially for mixed conifer forests.

The description of forest conditions in 1911 support previous assertions on the critical role of fire in these ecosystems (Kilgore and Taylor 1979, Skinner and Chang 1996, Scholl and Taylor 2010). Past fire evidence was clearly seen in approximately 95% of all mixed conifer structural groups and on 80% of ponderosa pine areas (Table 3). The vast majority of fire evidence was described as low to moderate damage (Table 3) with low percentages of high severity fire on this landscape (1–6%) (Table 4). Another piece of evidence of landscape-scale dominance of low-moderate severity fire is the ubiquity of large trees in all of the sampled transects (Table 1). This indicates that these trees persisted for a long period of time (200–400 years) without experiencing a stand-replacing disturbance. Comparing forest inventory data from 1911 to the present (Table 6) indicates that current forests have changed greatly, particularly in tree density, canopy cover, density of large trees, dominance of white fir in mixed conifer forests, and the similarity of tree basal area in contemporary ponderosa pine and mixed conifer forests. The vast majority of published studies on historic

mixed-conifer forests document lower tree densities and a more open structure comprised of a higher proportion of old and large trees that were more spatially heterogeneous (having gaps and patches of trees) and more uneven-aged compared to current conditions (Fulé et al. 2002, 2009, Moore et al. 2004, Stephens and Gill 2005, North et al. 2009, Collins et al. 2011).

Topography also influenced the historical distribution of vegetation in our study area. Ponderosa pine forests were associated with lower elevation, more southwesterly aspects, and greater values of AET. The influence of elevation on vegetation type, with ponderosa pine forests occurring below mixed conifer forests, has long been recognized (Show and Kotok 1929) and the association of greater pine dominance with more southerly aspects has also been observed (Fites-Kaufman et al. 2007, Lydersen and North 2012). However the association with AET was unexpected, as others have found this variable to be associated with greater productivity (Stephenson 1998; Kane et al., *in press*). The southern portion of the study area, which was predominantly ponderosa pine forest (Fig. 3) had higher water holding capacity, leading to greater values of AET. While water holding capacity and AET were relatively lower in the rest of the study area, perhaps the trees may be able to access deeper water stores in weathered bedrock (Meyer et al. 2007) allowing these areas to sustain more productive forest types.

One important artifact is the scale at which the 1911 data were recorded (0.9 ha transect area) such that any fine-scale patterning cannot be discerned (Hagmann et al. 2013). The majority of the variability in structure in frequent-fire forests has been observed at spatial scales smaller than 0.4 ha (Larson and Churchill 2012, Fry et al. 2014), and topographic characteristics that influence forest structure may also be observed at a smaller scale (Lydersen and North 2012). The scale at which the 1911 inventory data were recorded homogenizes this patchiness, which has been shown to include widely spaced individuals, clusters of large trees, dense patches of regeneration, and small openings (North et al. 2002, Franklin and Van Pelt 2004, Larson and Churchill 2012, Lydersen et al. 2013, Fry et al. 2014). This fine-scale patchiness, and the scale at

which topography affects forest patterns, are important characteristics that warrant further investigation.

The fact that the southern Sierra forests we studied were more open historically relative to current conditions is not surprising given the number of previous studies that have already demonstrated this trend (e.g., Parsons and DeBenedetti 1979, Scholl and Taylor 2010). What is more surprising is just how open these forests were in 1911, with average canopy cover being 25% and 12% in mixed-conifer and ponderosa pine types, respectively (Table 6). Fornwalt et al. (2002) modeled ponderosa pine reference canopy cover conditions of 13–22% on the Colorado Front Range and canopy cover in unmanaged Jeffrey pine-mixed conifer forests in northern Baja California, Mexico, was 27% (Stephens et al. 2007b). In addition, other canopy cover studies including White (1985), Covington and Sackett (1986), and Covington et al. (1997) reported 21.9%, 19.0%, and 17.3% canopy cover for ponderosa pine reference conditions on the Fort Valley Experimental Forest, Arizona, respectively (Reynolds et al. 2013); these values are similar to canopy cover estimates from southern Sierra Nevada ponderosa pine forests in 1911 (Table 1).

The 1911 forest inventory data depict a forest with high heterogeneity (Tables 1 and 3). As such, the historical data we present do not support the idea of basing management goals for restoration and forest resilience treatments on average values (Stephens and Gill 2005, North et al. 2009). Perhaps the ranges documented in this work in canopy cover and tree densities by size classes can assist in the creation of restoration plans to increase forest resilience (Collins et al. 2011). The second point related to the historical distributions found here is that common restoration goals of mixed conifer and ponderosa pine forests, particularly canopy cover and tree density, are on the upper end of or entirely exceed the values we report based on the 1911 data (Table 1). Consequently, forest restoration goals in southern Sierra Nevada mixed conifer and ponderosa pine forests are probably misaligned with the historic range of variation in stand structure. We note that our analysis is at the landscape scale, which may not capture finer scale heterogeneity brought about by openings and denser forest patches, however our estimates

of landscape conditions are robust.

Relevance to dry forest management

The 1911 forest inventory data describes a forest that is a product of a range of fire effects over a long period of time (i.e., a functioning fire regime), as well as the underlying topographic/moisture availability influence. The changes in forest structure and composition relative to 1911 indicate severely altered present forest conditions. The present forest in the western portions of Sequoia and Sierra National Forests is characterized by much higher overall tree densities, shifted species dominance from pine to fir (especially in mixed conifer forests), lower density of large trees, and higher canopy cover. These findings are consistent with those from previous studies in the Sierra Nevada (Parsons and DeBenedetti 1979, Ansley and Battles 1998, North et al. 2007, Scholl and Taylor 2010, Collins et al. 2011, Knapp et al. 2013, Dolanc et al. 2014).

Periods of frequent fire in mixed-conifer and pine-dominated forests gave fire-resistant species a competitive advantage, allowing them to establish dominance (Stephens et al. 2008). During “fire-free” or less frequent-fire periods, pines persisted due to their dominant positions in the forest canopy (Fulé et al. 2009). However, extensive fire-free periods, such as that associated with fire exclusion, coupled with grazing, selective logging, and favorable climatic conditions for young tree establishment in the early 20th century has created atypical stand compositions and structures in many of today’s Sierra Nevada ponderosa pine and mixed-conifer forests. In many locations, large, dominant ponderosa pine trees have been significantly reduced leaving today’s stands dominated by small trees. This has also been documented in other studies in mixed-conifer and ponderosa pine forests in the western US (Swetnam and Baisan 2003, Moore et al. 2004, North et al. 2009).

Recently a new procedure has been used to estimate past forest structure based on the establishment of a public land survey system (PLSS) by the General Land Office (GLO), the advantage of this dataset is it covers most of the western US. Baker (2012, 2014) used this system (GLO), which used eight trees per section (259 ha) that were marked to assist in the relocation of survey section corners, to reconstruct historical

Table 7. Average historic forest structural conditions in central Oregon and the Sierra Nevada estimated by General Land Office Survey (GLO) and Direct Forest Inventory (DFI) methods that used conventional inventory techniques. (MC, mixed conifer; PP, ponderosa pine; min, minimum; dbh, diameter at breast height; n/a, not available).

Forest type/location	Tree density (ha ⁻¹)			Tree basal area (m ² ha ⁻¹)			Reference and min dbh
	DFI	GLO	Percentage difference	DFI	GLO	Percentage difference	
Oregon							
MC north central	67	275	410	14	n/a	...	GLO: Baker (2012), min dbh not given.
PP south central	63	219	348	13	n/a	...	DFI: Hagmann et al. (2014), 15 cm GLO: Baker (2012), min dbh not given.
MC south central	71	275	387	18	n/a	...	DFI: Hagmann et al. (2013), 15 cm GLO: Baker (2012), min dbh not given.
							DFI: Hagmann et al. (2013), 15 cm
California							
MC central Sierra Nevada	52	277	533	17.9	36.9	206	GLO: Baker (2014), <i>typically</i> 10 cm. DFI: Collins et al. (2011), Collins et al. (2005), 15 cm
PP central Sierra Nevada	44	260	591	14.1	33.6	238	GLO: Baker (2014), <i>typically</i> 10 cm. DFI: Collins et al. (2011), Collins et al. (2005), 15 cm
MC southern Sierra Nevada	75 (132)†	277	369 (210)†	29.5	36.9	125	GLO: Baker (2014), <i>typically</i> 10 cm. DFI: this work, 30 cm (15.2 cm)
PP southern Sierra Nevada	25 (45)†	260	1040 (548)†	11	33.6	305	GLO: Baker (2014), <i>typically</i> 10 cm. DFI: this work, 30 cm (15.2 cm)

† Estimates in parentheses include trees 15.2–30.4 cm dbh based on the limited number of transects that measured trees in the 15.2–30.4 cm dbh class ($n = 35$). Estimates were based on the ratio of tree density in the 15.2–30.4 cm dbh class to that in the 30.5–45.7 cm dbh class, which was 2.5:1.

forest conditions in eastern Oregon and the Sierra Nevada. Four townships (or 144 sections) in eastern Oregon (Baker 2012) overlap an area that used similar historical transect data analyzed in this work (Hagmann et al. 2013). GLO survey data collected in 1866–1895 would include a record of approximately 1152 trees marking section and quarter section corners in this four township area while the historical timber transect inventory included 163,558 trees on 1355 transects (Hagmann et al. 2013). More recently Baker (2014) used similar GLO procedures to estimate past forest structure and fire severity in the Sierra Nevada. A comparison of the results from the GLO procedures to four different study sites from northern Oregon to the southern Sierra Nevada demonstrates that the GLO methods overestimate historic tree density (Table 7). One challenge in the comparison of these results is possible differences in lower diameter limits in these studies. The transect studies (Collins et al. 2011, Hagmann et al. 2013, 2014, this work) all have explicit lower diameter limits whereas the GLO reconstructions do not include this infor-

mation (Table 7). One study that also compared these two methods determined that the large differences in tree densities between the direct inventory and GLO could not be reconciled by possible differences in diameter limits of the two datasets (Hagmann et al. 2013). Another limitation of all historical datasets is they are from one brief time period which characterizes past fire regimes with limited temporal depth.

Our estimate of past mixed conifer and ponderosa pine high severity fire (1–6%), which are similar to estimates from other work (Stephens et al. 2007a, Mallek et al. 2013), are much lower than those reported by Baker (2014) for the Sierra Nevada (31–39%). Perhaps information from contemporary restored fire regimes, for which fire severity patterns can be quantified more robustly, can provide insight. Working in mesic upper-elevation mixed conifer forests in the Sierra Nevada that have been burned repeatedly by lighting fires, Collins and Stephens (2010) found that high severity fire accounted for 15% of the total burned area in recent large fires. These fires occurred 30 years after the start of the

natural fire program in this area, suggesting a relatively intact fire regime. However, despite having an intact modern fire regime, this area previously experienced nearly 100 years of fire exclusion, which corresponded with a large increase in tree establishment (Collins and Stephens 2007). It is reasonable to assume this large pulse of tree establishment led to higher levels of severe fire than occurred historically. Furthermore, the higher elevation and associated shifts in species composition (high dominance of red/white fir and lodgepole pine [*Pinus contorta* sub. *murrayana*]) may also contribute to the greater proportion of high severity fire reported by Collins and Stephens (2010). Collectively, these points suggest that 15% high severity fire is likely an overestimate for historical high severity proportions in ponderosa pine-mixed conifer forests, indicating that our 1–6% estimates are likely closer to actual conditions than the 31–39% posed by Baker (2014).

Changing climates are already warming temperatures in the Sierra Nevada so a specific goal to recreate past conditions is not advisable (Stephens et al. 2010). However, the information from this work could be used to inform the production of desired landscape conditions because the forests sampled in 1911 were highly resilient to many of the same environmental processes affecting today's forest ecosystems, including insects, diseases, and fire. Increasing forest resiliency is the most common goal that forest managers desire in a world of changing climates (Fulé 2008, Stephens et al. 2010) and this work could be used to inform this goal.

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SUPPLEMENTAL MATERIAL

APPENDIX

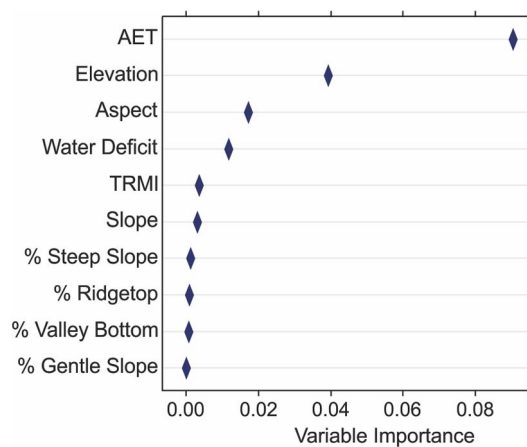


Fig. A1. Importance ranking of the topographic variables based on their association with vegetation class of historical survey transects, as determined by random forest analysis. Variables included in the analysis were actual evapotranspiration (AET), elevation, transformed aspect, water deficit, topographic relative moisture index (TRMI), slope steepness, and proportion of transect area in each of the four topographic position index categories (% Steep Slope, % Ridgetop, % Valley Bottom and % Gentle Slope). The three variables that appear in Table 2 (AET, elevation, aspect) are the three most highly ranked variables.

Table A1. Complete surveyor notes from the Kern National Forest in 1911 as recorded on the United States Department of Agriculture Forest Service Form 321A. Notes on condition of timber and classification for fire damage, oak prevalence, pest/pathogen, regeneration and tree distribution for each transect. Where indicated, relevant notes recorded for understory and factors affecting logging are also included.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25320405	MC Shrub	Timber is very widely scattered and very much stunted in growth. The stand very open and uneven age. The abundance of boulders and scrubby undergrowth as well as dense forest floor in places of bear clover prevent reproduction. No clear length. Considerable fire damage to trees tallied. Also insect depredation present as many trees dead and yet standing.	low	n/a	n/a	moderate (understory)	insect	none	scattered
25320412	MC Shrub	Timber is very widely scattered singly and in small groups. A very open stand. Also very uneven aged stand. Clear length to the yel P. on av. About 16'. Has been much fire damage but it has injured the trees not very far up the trunks. Insect depredation present as there are many dead trees standing and a few fallen ones	low	n/a	n/a	low (understory)	insect	scarce	scattered
25320413	MC Shrub	Timber is very uneven aged and very much scattered more or less singly. Good clear length to the pine trees (yel + sug) of 16' of trees over 24" in D. Stand is very open with a little dead timber standing and an understory of sparsely scattered scrub black oak and with a forest floor of very dense bear clover. Insect depredation very prevalent.	none	n/a	n/a	low	insect	none	scattered
25320501	MC Shrub	Timber is very uneven aged; it is more or less uniformly distributed thru the forty. Stand is very open but the forest floor is not thickly covered with underbrush to prevent reprod – but very little reprod present. The clear length to the yel and sug p exceeds 16' on ave. and on a few trees there 2 and 3 16' lengths. Considerable fire damage but not injuring the butts of the nearly mature trees much. Much insect depredation as many dead trees standing and fallen trees.	low	n/a	n/a	none	insect	scarce	uniform
25320502	MC Shrub	Timber is very uneven aged and more or less widely scattered in small groups. The stand is very open – reproduction being poor and forest floor of bear clover thicker than it has been. Clear length to the yel and sug p about 24" and over 16' good. Timber very slightly fire scarred. There has been much insect depredation present as much timber dead and yet standing.	low	n/a	n/a	none	insect	low	groups
25320503	MC Shrub	Timber is very uneven aged, there being clear length to the sug and yel p of 24" and over of 16'. The stand is very open and more or less uniformly distributed except in the NE corner where there seems to be nothing but manzanita and chaparral and boulders. A bad fire been thru but it has only injured the cedar trees badly. Also insect depredation, shown by the dead standing trees and the many stagheaded trees.	moderate	n/a	n/a	none	insect	scarce	uniform

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25320504	MC Shrub	Timber is very uneven aged; but is very uniformly distributed – it being a very open stand. Clear length to the sug and yel P. 16' and over for trees above 24". Been a bad fire thru here but not injuring the live timber much – cedar being most scarred. Much insect depredation as many dead, standing trees as well as few fallen trees (uprooted).	low	n/a	n/a	none	insect	scarce	uniform
25320505	MC Shrub	it is very uneven aged and a very open stand more or less in groups; clear length to the yel. and sug p. about 16' (of nearly mature trees). A little damage done by fire. There has been much insect damage done as there are many standing dead trees as well as fallen trees. The stand being very open is filled up by groups of chaparral and bear clover with a little very young bl oak. So there is practically no reproduction of trees tallied.	low	n/a	n/a	low	none	scarce	groups
25320506	MC Shrub	The timber is very uneven aged but distributed uniformly thru the forty; clear length to the nearly mature pine is 16' and over. Has been a bad fire but it has not done much damage to the yel or sug p. insect depredation present – many dead standing trees and few fallen trees. Forty very open with forest floor of thick clumps of chaparral and bear clover – there no reproduction.	low	n/a	n/a	none	none	scarce	uniform
25320507	MC Shrub	Timber is very uneven aged and more or less scattered in groups. Clear length to the yel and sug p 16' and over (for nearly mature trees 24" and over). Timber been fire scarred but not very badly except the cedar. Insects have been present as there are many dead trees standing and many fallen. The stand is very open and the reproduction seems to get hold better but only in very few places. A very little immature oak scattered.	low	n/a	n/a	low	insect	scarce	groups
25320508	MC Shrub	first few chains the timber more or less uniformly distributed but at top of ridge about 6 ch come to practically nothing but young scrub oak which follows us about 10 chains (with a little scattering coniferous trees). The pine about 24" has clear length of 16'. Timber is slightly fire scarred and insect depredation present as usual – few dead trees standing. Get fair mature timber thru first few ch and then oak for few ch and then young timber.	high	chaparral (along ridge)	10	moderate	insect	none	groups
25320509	MC Shrub	Timber is not of especially good development, especially the younger trees as many are wind topped and stagheaded. Very uneven aged stand and widely scattered, singly and in groups. Clear length to the older pine (yel and sug) good for 16'. Much fire damage to trees but not affecting the butts far up the trunk. Much insect depredation present; dead trees standing - all species. Reprod confined to latter part of forty	low	n/a	n/a	low (understory)	insect	low	scattered
25320510	MC Shrub	Timber is very uneven aged there being clear length to the older sug and yel p of 16' and more. Timber has been badly fire scarred but only affecting a few very badly, the pine and cedar mostly. Much dead standing timber present – proof of insect depredation. The stand is very open and more or less the trees scattered in groups. But even then there very little reprod even though the forest floor is not densely covered with brush.	low	n/a	n/a	none	insect	scarce	groups

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25320511	MC Shrub	Very uneven aged. The pine (yel and sug) of nearly mature age has over 16' of clear length. The timber is very open giving room for abundance of chaparral and bear clover and thus preventing reproduction. Insect depredation have been present as there are many dying, dead and stagheaded trees. Been a bad fire thru forty but it has not damaged the open stand greatly.	low	n/a	n/a	none	insect	scarce	open
25320512	MC Shrub	Majority of the timber is immature but of good size and development. Very uneven aged. It is a very open stand. Good clear length to nearly mature P. being 16' and over. All or nearly all of the open space occupied either by bear clover or chaparral and large boulders preventing reproduction. Much insect depredation present and many dead standing trees and some have been blown over. Fire damage not very bad.	low	n/a	n/a	none	insect	none	open
25320513	MC Shrub	Much of the timber is quite immature yet but of good size. (Would say that the ground ought to be cleaned up (the bear clover-sage brush and manzanita taken up to give reproduction a chance). Timber is more or less widely scattered with no clear length except the yel and sug p. d about 30" and over. Been a rather severe fire thru here injuring all timber more or less. Also many trees killed either by insects or fire as many dead trees are standing. Stand very open.	low	n/a	n/a	none	insect	scarce	scattered
25320514	MC Shrub	Stand is very uneven aged and scattered very much giving a very open stand. The nearly mature pine has good clear length and some of the younger pine also. Considerable fire damage but not injuring the trees much – cedar the exception. Insect depredation present as many stagheaded and dead standing trees. The forest floor of chap and bear clover preventing reproduction.	low	n/a	n/a	none	insect	scarce	scattered
25320515	MC Shrub	Timber is of good development but very uneven aged. Both yel p and sug p have clear length of 16' and over. Timber has been touched by bad fire but only a very few trees are very badly damaged and then only for 2' to 4' up. Must have been much insect damage present as there are many dead trees standing. Stand is very open but with no reproduction though forest floor is not covered with brush.	low	n/a	n/a	none	insect	none	open
25320516	MC Shrub	The timber is very widely scattered thru the forty – both singly and in groups. Very uneven aged. Clear length to pine (yel and sug) 16' (for trees above 24"). Stand being open and much oak in the open places as well as bear clover for an understory. Good reprod of cedar and yel p. fire has damaged the trees considerably at butts. Insect depredation present, as many trees dead and standing or trees stagheaded – all species.	low	n/a	n/a	moderate	insect	moderate	open
25320608	MC High	Timber is very uneven aged and is very evenly distributed thru the forty. Clear length to the yel. p and sug p. about 16'. all timber has fire scars marked on it but in general they are not bad. Insect depredation present as many stagheaded trees present; also dead trees standing. We pass 2 seeps one at 7 chains and another about at the end of the forty.	low	n/a	n/a	none	insect	none	uniform

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25320609	MC Ave	Timber is uneven aged but quite evenly distributed thru the centre of the forty thinning out to the west + east. Clear length to the yel and sug p about 16'. Considerable fire damage injuring some of the pine trees quite badly at the butts. Insect depredation present shown by the sickly condition of some of the trees. Although stand very open and forest floor free for reproduction - none apparent.	low	n/a	n/a	none	insect	none	uniform
25320616	MC High	Timber in general is mostly even aged and evenly distributed thru the centre of the forty; it thinning out toward the ends very rapidly. Clear length to Yel and Sug P. about 16'. All timber badly fire scarred at the butt. Also insect depredation quite prevalent as there are many trees dead and standing. Stand is very open but no reproduction seems to get started.	low	n/a	n/a	none	insect	none	uniform
25320701	MC High	On the east slope an open stand of fairly even aged. It is uniformly distributed here too. All timber slightly fire scarred but not damaging the trees badly at the butts. Clear length to yel and sug pine 16'. Although the stand is open and no forest floor hindrance yet there is no small reproduction. Insect depredation here in abundance. Boulders appearing in groups. Many dead trees and stagheaded trees standing and fallen trees.	low	n/a	n/a	none	insect	none	uniform
25320702	MC Shrub	Timber more or less uneven aged. It scattered but more or less uniformly thru forty. It is fire scarred but not badly, there being clear length of 16' to the pine (yel). Also insect depredation present. The stand is very open the rest of area being well covered with chaparral and very young cañon live oak and bear clove with abundance of large and small boulders.	low	n/a	n/a	high	insect	low	uniform
25320703	MC Ave	Timber is very much scattered and uneven aged. Stand very open. Clear length to the Yel. Pine of 16' for nearly mature timber. All timber is slightly damaged by fire but the damage does not extend far up the butts. Much insect depredations present as there are many trees fallen and many stagheaded trees present - both fir and pine.	low	n/a	n/a	none	insect	scarce	scattered
25320704	MC Shrub	Timber is very uneven aged and widely scattered; the stand is very open. Clear length to the Yel P. is about 16'. All timber has been more or less fire scarred but it does not extend far up the butts. There is insect depredation present and it has been present as many dead trees standing, many stagheaded trees and much fallen timber.	low	n/a	n/a	none	insect	none	scattered
25320707	Pond Pine	Timber is very uneven aged; more or less scattered with open spaces filled in with manzanita, very young cañon live oak and bear clover. Clear length to the nearly mature pine about 16'. Fire has injured the trees to a considerable extent at the butts but it does not extend far up the tree. Also insect depredation present as there are many trees dead and yet standing. The south part of the forty shows mostly very young cañon live oak.	low	n/a	n/a	moderate	insect	low	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25320708	MC Shrub	Timber is very uneven aged; stand being scattered and places filled in by black oak of fair good size, a forest floor of bear clover. Clear length to the pine about 16'. There has been a severe fire thru forty but not injuring the nearly mature timber much insect depredation present as there are many dead trees standing. Quite a good bit of reproduction of cedar and pine.	low	n/a	n/a	moderate	insect	moderate	scattered
25320709	Pond Pine	Clean	none	n/a	n/a	excluded	excluded	moderate	excluded
25320710	Pond Pine	Clean. Fired some	low	n/a	n/a	excluded	excluded	moderate	excluded
25320711	MC Ave	Fired. Clean	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25320712	MC Ave	Fire scarred a little. Clean	low	n/a	n/a	excluded	excluded	none	excluded
25320713	MC Ave	Fired, a little. Clean. Extra good length	low	n/a	n/a	excluded	excluded	moderate	excluded
25320714	MC Ave	Fired a little. Clean	low	n/a	n/a	excluded	excluded	moderate	excluded
25320715	MC Ave	Fire scarred. Clean	low	n/a	n/a	excluded	excluded	moderate	excluded
25320801	MC Ave	Very little fire scar. Clean. Yellow pine in first class condition. There is a yellow pine on this forty of 73" average diameter and 200 ft. estimated height. fire scarred - clean	low	n/a	n/a	excluded	excluded	moderate	excluded
25320802	MC High		moderate	n/a	n/a	excluded	excluded	low	excluded
25320803	MC High	Fir mostly decadent. All fire scarred. Signs of insect attack on Y. pine.	moderate	n/a	n/a	excluded	insect	moderate	excluded
25320804	MC Ave	A little insect boring on Y. pine. Fire scarred	moderate	n/a	n/a	excluded	insect	moderate	excluded
25320805	MC Ave	fire scarred - clean	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25320806	MC Ave	Fire scarred - not badly. Yellow pine poor condition b/c insects. Note the dead on other side of sheet.	low	n/a	n/a	excluded	insect	none	excluded
25320807	MC Ave	A little fire scarred. Clean	low	n/a	n/a	excluded	excluded	moderate	excluded
25320808	MC Ave	fire scarred - clean	moderate	n/a	n/a	excluded	excluded	high	excluded
25320809	MC High	Fire scarred. Clean	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25320810	MC High	fire scarred - clean	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25320811	MC Ave	fire scarred - clean	moderate	n/a	n/a	excluded	excluded	low	excluded
25320812	Pond Pine	somewhat stunted	none	n/a	n/a	excluded	excluded	low	excluded
25320813	MC Ave	stunted - clean	moderate	n/a	n/a	excluded	excluded	low	excluded
25320814	MC High	Clean. Fire scarred	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25320815	MC High	Large timber decadent. Fire scarred - clean. A badly fire scarred yellow pine of 80" diameter stands on this forty.	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25320816	MC Ave	Decadent (larger timber). Fired a little	low	n/a	n/a	excluded	excluded	high	excluded
25320903	MC Shrub	Timber uneven aged and very much scattered in groups - a very open stand filled in with a little very young scrub oak and with a dense floor of bear clover. Pine (Yel and Sug) has clear length of 16' above 20" in D. The timber very little fire damaged. Insect depredation been present shown by dead trees yet standing.	low	n/a	n/a	low	insect	scarce	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25320904	MC Ave	Timber is very much scattered thru first part of the forty and seems to be thicker (denser) toward the west up the slope. At the last few chains 5-8 we come to a more or less open place where the timber is immense and not damaged by fire. Clear length to the pine is about 16'. The scattered timber to the E is a little stagheaded and many dead trees standing. In general the forty is very open with more or less dense young oak.	low	n/a	n/a	high	insect	low	patchy
25320905	MC Ave	Timber is very much scattered in groups of 2-5 leaving the open spots to dense clumps of young immature oak and manzanita and bear clover. Pine has clear length of 16'. There considerable damage done to all trees (pine and cedar especially) by fire - also insect depredation have been present. (Many trees dead and not yet fallen).	low	n/a	n/a	moderate	insect	low	groups
25320912	MC Shrub	Most of the timber tallied is of good form and very little damaged by fire. It is very much scattered in groups. The sug and yel p. have a clear length of 16'. There has been insect depredation present as many cedar trees are stagheaded and the yel. P. trees (some) are dead and standing. Fair good timber thru first 6 ch. then all chaparral until ch 16 and then get a little bunch of timber again, end of forty brings us to light timber.	high	chaparral (through canyon)	10	low (understory)	insect	low	groups
25320913	MC Ave	Timber is in fairly good condition and nearly mature. Clear length to the Yel. P. 16'. All timber is badly fire scarred, pine and cedar worse than the fir. There is very little insect depredation. Much oak only along the first part of the forty and then disappear - very good young reprod. The timber is more or less scattered in groups.	moderate	n/a	n/a	moderate	insect	high	groups
25321403	MC Shrub	Timber is very widely scattered thru the first part of the forty but is in fairly dense groups thru the last few chains of the forty. Though the pine is very badly fire scarred would say that there is clear length of 16'. All timber is more or less stunted and stagheaded and also insects have killed a few trees - yet standing. There is little to no reproduction the forty being very open and exposed.	moderate	n/a	n/a	moderate (understory)	insect	none	patchy
25321404	MC Shrub	Most of the timber is far from maturity but has good clear length. Timber more abundant thru last part of forty. Little to no reproduction of any kind below pole stage (6"-8"). Clear length to pine 16'. It very badly fire scarred. Also insect depredation present as many stagheaded trees and dead standing trees. The forty is very open with a dense growth of bear clover on the ground.	moderate	n/a	n/a	moderate (understory)	insect	none	open
25321405	MC Shrub	Timber only of fair development, much being more or less wind topped and stunted in growth. Clear length about 16' to pine only. Considerable fire damage present but not injuring the trees very bad (however some bad fire scars at the butt). There much insect depredation present as shown by the dead standing trees and stagheaded trees. The ground is very open.	low	n/a	n/a	moderate (understory)	insect	none	open

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25321406	MC Shrub	Timber is very much scattered and in groups more or less. It is of good form, especially the pine but both pine and cedar are very badly fire scarred. Clear length to the pine is about 16'. There has been much insect depredation present as there are many dead standing trees besides many stagheaded ones. The country is very open and the ground exposed to sun's rays.	moderate	n/a	n/a	low (understory)	insect	none	groups
25321411	Pond Pine	Timber is very much scattered, with only the older nearly mature timber having clear length of 16'. Considerable fire damage done to the older trees. The country quite open and the timber is not exceptionally good. Much open area covered by the Bear clover and large boulders. Much insect depredation present as many dead standing trees.	low	n/a	n/a	low (understory)	insect	none	scattered
25321412	MC Ave	Timber is more or less scattered but of a great deal better development than any passed thru this afternoon. Some good fine large pines, clear length 16' and over. All timber is slightly fire scarred at the base. Much insect depredation has been present (dead standing trees). The timber is mostly of same age with very little reproduction. Country is more or less bare and open except for the fine nearly mature pine.	low	n/a	n/a	low (understory)	insect	scarce	scattered
25321501	MC Shrub	Timber is fairly mature but most of it very immature. Pine (sug and yel) has clear length of 16'. All trees more or less fire scarred. Some of the trees are badly wind topped. Also insect depredation been present. Timber very open and scattered in groups. There a little cañon live oak in places that is fairly mature. Many stagheaded pine and fir trees.	moderate	n/a	n/a	low	insect	none	groups
25321502	MC Shrub	Timber is very much scattered most of it being young timber past the pole stage. Much fire damage done to the timber. Practically no reproduction younger than (6"-8"-12"). Timber is wind topped and stagheaded and some dead timber in it. Would say that there is no clear length. The timber widely scattered and there is much scrub young immature oak.	low	n/a	n/a	high	none	scarce	scattered
25321503	MC Shrub	Timber is very much scattered and most of it is pretty young. No clear length. Timber is badly fire scarred. Insect depredation present as there are many dead and stagheaded trees present on the forty. The country is very open there being a good deal of young black oak as an understory.	low	n/a	n/a	high	insect	none	scattered
25321504	MC Ave	Timber is mostly middle aged and has no clear length. It is more or less scattered in groups with very immature black and cañon live oak as understory. There has been much damage by fire and also insect depredation has been present as there are many trees stagheaded and dead. The country is very scattered with coniferous timber with oak as a thick understory.	low	n/a	n/a	high	insect	none	groups
25321505	MC Ave	Timber for first few chains fairly dense but not uniform in size. After passing across creek get timber much more scattered thru boulders and of uniform size mostly. There a clear length to the pine of 16' and over. Considerable damage by fire to the butts of the nearly mature timber. Insect depredation present thru the last 10-14 chains as many stagheaded trees and many already dead.	low	n/a	n/a	none	insect	none	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25321506	MC Shrub	All of the timber is more or less stunted in growth but of the nearly mature pine would say that there is a clear length of 16'. Considerable fire damage done to the nearly mature trees. Insect damage very much present as shown by the stagheaded and dead standing trees. The stand is very open and gives trees abundant light on the ground.	low	n/a	n/a	none	insect	none	open
25321507	MC Shrub	There is quite a little timber past the pole stage but not mature yet. The timber nearly mature (pine only) has clear length of 16'. Cedar is too badly fire scarred. Timber is scattered in groups. There is insect depredation present but the timber thru most of the forty is of good form and size but farther S. up the slope timber wind topped.	moderate	n/a	n/a	none	insect	none	groups
25321508	Pond Pine	Timber is scattered in groups. The nearly mature pine has a good clear length of 16'. All of the timber is badly fire scarred the cedar being the most damaged. Insect depredation has been present as there are many dead standing trees and stagheaded fir trees. Country is very open giving easy access for the sun to the ground cover quite a bit of pine reprod the last 2 chains.	moderate	n/a	n/a	low (understory)	insect	low	groups
25321509	MC Shrub	As go east the timber gets better and it then of fairly good development at the end of the forty. Pine has clear length of about 16'. all timber has had a touch of fire as shown by bad fire scarred butts. Insects have also played havoc as there are many dead standing trees. But even yet there a few trees that are wind topped.	low	n/a	n/a	none	insect	none	excluded
25321510	MC Ave	The timber is more or less scattered in groups leaving the ground cover very much exposed to the sun's rays. To the nearly mature pine timber may get 16' of clear length but most of the timber except in the draws are very much stunted in growth or wind topped or killed or nearly so by insects (as there be many trees that are dead and standing). In general very poor timber thru forty.	none	n/a	n/a	low (understory)	insect	none	groups
25321511	MC Shrub	Timber is widely scattered and in bad shape. There is no clear length. All timber is very much stunted in growth, stagheaded and wind topped. And some is very badly fire scarred. There is no clear length. There is quite a little cañon live oak but it is very small and scrubby. Boulder outcrops are very abundant all thru the forty. The country is very very open, sun having easy access to soil.	none	n/a	n/a	moderate	none	none	scattered
25321512	MC Ave	Timber is very much scattered in groups more or less. There is good clear length to the nearly mature sug and yel p. timber thru the last part of the forty is gets stunted in growth (even the young timber) and is more or less wind topped. Also thru the last part of forty there must be insect depredation present as the pine trees - young ones are getting stagheaded and dying.	none	n/a	n/a	low (understory)	insect	none	groups
25321513	MC Shrub	Timber is of fairly good development but is more or less scattered. Would say that there is no good clear length. The timber is very badly fire scarred by severe fire. There insect depredation present which accounts for the dead standing timber. Last four chains consist chiefly of scrub cañon live oak with little scattering pine trees.	high	chaparral (west side of ridge)	4	moderate	insect	none	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25321514	MC Ave	Timber is still bad stunted and wind topped. It is more or less scattered until the end of the forty when the ground cover is more shaded by little better timber and good deal of cañon live oak (scrubby growth). The timber is quite a little fire scarred so no clear length. Timber is very immature. The timber is very much better toward the end of the forty. Dead standing timber asctr [?] for insect depredation prevalent.	moderate	n/a	n/a	moderate	insect	none	patchy
25321515	MC Ave	Timber is very widely scattered and very immature. No clear length; the timber has been more or less badly fire scarred. The timber is stunted and wind topped. The country is very open and very much filled up with boulders. The timber is in bad shape as there are many dead standing trees and there insect depredation present.	moderate	n/a	n/a	low (understory)	insect	none	scattered
25321516	MC Ave	It is very much scattered and yet very immature. No clear length. It rather badly fire scarred so there is no clear length. There has been a little insect depredation for there is a few trees dead and standing. The country is very open and exposed. It is stunted in growth and topped.	moderate	n/a	n/a	low (understory)	insect	none	scattered
25321601	MC Ave	Fire scarred. Clean	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25321602	MC High	Fire scarred. Good many fir and cedar stags	moderate	n/a	n/a	excluded	excluded	high	excluded
25321603	MC High	Cedar badly fired. Rest fired some. Clean.	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25321604	MC Ave	Fire scarred. Clean	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25321605	MC Ave	A little fire scar. Clean	low	n/a	n/a	excluded	excluded	moderate	excluded
25321606	MC High	larger timber decadent	none	n/a	n/a	excluded	excluded	moderate	excluded
25321607	MC High	Fir and cedar decadent. Fire scarred. Timber in clumps.	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25321608	MC Ave	Fire scarred. Clean	moderate	n/a	n/a	excluded	excluded	moderate	excluded
25321609	Pond Pine	The timber is widely scattered thru the last 15 chains of the forty. The first 5 chains has very dense reproduction of fir especially and it ought to be heavily thinned. Been a severe fire thru here shown by few old coniferous trees and the badly scarred oak. The last 10 chains is very very dense with cedar reprod. and oak scrubby in form (very hard to get thru.) no insect depredation present. Thru first part of forty few trees weakened by fire and blown over.	high	dense reproduction, trees weakened by fire	20	moderate	none	high	scattered
25321610	MC Ave	Timber is very much scattered. Timber is in fair dense groups after 11 chains and then it thins out again. The timber has no clear length. Very much fire damage only attacking the nearly mature timber. No insect depredation present. Much oak up to 11 chains and then not so dense thru the last few chains. Most of the oak is immature. The country is more or less open where the oak grows.	moderate	n/a	n/a	moderate	none	none	patchy
25321611	MC Ave	Only the nearly mature pine has clear length of 16' and over. The nearly mature timber is scattered in groups. Thru first 10 ch the old timber ought to be cut and the younger growth thinned out. Also the ground floor needs to be cleaned up of dead wood. The last 10 ch consist mostly of dense young oak in clumps. It quite immature. Thru first 10 ch very little fire or insect damage to trees.	low	n/a	n/a	high	insect	high	groups

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25321612	MC Shrub	Timber is more or less scattered in groups mature timber clear length of older timber about 16' (but applies only to sug p and yel p). This older timber ought to be cut and the younger timber thinned out a little and the ground cleared up. There is [h. . . - can't decipher a word] good - too good reprod of cedar fir and sug and yel p. apparently no insect depredation. Fire damage to older timber in some cases very great extending up the tree 30'. More or less oak of fair size scattered thru forty.	moderate	n/a	n/a	low	none	moderate	groups
25321613	MC High	Most of the timber is quite young and about the pole stage. The few older trees are nearly mature and ought to be cut. The younger timber ought to be thinned out especially in the last few chains (fir trees). Little to no fire damage even to the old nearly mature timber. No insect or fungous disease apparent. Very little black oak and mostly in the first part of 40.	high	most timber immature, little fire damage	20	low	none	moderate	excluded
25321614	MC High	The nearly mature timber is of fairly good development but more or less in scattered groups. No clear length. There is a little fire damage to nearly mature trees but it does not extend far up the tree from the base. Considerable moss found growing on the bark and limbs of older trees. A very little oak scattered here and there but mostly young and immature.	low	n/a	n/a	low	moss	moderate	groups
25321616	MC Ave	Timber thru first 8 chains of fair size but rather too dense and old timber ought to be cut out and the younger timber lightly thinned. No clear length. Not much very bad fire damage to the nearly mature timber. Thru the last 12 chain the timber extremely sparse - all mostly very young cedar reproduction and oak of immature age (abundant in clumps).	high	patch of reproduction	12	moderate	none	moderate	patchy
25321701	MC Ave	No Notes	excluded	n/a	n/a	excluded	excluded	high	excluded
25321702	MC High	No Notes	excluded	n/a	n/a	excluded	excluded	high	excluded
25321703	MC Ave	No Notes	excluded	n/a	n/a	excluded	excluded	high	excluded
25321704	MC Ave	No Notes	excluded	n/a	n/a	excluded	excluded	high	excluded
25321705	MC Ave	Timber is very much scattered; no clear length; timber is not badly fire scarred. No insect depredation present there is much oak very immature but is very abundant not leaving the ground free from shade. There is also a little cañon live oak.	low	n/a	n/a	high	none	none	scattered
25321706	MC Ave	Timber is very much scattered; there is no clear length as the pine and rest of the timber are badly fire scarred. No insect depredation present. There is quite a little cedar and fir reproduction but all of the fir reproduct is about pole size; much younger cedar reprod. A little bl oak and cañon live oak but both species are very immature. Country is more or less open but the high trees (coniferous) and the oak shade ground.	moderate	n/a	n/a	low	none	high	scattered
25321707	Pond Pine	Timber is very much scattered. There is no clear length as considerable fire damage and also the limbs cling to the tree (lower limbs). There is a little insect damage as there a large yel p. tree has just been killed this year by dendroctonus. There a little oak scattered here and there (bl. oak). There cedar reproduct is very dense - too dense. There is quite a bit dead timber lying on the ground.	moderate	n/a	n/a	low	insect	high	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25321708	Pond Pine	Timber is very much scattered, there is no clear length to the timber. There a little fire damage – even the small cedar being scorched. There a little insect disease present as there are a few trees on the forty which are dead and standing and also a few trees that are decaying and lying decaying on the ground. Quite a little oak scattered here and there.	low	n/a	n/a	moderate	insect	none	scattered
25321709	MC Ave	Timber is very widely scattered with no clear length. Considerable damage done to the base of the trees by fire but taking 4 ½' DBH will not seriously affect the timber. Very good reproduction of cedar the last few chains going west in the forty; mostly pine the first part of the forty. Very little insect depredation. Quite a little immature black oak scattered her and there thru the forty.	moderate	n/a	n/a	moderate	insect	moderate	scattered
25321710	Pond Pine	Timber is very much scattered and no clear length and quite a little fire damage but does not gut the butt very badly. A little insect depredation but not abundant. Quite a little oak of fairly good size very thick thru the forty. Also quite an abundance of young reproduction. The ground is well covered either with pine and cedar reprod or of black oak	low	n/a	n/a	moderate	insect	high	scattered
25321711	MC Ave	Timber widely scattered thru first 10 chains but when we descend timber becomes more dense. Good reproduct of fir, cedar and pine thru last few chains so that the older and nearly mature timber ought to be cut to give the young reproduct a chance. There is no clear length. Very little fire damage present quite a little oak present but quite immature.	low	n/a	n/a	moderate	none	moderate	patchy
25321712	MC High	Timber is of more or less uniform density thru first 10-15 chains but no clear length. A little fire damage and very little moss found growing on the bark and limbs of the coniferous trees. This timber ought to be thinned out to give a chance for young reproduct and let the younger timber have a chance. To grow. In places very good reproduct of fir and cedar but too dense. Much very immature growth of oak last 5 ch.	low	n/a	n/a	moderate	moss	moderate	uniform
25321716	Pond Pine	The timber is very much scattered widely thru the forty, the forty consisting mostly of small black oak and toward the end of the forty quite a little reproduct of yel p. (cedar and fir) about pole stage. Considerable fire damage done to the nearly mature timber but it does not extend over 2-5 ft. from base of tree. Little to no insect damage and there no clear length to any of the timber. Oak very abundant.	low	n/a	n/a	high	insect	low	scattered
25322001	MC Ave	Timber is very very sparsely scattered. No clear length and some of the nearly mature cedar is badly fire scarred at the butt but fir is not so badly scarred. The remainder of ground is covered with considerable oak of fair size (Bl. Oak) and quite a little seedling reprod. Of cedar and fir and quite a lot of sug p in places. There has been insect depredation as can see the few dead standing trees here and there thru the forty.	moderate	n/a	n/a	high	insect	moderate	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25322002	MC Ave	timber is very much scattered thru the forty but more so thru first 10 chains W. the rest of the ground is densely filled with young oak and cedar and fir and little sug p. reprod so that there are no open places. No clear length to timber and only the cedar very badly fire scarred. Last 10 chains show timber a little thicker but no much more than 10 ch. W. Same condit. Here except more litter and less oak and coniferous reproduct. Been a little insect depredation present.	moderate	n/a	n/a	moderate	insect	high	patchy
25322007	MC Ave	The timber is very much scattered until we reach the end of the forty when we enter a good fair dense stand of uniform timber - all about the same age. There clear length to the pine of about 16' and more. No very bad fire damage done to the nearly mature trees. All of the ground well covered or sheltered - along the first of the forty by oak and young reproduction and thru last of forty by the uniform dense stand of timber very little insect depredation.	low	n/a	n/a	moderate	insect	moderate	patchy
25322010	MC Ave	Get a good development of uniformly stocked timber at 7 chains and then for 3 chains very light and widely scattered and when we again ascend the timber is uniformly stocked to fair density. All of the timber needs to be thinned out a good deal to allow young reproduction to get a chance and also the ground should be cleaned up of dead logs and limbs. The pine in general has a good clear length of 16'. Very little insect depredation present.	high	patch of sparse timber on steep slope	3	none	insect	none	patchy
25322014	MC High	The timber is rather dense but uniformly distributed thru the first 13 chains of the forty - then this timber slackens off and curves around to the top of the ridge. There is no reprod. here. The clear length of the pine (Yel and Sug) 16' and over. <u>Good place for timber sale as most of timber is ready to be cut (even aged).</u> Thru last part of forty some cedar reprod. and much oak (immature). Very fungus or insect depredation.	high	even aged timber	13	moderate	fungus, insect	none	uniform
25322105	Pond Pine	Much of the timber is of good development but practically no clear length. There is a little fire damage done to the trees, but below the 4 1/2' mark on the butts. A little moss found growing on the bark and boughs of man of the fir and cedar trees. A little oak scattered here and there. In general the whole ground thru forty is shaded either by young reproduction or by nearly mature trees.	low	n/a	n/a	low	moss	high	fairly dense
25322108	MC Ave	Timber is very much scattered but one good thing is that the reprod is very good, too good of cedar. Clear length to pine is about 16'. Very little injury to the remaining timber standing. Very fungus or insect disease apparent. Also much young and immature black oak present together with a little cañon live oak.	low	n/a	n/a	moderate	fungus, insect	high	dense reproduction
25322111	MC Ave	Timber is more or less scattered thru the forty with no clear length. The reproduction is very thick so would advocate cutting off the mature timber. A little fire damage done to the nearly mature timber. But young reprod is fine. Very fungus or insect disease present. There are both cañon live and bl. oak scattered promiscuously thru forty.	moderate	n/a	n/a	moderate	fungus, insect	high	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25322112	MC Ave	Thru first part of forty the nearly mature timber is very scattered but the last five chains show much more timber and more uniform. There is no clear length. The timber is considerably fire scarred but apparently will not injure the good timber much. Very little moss found growing on the mature limbs.	low	n/a	n/a	none	moss	moderate	patchy
25322113	MC Ave	Most of the timber is pretty young and not uniformly distributed thru the forty. There is no clear length. Very little damage by fire apparent to any of the trees. Very little insect and fungous depredation present. There is quite a little black oak mixed in the forty and about half of it in good size while the other 1/2 very immature. Country in places more or less open.	low	n/a	n/a	moderate	fungus, insect	high	patchy
25322114	MC Ave	Most of the timber present is yet quite young and only the very old trees ought to be cut. There are signs on the trees of a very bad fire thru here but the timber in general is not very much damaged. Only the very mature timber shows fire damage. Very fungus disease present. A little moss covers the bark and limbs of the coniferous trees. A little oak scattered here and there.	low	n/a	n/a	low	fungus, moss	moderate	excluded
25322201	MC Ave	Timber is mostly stunted and wind topped. It is far from maturity and very widely scattered. Considerable damage done by fire to the timber - butts being badly scarred up to 8' to 10'. No clear length. A little insect depredation has been present as the dead standing timber has been killed by drought. Very open and very rough country.	moderate	n/a	n/a	low (understory)	insect	none	scattered
25322202	MC Ave	Timber is yet quite young and immature and very widely scattered with little to no reproduction. There is no clear length. Timber is quite badly fire damaged at the butt to distance of 10-15' up the trunk. Quite a little insect depredation some time ago as shown by the many standing dead trees. The country is very open the sun having easy access to the ground floor.	moderate	n/a	n/a	none	insect	none	scattered
25322203	Pond Pine	Most of the timber is yet very immature but is not of good development as they are stunted in growth and wind topped. No clear length to the timber. Damage by fire slight; must have been considerable insect damage to trees as there a number dead standing trees. Also many fallen logs lying on the ground and decaying. The country is very open.	low	n/a	n/a	none	insect	none	open
25322204	MC Ave	Timber is very much scattered and yet quite immature. The reproduction does not seem to get a very good start - country being too dry. Timber is badly fire scarred and extends considerable way up from the base of the tree. A clear length to sug and yel p of 16'. Trees are not of especially good ht. the country is very open letting in much sunlight.	moderate	n/a	n/a	none	none	none	scattered
25322205	MC Shrub	Timber is very much scattered but very little has any clear length except perhaps the pine. A little damage done by fire but it has not gutted the trees badly. There has been a fungus and insect depredation due to the few dead standing trees. Much scrub oak scattered here and there.	low	n/a	n/a	moderate	fungus, insect	scarce	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25322206	MC Ave	Timber is very widely scattered but of not very good development as the tops are more or less injured. Not much damage by fire to the nearly mature trees. Clear length to the yel p about 16'. Very little insect or fungous depredation present. The country is more or less open with much scrubby stuff growing around the boulders.	low	n/a	n/a	low (understory)	fungus, insect	scarce	scattered
25322207	MC Ave	No Notes	none	n/a	n/a	none	none	none	excluded
25322211	MC Ave	Timber is very sparsely and scattered and there is no clear length to any of the timber. There is very little reprod as there is not a great amt of spare ground where the reproduction can get a chance. Not much fire damage on the trees only scorching the bark a little. Not much insect or fungous disease present. Quite a little oak (cañon) scrubby in form.	low	n/a	n/a	moderate	fungus, insect	scarce	scattered
25322212	MC Shrub	The timber tallied found mostly thru the last few chains of the forty, the first part of forty being devoted to very young and immature cañon live oak and bl oak. The timber very uniform thru last few chains and hardly any in first part. Clear length to pine about 16'. Many dead standing coniferous trees but no more insect damage apparent. Fire damage is not bad.	low	n/a	n/a	high	insect	scarce	patchy
25322801	Pond Pine	The timber is very widely scattered the pine reproduction coming up in good shape along the first part of the forty but not so abundant along the last few chains of the forty. Very little fire damage apparent and no clear length to any of the timber. Practically no fungous or insect disease present. A very little oak, very immature growing here and there.	low	n/a	n/a	low	none	low	scattered
25322807	MC Ave	Timber is very much scattered thru the forty and for an average thru forty there is no clear length. A little damage done by fire but it has not injured the nearly mature timber greatly nor the rather abundant reproduction. No fungous or insect diseases apparent. Quite a little black oak and Calif live oak present thru the forty.	low	n/a	n/a	moderate	none	moderate	scattered
25322808	Pond Pine	Timber hardly worth taking into account. There was a little digger pine found here and there. The whole forty practically covered with chaparral but would not call it very dense. A little yel. Pine trees to get started and also a little cedar. No clear length to any of the timber.	none or high	chaparral (edge of timber line)	20	none	none	scarce	scattered
25322809	MC Ave	Timber very very widely scattered, most of the open places (practically the whole forty) are filled in with both calif live oak and the black oak. Most of oak is yet quite immature. No clear length to any of the coniferous timber. Very little fire damage apparent.	low	n/a	n/a	high	none	low	scattered
25322810	MC Ave	Timber is very widely scattered and there is no clear length to the timber. The rest of the surface is covered more or less dense with black and calif live oak and considerable pine and fir reproduct. No fungous or insect disease present.	none	n/a	n/a	high	none	high	scattered
25322815	MC Ave	Timber is very much scattered but there is no clear length. There is quite a little bit of reproduction together with the black oak and calif live oak in the many more or less open spots. A little damage by fire but it does not injure the nearly mature timber much.	low	n/a	n/a	moderate	none	high	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25322816	Pond Pine	Timber is very very sparsely scattered with oak and manzanita and young reprod. Filling in all of the large open area. No clear length. A little damage done by fire but it is not severe. No insect or fungous disease apparent. Much calif live oak and bl. oak present.	low	n/a	n/a	high	none	low	scattered
25322902	MC High	The older mature timber is much scattered and ought to be cut. There is not any [can't read word, starts with a "t"] good young reprod. Some of the young timber ought to be thinned. There is no clear length. Most of the ground is well shaded and it ought to be cleaned up. Fire damage to some of timber is severe but it is not on many trees. Very little insect or fungous disease. The young fir trees seem to have a little pitch oozing out and not know if it insect disease.	moderate	n/a	n/a	none	fungus, insect	none	scattered
25322903	MC High	the timber of good development up to 10 chains when we strike a strip of 2-3 chains wide consisting chiefly of dead standing timber killed probably by the fire. Then there is good timber for the last 7 chains. But there is no good clear length to the timber on average. Considerable fire damage. Moss present but not too abundant.	high	patch of fire killed timber	2.5	none	moss	scarce	excluded
25322904	MC Ave	Timber is more or less scattered more numerous thru the first part of the forty and more much more scattered thru last part of forty. Clear length to the pine is about 16'. No clear length to the fir. Considerable fire damage done to the nearly mature timber both pine and fir. Much oak, immature, scattered here and there. Last part of forty is more or less open, with good cedar reproduction, little insect depredation.	low	n/a	n/a	high	insect	moderate	scattered
25322905	MC Ave	Coniferous timber of fair density and uniformly distributed thru the first 8 chain. This timber should be thinned out and the ground cleaned up., no clear length. Thru last 10-12 chains the timber is sparsely scattered and the black oak takes the place – this black oak is found in clumps and is very immature. Thru this last 10 ch the country is more or less open and little fern growing. Very little insect disease present.	none	n/a	n/a	high	insect	none	patchy
25322906	MC Ave	Timber thru the first 11 chains nearly mature and not growing in a dense mass together. No clear length. There is considerable damage done to the nearly mature trees gutting thru butts out to a considerable height. Moss covered bark and branches very prominent. Last 9 chains much young and very immature oak found in little clumps.	low	n/a	n/a	high	moss	scarce	fairly dense
25322907	MC High	Nearly mature timber is more or less uniformly distributed thru forty. As there is not much young reproduct. This nearly mature timber ought to be heavily cut and the ground cleared up. The timber is not very badly damaged by fire except the real large fir and sug p. trees. Very little insect disease apparent as all the timber is in good shape. All ground practically shaded by the moderately dense stand.	low	n/a	n/a	none	insect	scarce	uniform

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25322908	MC Ave	Timber is more or less dense and scattered in places and has rather poor development. Much needs to be thinned to get the desired reproduction. The timber is very badly fire scarred and especially the cedar which is gutted right out and up the trunk a ways. A very fungus disease present on the timber. A little black oak scattered here and there but very little.	moderate	n/a	n/a	low	fungus	moderate	patchy
25322909	MC High	Thru first part of forty the timber rather dense and not near maturity and it ought to be thinned out if reproduction is desired. No clear length. Very severe fire has been thru here scarring the cedar very badly but the rest of timber but little scarred at the base. Very little moss present. Quite a little oak very immature near end of forty.	moderate	n/a	n/a	moderate	moss	low	dense
25322910	MC Ave	The timber is uniform and of fair density thru the forty. Most of this timber ought to be cut to give the young reproduction a chance and let it come in. the fir or cedar trees are not badly damaged by fire. But the very old fir trees look hollow butted and badly scarred. No clear length. Fungus or insect damage present. Most of the ground is well shaded.	moderate	n/a	n/a	none	fungus, insect	none	uniform
25322911	MC Ave	Timber is more or less uniformly distributed thru the strip. But all timber of nearly mature size show bad fairly bad fire scars at the butt. On average there is only clear length on the yel p and sug p of about 16'. Moss found in great abundance on the bark and boughs of the nearly mature timber. Most of ground is shaded by the tall trees. [from logging section notes:] There a good deal of dead timber standing on this forty. Surface is a little bit hindered by lying and half decayed logs.	low	n/a	n/a	none	moss	low	uniform
25322912	MC High	1st 7-10 chains very scattered coniferous timber and abundant young oak. Last 10 chains good timber of fair density and uniformly distributed. Really no clear length to timber unless the sug p has a clear length of 16'. Timber especially fir is considerably fire scarred up to distance of 10-15' from the base of tree. The timber ought to be thinned out and the ground cleared up thru last 10 chains to give the younger timber a chance there is very little insect depredation apparent.	moderate	n/a	n/a	moderate	insect	excluded	patchy
25322913	Pond Pine	The development of timber thru last 13 ch is pretty bum [not a typo – I think it really says bum] slope being west and pretty well up on a high ridge. It is stunted and spread out on top and trees stunted more or less in growth. The first few chains has timber of good development but no clear length and the fire damage is slight. The oak begins to come in at 7 chains but it is very young and immature and very dense and thick.	low	n/a	n/a	moderate	none	none	patchy
25322914	MC Ave	1st 8 chains the timber rather dense and needs to be heavily thinned as no reprod beneath. No clear length. Timber shows considerable damage by fire. Much moss also growing on the bark and boughs of the fir trees. The last 12 chains consist mostly of young groups of young black oak with wild fern and oak leaf litter for ground cover.	low	n/a	n/a	high	moss	scarce	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25322916	MC High	Timber is very dense thru most of the forty. It is not yet mature but ought to be thinned if reproduction is desired. There is practically no clear length to any of the timber tallied. Some of the timber and especially the cedars are very badly fire scarred.	moderate	n/a	n/a	none	none	scarce	dense
25323108	Pond Pine	Timber is very scattered thru first 10 ch. and then get a little denser stand for 2-3 ch. and then into a mess of very young and immature black oak. Clear length to the pine is a good 16' length. A good deal of this pine is nearly mature. The nearly mature trees show rather bad fire scar but they do not extend very far up from the base of the trunks. There is a little timber blown over by the wind and a few standing dead trees killed probably by insects.	low	n/a	n/a	high	insect	none	patchy
25323109	MC High	the timber thru first part of the forty is of good density - the older mature timber ought to be cut and the younger ought to be thinned out and the ground floor cleaned up a bit. Practically no clear length to any of the timber. It thins out giving place to young sug p, fir and cedar reprod. together with much immature black oak. Apparently very little insect depredation present. Fire damage is considerable but not injuring the trees far from the base of the tree.	low	n/a	n/a	high	insect	moderate	patchy
25323115	MC Ave	After 6 chains get a little stretch of fair timber which extends down slight incline and up the next for a little way and then drops off immediately. Oak in clumps (very dense) takes its place. The timber ought to be cut as it nearly mature. But there not such a great deal of it. Sug. P. badly fire scarred as is the fir but pine has clear length of about 16'. Much very small oak.	moderate	n/a	n/a	high	none	low	excluded
25323116	MC Ave	Timber is near maturity, more or less open but shading ground enough with chinquapin to prevent reproduction from getting a good start. Sug pine has a clear length of about 16' and would have twice that much if not badly fire scarred. Fir also badly fire scarred. Little moss growing on fir bark and boughs.	moderate	n/a	n/a	none	moss	scarce	open
25323201	MC High	Most of timber almost ready to be cut - at any rate it ought to be thinned out. Clear length to (yel and sug) pine about 16'. Best use saw logs. All timber very badly damaged by fire. The bark of the cedar and fir just completely covered with moss. The stand is very uniform.	moderate	n/a	n/a	none	moss	moderate	uniform
25323202	MC High	Some of the young but merchantable timber is too crowded and ought to be thinned out. There is no clear length to any of the timber. Considerable damage done to the older and more mature timber. Quite a bit of moss found growing on the bark and limbs of the fir and cedar trees. In spots the land more or less open (but spots are very few and are covered with a deep litter (3"-6") of coniferous litter).	low	n/a	n/a	none	moss	moderate	patchy
25323203	MC High	After the first few chains the timber is quite dense and too dense and ought to be thinned out as there is no reproduct on the ground. No clear length and the timber is badly fire scarred; a few trees here and there are dead stubbs. At the end of the forty the land is very open and a few oak come in. then at the end of forty get dense timber again.	moderate	n/a	n/a	moderate	none	low	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25323204	MC High	Most of timber is ready to be cut. But as there is no reproduction where the large timber is (and it is uniform) the stand ought to be heavily thinned. The first few chains consist mostly of oak (very immature). Then the remainder of the forty very uniformly stocked with ripe timber. Clear length to fir on av about 16'. All timber badly fire scarred. Moss very prevalent.	moderate	n/a	n/a	moderate	moss	low	uniform
25323205	MC High	Timber is nearly mature but very much scattered. On account of the very bad fire scars to the trunks of the timber tallied there is really no clear length to any of the timber. There is very little moss or insect disease apparent on the timber tallied. There just a little black oak scattered here and there.	moderate	n/a	n/a	low	moss, insect	scarce	scattered
25323206	MC Ave	Condit. Of timber is very much scattered and when it occurs it in groups of 3-4. No clear length. The oak is the predominating species in the forty although the oak is far from maturity (most of it). The mature timber is badly fire scarred at the base. There are also many dead stubbs standing throughout the forest. The country is rather open with much oak reproduction in clumps.	moderate	n/a	n/a	high	none	low	groups
25323207	MC High	Timber is in need of being thinned out and the turned over timber and dead stubbs standing need to be cleaned up. Too much trash in this forty. No clear length to any of the timber. There considerable fire damage done to all merchantable timber and ground in excellent condition for a very bad fire, if not cleaned up.	low	n/a	n/a	none	none	scarce	dense
25323208	MC High	The timber is of good form but ought to be thinned out to let some of the younger merchantable timber take on diam growth. No clear length. Fire damage is considerable and especially so to cedar. Moss is not so abundant here as in the previous forty. Very little hardwood species found here and there and it very immature.	low	n/a	n/a	low	moss	low	fairly dense
25323209	MC High	Timber is of fair development but is really too thick and ought to be thinned out there is no clear length. Best use is saw logs. There is considerable damage by fire to the nearly mature timber but is not scarred up from the base much. At 10 chains get a fairly wet place but dried up in most places. Thru last 10 chains there a little decayed timber.	low	n/a	n/a	none	none	low	fairly dense
25323210	MC High	The stand is very open. The timber is in fairly good condition but all of it has large side limbs (proof of the open country). No clear length. Much damaged by fire. Little damage by insects apparent or by fungous diseases. A little oak (very young) found here and there.	moderate	n/a	n/a	low	fungus, insect	scarce	open
25323211	Pond Pine	The timber is not very dense. In NW part of the forty it very open and there plenty of skunk cabbage and wild high bush pea grow. There is no clear length to the fir which is badly fire scarred. There is considerable moss found growing on the fir boughs and bark. No insect damage apparent.	moderate	n/a	n/a	none	moss	scarce	patchy
25323215	Pond Pine	Most of timber is yet quite immature as we did not get into it until the last 5 chains of the forty, the first fifteen chains being very young oak growing in groups. The timber is hardly fire scarred. No clear length no fungous disease yet apparent.	low	n/a	n/a	high	none	low	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25323216	MC High	A good deal of the timber is fairly young yet but of good development. No clear length. There considerable damage by fire to the trees tallied. A little moss apparent here and there on the bark and boughs of the timber tallied. There many logs lying on the ground and decaying. A little oak present but a very little.	low	n/a	n/a	low	moss	low	excluded
25323301	MC Ave	Timber is very much scattered and of good merchantable size. No clear length. Fire damage is slight though cedar bark is well scortched. Very fungus and insect disease present. A little oak here and there, mostly the calif live oak. The land is more or less open.	low	n/a	n/a	low	fungus, insect	moderate	scattered
25323302	MC Ave	Timber is more or less scattered with quite a bit of young reproduction in the open places. No clear length except on the sug p. considerable damage done to some of the cedar and the sug p. a very little insect and fungous disease present. A little oak (bl and live oak) present.	low	n/a	n/a	low	fungus, insect	moderate	scattered
25323303	MC Ave	Timber of fair size and development but ave is nowhere near mature. No clear length. Considerable damage by fire but it (fire) has not severely injured the trees. Very fungus disease. Quite a little oak found at the end of the forty in the open places.	low	n/a	n/a	moderate	fungus	moderate	open
25323304	MC High	Timber is more or less scattered being found both singly and in groups. There is no clear length on the average. Considerable fire damage noted on the butts and trunks of the nearly mature timber tallied. Much moss found growing on the bark and dead boughs of the timber. There is a little oak scattered thru forty but most of it is toward the end of the forty and is very young and immature. There a few dead stubs found standing.	low	n/a	n/a	low	none	moderate	scattered
25323305	MC Ave	Timber is very much scattered but most of it is near maturity; no clear length. Very much damaged by fire and considerable moss found growing on the bark and limbs of the trees. A little young and immature oak found scattered thru the forty.	moderate	n/a	n/a	low	moss	moderate	scattered
25323306	MC Ave	Timber is very much scattered and is nearly mature. There has been a fire thru here but has not done a great deal of damage. No clear length. Much moss found growing on the bark and limbs of the timber tallied. Timber is very very poor as many standing dead butts.	low	n/a	n/a	none	moss	moderate	scattered
25323307	MC Ave	Timber is yet quite immature and is very much scattered; it not of good quality along fist 12 chains but after ridge passed and descend east slope the young as well as the nearly mature timber has fine form. No clear length. Very much fire damage thru first 12chains but last 8 chain very little fire damage apparent. Very little oak present.	moderate	n/a	n/a	low	none	low	scattered
25323308	MC Ave	Most of the timber quite immature as yet. The nearly mature timber is very much scattered with a great abundance of pine and cedar reprod. Clear length to cedar and pine about 16'. There is a little damage by fire but not very apparent. Very little insect or fungous disease present.	low	n/a	n/a	none	fungus, insect	high	dense reproduction

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
25323309	MC Ave	The timber is very much scattered; the yel. P. on av. Has a good clear length of 16' or more. Most of the pine is ready to be cut but it ought to be thinned lightly as there is not much reproduction. Considerable damage done to all timber by fire and especially so to the cedar. A little oak scattered here and there. The country very open but not much ground cover except a very few wild weeds.	low	n/a	n/a	low	none	low	scattered
25323310	MC High	Timber is very much scattered. About 1/2 of it is ready to be cut and especially the yel. P. yel. P. has a good clear length of 16' and more. Considerable damage done to cedar trees tallied, also a little fire damage to firs and pine. Very fungus disease present; neither much insect disease. Quite a bit of oak but very much scattered. Very little reproduction.	low	n/a	n/a	low	fungus, insect	low	scattered
25323312	MC High	Quite a little of timber near maturity but there is no clear length as it is more or less widely scattered. There is a little damage done to the trees by fire but it does not amount to much. Quite a few trees moss covered. Also a number of dead trees standing - mostly firs.	low	n/a	n/a	none	moss	moderate	scattered
25323313	MC High	Is more or less uniform. There is no clear length on any of the timber as it is yet quite immature. Very little damage by fire apparent. Much moss found growing on the trunks and branches of the tallied timber. Last part of the forty more or less open. Would be a good idea to thin out the timber and clean up the dead standing timber and also the dead and decaying timber lying on the ground.	low	n/a	n/a	none	moss	moderate	patchy
25323314	MC High	Timber is pretty thick and dense in places, the older timber thus ought to be cut to let younger merchantable timber a chance. No clear length to cedar or fir or pine. A little fire damage done to trees but as a whole a good stand of timber but too thick in spots. Very very little scattered oak.	low	n/a	n/a	low	none	moderate	patchy
25323315	MC Ave	Timber is more or less uniformly distributed thru the forty. No clear length to any of the timber tallied. Considerable damage by fire, especially to the cedar trees. Very little moss or insect disease apparent although there are a number of dead standing trees. Quite a bit of calif live oak and a little bl. oak present.	low	n/a	n/a	moderate	moss, insect	low	uniform
25323316	MC Ave	Timber of fair development but would be no clear length to any. Fire damage not very bad only scarring butts of timber but slightly. Not much fungous or insect injury present. There is plenty of bl. Oak and calif live oak present thru the forty. The timber (coniferous) is very much scattered.	low	n/a	n/a	moderate	fungus, insect	low	scattered
26312101	Pond Pine	It of fair development but most yet quite immature although merchantable. Clear length about 16'. Best use is saw logs. Virgin stand. Pine shows little fire scars at the base. The branches have good deal of moss growing on them. Country very open. Little oak of fair large growth.	low	n/a	n/a	low	moss	scarce	open
26312108	Pond Pine	In a rather young stage yet but of good development. No clear length. Best use of timber for saw logs. Virgin stand. Considerable damage done by fire shown in the nearly mature pine and fir scarred at the base and some distance up the trunk. Little moss covers the limbs of the coniferous wood. Dense stand thru first 15 chains and then more or less open until end in chaparral.	low or high	stand opens towards chaparral patch (edge of timber line)	5	none	moss	high	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312201	Pond Pine	The pine is nearly mature and is of good development, clear length being about 16'; also the cedar has about same clear length. Best use for logs, saw logs. Virgin stand. Damage by fire more apparent to the cedar. Much good merchantable oak. Country is very open and has many very large and park like places.	low	n/a	n/a	high	none	high	open
26312202	Pond Pine	The pine tallied is near maturity and has a clear length of about 16'. Best use is for saw logs. Virgin stand. Virgin stand. Little to no damage by fire. There is considerable oak of merchantable size scattered promiscuously here and there. The country is very open, there being good, wide, spacious places for grazing.	low	n/a	n/a	high	none	high	open
26312203	Pond Pine	The pine of good form and about reached maturity. The little fir clings to its lower branches. Clear length of pine about 16'. Best use of timber is for saw logs. Virgin stand. Considerable damage done to all coniferous trees due to fire - it more apparent in case of cedar and fir as butts and trunk gutted up some distance. Country more or less open with a fairly heavy stand of trees. Much good merchantable oak.	low	n/a	n/a	high	none	high	patchy
26312204	MC High	Pine of good development and especially so in case of the sugar pine. Clear length of the pine (sugar and yellow) about 16'. Fir has no clear length. Best use is for saw logs. Virgin stand. Little damage by fire to pine, cedar and fir. Much moss found on the limbs and trunks of the coniferous species a little oak (black) scattered here and there. The stand of both hard wood and coniferous, fairly dense.	low	n/a	n/a	low	moss	high	fairly dense
26312205	Pond Pine	Very sparse until at about last 4 chains come into a good stand of timber. Pine has clear length of about 16' but fir has none. Best use of timber saw logs. Little fire damage but not very apparent. A little moss on the coniferous trees. Little black oak and very little live scrub oak. Country very open over the first 16 chains. Last 4 chains there good stand.	low	n/a	n/a	low	moss	moderate	patchy
26312206	Pond Pine	The stage of development is good and nearly mature; no clear length as it so sparsely scattered. Best use saw logs. Virgin stand. Very little fire damage. Little moss found on the limbs of the pine. There not so much oak as previous forty and the country is more open.	low	n/a	n/a	low	moss	moderate	scattered
26312207	Pond Pine	Good stage of development but very much scattered. Clear length about 16'. Best use saw logs. Virgin stand. Little fire damage as shown by the butts near the base of the big pine trees. Country very open and there a good deal of oak of good merchantable size present. Much mistletoe present on the pine limbs.	low	n/a	n/a	moderate	mistletoe	moderate	scattered
26312208	Pond Pine	Timber in good age of development but very much scattered. Clear length of nearly mature pine is about 16'. Best use is saw logs. Virgin stand. No damage by fire apparent. Much mistletoe found on the pine, also moss. Country very open. Much oak of good merchantable size on the forty.	none	n/a	n/a	moderate	mistletoe, moss	moderate	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312209	Pond Pine	Very much scattered and would say that it runs 16' of clear length. Pine of good form too. Saw logs best use for the timber, no fire damage apparent to the mature timber. There is much oak (black) and of good merchantable size scattered thru the forty. The country is very open but barren in most places with exception of few places where we get little wild pea.	none	n/a	n/a	moderate	none	high	scattered
26312210	Pond Pine	Large timber is very sparse and no clear length to the pine. Much young pine coming up. Fir is mostly young but of very good form. Little fire damage but it has not apparently affected the young pine or fir. Country very open with a good deal of oak very densely scattered. Most of the oak is of good merchantable size.	low	n/a	n/a	high	none	low	scattered
26312301	Pond Pine	Very good form but a good deal is immature yet and still growing. Clear length of pine is about 16'. Best use is for saw logs. Virgin stand. Considerable damage by fire to both sug. and yel. p. a little oak (very little) oak scattered here and there thru country. Much moss and mistletoe present on the limbs of the trees. Country is more or less open.	low	n/a	n/a	low	mistletoe, moss	low	open
26312302	Pond Pine	Good development with clear length of about 16' for the sug and yel p. most dense stand of timber passed thru on this forty. Most of timber nearly mature. Best use for timber for saw logs. Virgin stand. Considerable damage by fire to both sug pine and yel p. country very open and the mature timber has shaded ground preventing grasses from coming. A little oak, most of it very immature.	low	n/a	n/a	low	mistletoe, moss	moderate	open
26312303	Pond Pine	Timber near maturity but it is scattered in groups more or less, clear length about 16'. Best use for timber - saw logs. Virgin stand. Considerable damage done by fire, also little moss and mistletoe present in small quantities. The country is more or less open with a little oak very small.	low	n/a	n/a	low	mistletoe, moss	moderate	groups
26312304	Pond Pine	About reached maturity but it more or less scattered thru forty and both fir, cedar and pine are scarred at the butts bad. Best use is saw logs. Virgin stand. Much moss and mistletoe growing on the branches of the conifers. Little oak but it very sparse and widely scattered. Country is very open.	low	n/a	n/a	low	mistletoe, moss	moderate	scattered
26312305	Pond Pine	Good development and it nearly mature and has clear length of about 16'. Best use is for saw logs. Virgin stand. Little fire damage but not harming mature timber much. Moss and mistletoe present in small quantities on the branches of the trees. The country is very open and much good merchantable oak present scattered in open places.	low	n/a	n/a	high	mistletoe, moss	low	open
26312306	Pond Pine	Most of timber estimated was of good size and form and has clear length of about 16'. Best use I for saw logs. Virgin stand. A little fire damage by fire. Also moss and a little mistletoe present on the branches. Oak is very thick in the more or less open country.	low	n/a	n/a	high	mistletoe, moss	moderate	open

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312307	Pond Pine	Timber is very much scattered but the large timber is nearly mature - the sug and yel p well over 16' of clear length. Best use is saw logs. Virgin stand. Considerable damage done by fire to pine also moss and mistletoe grows quite abundant on branches. Thru last 10 chains ground level and then mostly oak with a large pine scattered here and there. The oak is of fine merchantable size. Country more or less open.	low	n/a	n/a	high	mistletoe, moss	low	scattered
26312308	Pond Pine	Timber of good development, pine having clear length of about 16' but there is no clear length for the fir. Best use for timber is saw logs. Very much damage done by fire and especially to the cedar and fir. There also a good deal of oak of good merchantable size. Much moss and mistletoe growing on the pine especially and also the cedar.	low	n/a	n/a	high	mistletoe, moss	low	excluded
26312309	MC Ave	Most of the timber is of good form and near maturity having a clear length of about 16'. Best use for logs - saw logs. Virgin stand; little to no fire damage. The fir has no clear length. Little mistletoe growing on limbs of pines and firs together with the moss. Much oak at the beginning of the forty and also much oak at the last few chains of the forty. country more or less open; good timber in centre	low	n/a	n/a	moderate	mistletoe, moss	low	patchy
26312310	Pond Pine	The timber tallied is nearly mature and of good form with clear length of about 16'. Best use is for saw logs. Virgin stand. Little damage done to sugar p and yel p. also considerable mistletoe, moss growing on the branches of the pine. Much oak and of good merchantable size. The country is very open, more open than forty passed thru.	low	n/a	n/a	high	mistletoe, moss	moderate	open
26312311	Pond Pine	Timber tallied near maturity and of good form and clear length of about 16'. Best use of timber is for saw logs. Little damage done by fire apparent at the base of the nearly mature trees. Little moss growing on the branches of the pine trees. There much oak of good size scattered here and there thru the forty. Country very open and reproduction as well as timber is widely scattered.	low	n/a	n/a	high	moss	moderate	scattered
26312312	Pond Pine	It of good size and nearly mature but it is very much scattered. Clear length of about 16'. Best use saw logs. Virgin stand. Quite a good deal of damage to the nearly mature pine timber, the butts being well gutted and extending for 10-15' above the base. Little moss on the branches. There much oak both alive and black scattered thru the forty.	moderate	n/a	n/a	high	moss	moderate	scattered
26312313	Pond Pine	Timber near maturity but it is very scattered; there quite a good deal of timber about 12' in D of excellent form and also much young reproduction. Clear length of timber is 16'. Best use is saw logs. Very very little damage by fire apparent and must have been here before the reproduction came in as not fire scars. Much oak in open places.	low	n/a	n/a	moderate	none	moderate	scattered
26312314	Pond Pine	Most of the timber yet very immature but the few large trees tallied have good development and a clear length of about 16'. Virgin stand; best use - saw logs. Very little damage apparent from fire. A good deal of oak scattered here and there in open places. Country more or less open with oak trees being scattered in the open places. Some of oak large and some very young and growing.	low	n/a	n/a	moderate	none	moderate	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312315	Pond Pine	Timber has almost reached maturity and has good clear length of about 16'. Only a tree here and there is fire scarred at the butt and then not very far up from the base. Best use - saw logs. A little moss growing on the limbs of the pine and also insect depredation present as there are few trees whose foliage is turning russet color. Much oak scattered in the open grazing places.	low	n/a	n/a	moderate	moss, insect	moderate	open
26312316	Pond Pine	Most of the scattered timber near maturity and of good clear length of 16'. Best use is for saw logs. No damage by fire apparent. Country is very well populated with dense groups of pine reproduction and then there are wide open places where there is good grazing for cattle. There is also much young black oak of immature size but excellent for small cordwood.	none	n/a	n/a	high	none	high	patchy
26312401	MC Ave	Cedar is not of extra good form as it is badly fire scarred. There a clear length of about 20-30' on large timber. Most of pine and fir yet very immature. Virgin stand. Best use saw logs. There is also much oak of good size here and there. The country is not very crowded - more or less open and easy to tramp through.	moderate	n/a	n/a	high	none	moderate	open
26312402	MC Ave	Fairly good development but the nearly mature timber is quite badly fire scarred at the base. No clear length. Best use is saw logs. Virgin stand. Very much damaged by fire especially the cedar. There mostly thick forest of oak the 1st 10 chains and then we struck the heavy timber shown in tally sheet.	moderate	n/a	n/a	high	none	high	patchy
26312403	Pond Pine	The large timber tallied in good condition except at the butts where very bad fire scars extending for several feet from the base. Clear length about 16'. Virgin stand and best use of timber for saw logs. Timber a good deal injured by fire. There is much oak intermixed with the conifers and it of good merchantable size, there being plenty of it.	moderate	n/a	n/a	high	none	low	excluded
26312404	Pond Pine	Large timber in fair stage of development except that the pine and fir are badly fire scarred so that there would be no clear length. Best use of timber for saw logs. Very much damage by fire. Much oak scattered here and there. Also many open park but the large timber prevents grass to grow as it shades the ground.	moderate	n/a	n/a	moderate	none	low	open
26312405	Pond Pine	Timber is so scattered that lower limbs still persist. No clear length. Best use of the timber for saw logs. Virgin stand. Very much damage done by fire the pine butts in some cases being gutted up from base to ht of 15'. Insects also present shown by the resinous exudation and moss growing on the bark and limbs of the trees. Much oak scattered thru the 40 and of good size.	moderate	n/a	n/a	high	moss, insect	moderate	scattered
26312406	Pond Pine	The scattered pine (yel. p and sug p) have good form and clear length about 16' but are badly gutted at the butts by fire. Fir holds its lower branches. Best use for timber saw logs. Virgin stand. Much fire and insect damage. Much oak mixed in with the conifers and of good merchantable size	moderate	n/a	n/a	high	insect	moderate	scattered
26312407	MC High	Timber in good condition to be cut as it is nearly mature. There is more clear length on the pine than the fir as it tends to cling to lower branches even when of large size. Best use saw logs. There a good deal of sugar pine here. Much damage done to all mature timber by fire as the scarred butts are present but to no great height.	low	n/a	n/a	none	none	low	excluded

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312408	MC Ave	Cedar is in fair stage of development but is badly fire scarred at the butt and for about 4'-10' up the tree. Cedar has clear length of about 16'. Fir has not any clear length on average. Considerable damage by fire to mature cedar and young cedar reproduction (bark scortched). Much oak of good size here and there, country more or less open but no [? text ends here]	moderate	n/a	n/a	high	none	moderate	open
26312409	Pond Pine	Timber very scattered by there is plenty of young timber growing between age 6"-12" and under. Did not strike fir until on last 5 chains and then very dense reproduction. Few nearly mature timber but not much clear length (not 16'). Nearly mature timber is fire scarred at the butt but only for a couple feet. Country not dense. Covered with reproduct but enough to prevent grass or weeds to grow. Plenty of nearly mature oak scattered around.	low	n/a	n/a	high	none	moderate	patchy
26312410	Pond Pine	Timber for the first five chains like all of the previous forty but now we approach the top of ridge and the young cedar on the ridge and young pine on the west slope come in. the mature timber not much clear length. Best use of timber is saw logs. Virgin stand. Considerable fire damage at the butts of mature timber and young cedar reproduct. The last 15 chains more or less open country on top of ridge with steep west slope but not much old timber.	high	open country with young timber (along ridge)	15	none	none	moderate	patchy
26312411	MC Ave	Timber quite immature but is merchantable, no clear length. Best use for saw logs. Much damage done by fire and especially to cedar. Also pine is much gutted at the butt. Few dead timber standing indicate the presence of insect and fungous diseases. Much immature oak present. The young reproduction not very dense and easily passed through. There a few open places but very few.	moderate	n/a	n/a	high	fungus, insect	moderate	fairly dense
26312412	Pond Pine	Is of good development but on acct of sever fire scars at the butts there is hardly a clear length of 16'. Best use is for saw logs. Virgin timber. There is much oak intermixed and a great deal of it over 20" in D. looking across to the slope traversed going north could see many dead trees standing (about 5 to the acre - all pine).	moderate	n/a	n/a	high	none	moderate	excluded
26312413	Pond Pine	Timber in a fair stage of development but much of it yet quite immature although merchantable. Many of the trees (fir and pine) are stagheaded but yet alive. Cedar and pine have about 16' of clear length. Fungous disease and fire are very bad here. Number of oak scattered here and there over last 13 chains and dense forest.	moderate	n/a	n/a	low	fungous	moderate	dense
26312414	MC Ave	Timber is mostly very immature though much is merchantable. No clear length. Best use saw logs. Virgin stand. Very much damage done by fire and insects shown by few dead standing timber and the large fire scars on the butts of the merchantable timber. Good deal of oak intermixed with the coniferous trees. But the oak not of good merchantable size yet.	moderate	n/a	n/a	low	insect	moderate	excluded
26312415	Pond Pine	There a few scattered timber. The pine has good clear length but not so with the fir. Best use is for saw logs. Virgin stand. Damage by fire is quite a good deal shown on the mature timber. The country is more or less open with few trees scattered here and there and also much oak.	low	n/a	n/a	high	none	moderate	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312416	Pond Pine	Most of timber very young and immature averaging about 14-18" in D. best use saw logs. Virgin stand. No damage by fire apparent. Plenty of scattered oak in the forty.	high	immature timber not damaged by fire	20	low	none	moderate	excluded
26312501	MC Ave	Country pretty open so the trees seem to hold their lower branches. There considerable pine reproduction about 6"-12" in D and also fir. Best use for timber is saw logs. Virgin stand. Very much is the nearly mature timber damaged by fire, it being clearly marked on the butts and up to a distance (in some cases) to 15'-20'. Also the fir tree bothered with moss growing on the bark.	moderate	n/a	n/a	none	moss	moderate	open
26312502	MC Ave	The fir and cedar tallied is about 16' of clear length. Best use is saw logs. Virgin stand. Very badly damaged by fire the mature cedar and the fir (having hollow butts). Much moss growing on the cedar bark (merchantable trees). Some fungous and insect disease present. Toward the end of the forty bull pine begins to creep in. there also scattered oak mixed though the 40.	moderate	n/a	n/a	low	fungus, insect	low	excluded
26312503	MC Ave	Some of older timber calipered (cedar especially cedar of clear length 16' log. Best use of timber is saw logs. Virgin stand. Very much damaged by fire and even the small cedar is covered with moss growing all over it. There seems to be considerable sugar pine reproduction but no trees on strip run. Few scattered oak here and there.	low	n/a	n/a	low	none	high	excluded
26312504	MC Ave	A good deal of young fir over the pole wood type. The cedar is mostly old, mature timber and badly fire scarred and runs about 16' log of clear length. Best use for timber is saw logs. Virgin stand. The cedar and few pine are badly fire scarred. Fungus, moss on the nearly mature trees. The reproduction very dense consisting mostly of cedar with a little pine and fir but not accountable. A few scattered oak.	moderate	n/a	n/a	low	fungus, moss	high	excluded
26312505	Pond Pine	There considerable oak of fair size but not so dense as the previous forty passed through. The timber tallied nearly mature; clear length about 1 16' log. Best use is for saw logs. Virgin stand. The cedar is very severely damaged by fire, considerable moss also present on these cedar trees.	moderate	n/a	n/a	moderate	moss	moderate	excluded
26312506	Pond Pine	There considerable oak mixed in with the pine in the more or less open land. Timber tallied has nearly reached maturity with one 16' log. Best use for timber saw logs. Virgin stand; considerable damage done by fire, insect and fungous disease present in merchantable timber. Also growth of moss on the nearly mature timber very apparent. good deal of oak ascending slope and much oak descending very steep slope	low	n/a	n/a	high	fungus, moss, insect	low	open
26312507	Pond Pine	Good timber but more or less open and thus open making the young timber hold its limbs. Best use saw logs. Virgin stand. Considerable fire damage and trees over about 28" in D are completely covered with moss. Insect depredation probably present. The country is more open than the previous forty traversed.	low	n/a	n/a	none	moss, insect	low	open
26312508	MC High	Very heavy growth of fir of a good and nearly mature age. Clear length about 16' log. Best use for the timber saw logs; virgin stand. Very much damaged by fire. Great amt of moss growing on the bark, more so than anywhere else found. There a few scraggling oak and pine trees present. Thus a great amt of litter has accumulated.	low	n/a	n/a	low	moss	low	dense

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312509	Pond Pine	Very little of the merchantable timber is anywhere near maturity. Most of it is too large for poles (unless very large ones). Clear length of the nearly mature timber is about one 16' log but the stand is so open that the smaller sized timber has its branches persisting to the base of the tree. Best use for the timber saw logs. Virgin stand. Considerable damage done by fire and insects and fungous diseases.	low	n/a	n/a	none	fungus, insect	moderate	excluded
26312510	Pond Pine	Quite a little oak present. This a good timber section and clear length will run a 16' log. Best use is for saw logs. Virgin stand. Mature (merchantable) timber badly fire scarred and especially the fir having hollow butts. Moss and fungous disease present. Stand very open and only the pine will run 1 16' clear length all of the fir having its lower branches persist. Very open and park like country with many oak trees.	low	n/a	n/a	moderate	fungus, moss	low	open
26312511	Pond Pine	Timber mostly very young and immature. Of old timber as sighted from trips to sides found it will run 1 16' lot of clear length. Best use of the old tallied timber is saw logs. The young timber just a good pole stage. Virgin stand. Considerable damage done by fire. Also fungous and insect depredation clearly marked. When left the top of ridge and started to descend slope facing E no oak.	low	n/a	n/a	none	fungus, insect	low	excluded
26312512	Pond Pine	Most of the timber in the pole type (all cedar principally clear length of timber tallied (only of yel pine) is a 16' log in length, the cedar not having any clear length. But development of tallied yel. p. saw logs and the rest is best for poles. Virgin stand. Good deal of damage done to cedar and white pine by fire. It not apparent on young growth. Moss, insect depredation present.	low	n/a	n/a	none	moss, insect	low	excluded
26312513	Pond Pine	Timber has not yet reached maturity and is such an open country that the live limbs persist right to the ground. No clear length. Timber is virgin. Quite a little damage by fire to old nearly mature timber. Insect and fungous disease prevalent a little. There a great deal of scattered oak of good size. The country very open and park like in character.	low	n/a	n/a	low	fungus, insect	low	open
26312514	Pond Pine	The timber tallied nearly mature; very little reproduction of pine and fir. Toward the end of the forty cedar is creeping in. Forty was started in a valley and after ascending thru very open parkland where much oak and oak reproduction together with scattered pines we came to good road on top of ridge near end of forty. End of forty start down a slope sloping to W. best use for tallied timber saw logs. Virgin stand. Tallied timber damaged by fire; also fungous and insect disease present on tallied timber.	low	n/a	n/a	high	fungus, insect	low	open
26312515	Pond Pine	Timber is in a very open condition. There are many large park like openings where yellow pine is coming. Nearly mature timber has not quite a 16' log of clear length. The fir which is in open country holds its limbs right to the ground. Best use for the timber is for saw logs. Virgin stand. Considerable damage done by fire but the butts of the trees are not injured badly more than 3' from the ground. Oak trees growing in the very large open parks.	low	n/a	n/a	moderate	none	low	open

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312516	Pond Pine	We run into fir and sugar pine and some Jeffery pine but all is so scattered in the open that there no clear length hardly. Best use is saw logs. Virgin stand. Fire scars very markedly shown on the mature (merchantable) timber. Insect, fungus, moss disease slight. going west we descended a steep declivity flowing a draw which to the south of us where there a little oak and willow	low	n/a	n/a	low	light fungus, moss, insect	low	scattered
26312603	Pond Pine	Timber in first class condition but only clear length of 16' on the average. Best use is saw logs. Virgin stand. There has been here shown by the scortched bark on the pine here and there much oak scattered here and there of good merchantable size.	low	n/a	n/a	high	none	moderate	excluded
26312604	Pond Pine	Very good development with a clear length of 16'. Saw logs is best use for the timber. Virgin stand. Little damage by fire (only bark scortched). Mature timber very free from fire scars at the butts. A good deal of oak intermixed with the pine. The oak is of good size.	low	n/a	n/a	high	none	high	excluded
26312605	Pond Pine	Timber in excellent and very sound condition, about 16' of clear length, best use saw logs. Virgin stand. No fire apparent on young pine reproduction. Considerable oak of merchantable size.	none	n/a	n/a	high	none	high	excluded
26312606	Pond Pine	Timber in very good condition but very much scattered. Clear length about 16'. Best use is saw logs. Virgin stand. Is damage by fire apparent in young pine and cedar reproduction there much oak of merchantable size scattered thru the forty.	low	n/a	n/a	high	none	high	scattered
26312609	Pond Pine	Timber far from maturity and no clear length. Best use is saw logs. Virgin stand. Young cedar shows fire scortched bark. Also an old nearly mature pine butts are fire scarred somewhat. There more or less oak scattered broadly here and there.	low	n/a	n/a	low	none	moderate	excluded
26312610	Pond Pine	Trees not reached maturity and no clear length. Best use saw logs; virgin stand. Young cedar reproduction shows bark badly scortched. Few open places where grow mostly weeds with a little wild pea	low	n/a	n/a	none	none	moderate	fairly dense
26312611	Pond Pine	This pine tallied there's a good deal of it not reached maturity yet clear length of 16'. Best use is saw logs. Considerable damage apparent to young cedar reproduction and also to the pine butts tallied. Few open places. The reproduction not so [? can't read word, might be "terribly"] dense. Few oak trees scattered here and there.	low	n/a	n/a	low	none	moderate	open
26312612	Pond Pine	The pine is in good condition save a few bad fire scars at the butts. Cedar reproduction also shows that fire has been here some time ago but the bark of the cedar is only scortched. Clear length of the pine timber tallied is about 16'. Best use of the timber is saw logs. Virgin stand. Considerable black oaks present and also few open park like places.	low	n/a	n/a	moderate	none	moderate	fairly dense
26312613	Pond Pine	Very little timber on the forty but seems to be quite a little on the sides of the strip. We also passed, in the open, thru a little chaparral. The nearly mature timber badly fire scarred. Best use of timber is saw logs. Virgin stand. There are a few open park like places. there much oak scattered in with the young reproduction	moderate or high	chaparral (edge of timber line)	unknown	low	none	moderate	fairly dense

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26312614	Pond Pine	Pine and little cedar near maturity. Clear length 16' log. Best use for timber saw logs. Considerable damage done by fire. Insect and fungous depredation present. There is a great deal of young cedar about the pole type. There very few open park like places. crossed a little stream in descent at 18 1/2 chains	low	n/a	n/a	none	fungus, insect	moderate	fairly dense
26312615	Pond Pine	Nearly mature timber of good development except the cedar. The pine has 16' clear length but the cedar is badly fire scarred about 20'-30' up. The fir holds to its lower branches and many of the big ones are badly hollow butted. Best use is for saw logs. Very severely damaged by fire. There not much very young growth, most being about 4" in D (nothing less).	moderate	n/a	n/a	none	none	high	excluded
26312616	Pond Pine	Majority of timber near maturity, especially the pine is of good development and 16' clear length. Best use for timber is saw logs. Virgin stand. Fire has damaged the cedar and the pine badly even the young cedar reproduction shows it (3-6" in D). Insects and fungous diseases prevalent. There is a few open places where there is a little grass and weeds. But there very few of these open park like places.	low	n/a	n/a	none	fungus, insect	low	fairly dense
26313406	Pond Pine	Timber of fair good development, about 1 16' log of fairly good pine timber. It with the fir and cedar is badly fire scarred cedar being the worst. Best use for the timber is saw logs. Virgin stand. Bad fungous and insect damage.	moderate	n/a	n/a	none	fungus, insect	moderate	excluded
26313409	Pond Pine	The nearly mature fir, cedar and pine has fair good form but the cedar is very badly fire scarred. The pine fairly so but damage not so far up the trunk. The fir has hollow butts but most has grown over. Best use for the timber is saw logs. Virgin stand, insect and fungous disease present. Many oak trees present, scattered about.	low	n/a	n/a	moderate	fungus, insect	high	excluded
26313410	MC Ave	Cedar is of fair development but on acct of the very bad fire scars would not get a clear length. Considerable timber about the pole type. Best use for timber saw logs. Fungous and insect disease present. There a few oak here and there of good size. Country not really dense but not many open or large park like places.	moderate	n/a	n/a	low	fungus, insect	low	fairly dense
26313411	MC Ave	Timber of fairly good condit. Much fire damage, especially to the cedar. Clear length about 1 16' log. Best use saw logs. Virgin stand. Subject to fungous and insect disease. The fir on this N slope maintains its limbs so there no clear length to even the large fir trees. Fir trees much hollow butted, also.	moderate	n/a	n/a	none	fungus, insect	low	excluded
26313414	Pond Pine	Development of timber is good and nearly merchantable with exception of the badly fire scarred butts of the cedar. Clear length is 16'. Best use for the timber is saw logs. Virgin stand. Very bad from fire, fungous and insect diseases. Chaparral for 13 chains.	moderate or high	chaparral (edge of timber line)	13	none	fungus, insect	moderate	patchy
26313415	Pond Pine	Considerable timber of good size off at the sides for the first 7 chains. It of good development, clear length about 16'. Best use is for saw logs. Virgin stand. Very severely damaged by fire and even the young cedar bark is scortched. Insect and fungous disease present.	moderate or high	chaparral (edge of timber line)	13	low (understory)	fungus, insect	moderate	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26313416	Pond Pine	The pine near maturity a 16' log. The young timber about 16' D seems to hold the lower limbs. Best use is for saw timber. Virgin stand. Very badly damaged by fire. Fungous and insect disease present. There are many open park like places and fairly large with timber scattered through it. Great many oaks of D between 10"-15".	low	n/a	n/a	moderate	none	moderate	open
26313501	Pond Pine	Timber tallied about mature, most of young reproduction between ages of 20+40. Clear length is about one log; best use for the timber is saw logs; virgin stand. The mature cedar trees are badly damaged by fire -1/2 of butt burned up and up a distance of about 12'-15'. Also a few stray pines but the fir seems to be free from fire though right alongside of the cedar and about same D. mistletoe, moss has damaged mature trees a little.	moderate	n/a	n/a	none	mistletoe, moss	high	excluded
26313502	MC Ave	Great deal of young reproduction of fir and cedar, cedar reproduction predominating. About 5% of trees tallied are badly fire scarred up to 12'. They are mostly cedar with one or two pines and one fir. Clear length runs about one log. Best use for timber saw logs; virgin stand; damaged by fire 5%; little damage by fungus.	moderate	n/a	n/a	none	fungous	high	dense reproduction
26313503	Pond Pine	about 1 log of clear length; nearly mature; saw timber; virgin; young as well as old timber is damaged by fire; the old cedar trees are severely damaged but the bark of the trees about 6-10" in D is barely scortched.	moderate	n/a	n/a	none	none	high	excluded
26313504	Pond Pine	Oak the predominating species here. The nearly mature timber is all cedar and badly fire scarred at the base and some distance up the tree from the base. More pine on the E side. No clear length. Best use of timber, saw logs. Virgin stand. Trees badly damaged by fire. There is insect and fungous diseases present. Moss growing on the bark abundant. Oak is by far the predominating species.	moderate	n/a	n/a	high	fungus, insect	low	patchy
26313505	Pond Pine	Most of the timber is very immature yet along the first 5 chains; best use for tallied timber, saw logs. Virgin stand. Considerable damage done by fire; insects and fungous disease present. Thru the last 15 chains passed thru dense chaparral of oak and mt. mahogany. At end of the forty entered the timber again.	low or high	chaparral and immature timber (edge of timber line)	20	moderate	fungus, insect	moderate	excluded
26313506	MC Ave	About one log of clear length; saw timber, the old cedars badly fire scarred at the base.	low	n/a	n/a	none	none	high	excluded
26313507	Pond Pine	Large timber near maturity; about 1 log of clear length. Best use is saw logs; virgin; no damage by fire noted; very fungus disease. This forty was very open compared with the last dense forty (dense with undergrowth of cedar). This is very open and park like. Young reproduction mostly cedar that is of pole size.	none	n/a	n/a	none	fungous	high	open
26313508	Pond Pine	Running the first 1/2 of the forty was pine and the last half is of fir and cedar mostly. Mostly young reproduction between ages specified above [300/ac @ 10-20 yrs. and 75/ac @20-40 yrs.]. The timber tallied near maturity and good for saw logs. Virgin timber; the cedar about 43 yrs. old damaged a little on bark but the old timber does not show fire marks. Very little injury by insects but great deal of damage done by mistletoe.	low	n/a	n/a	none	mistletoe, insect	high	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26313509	Pond Pine	Mostly young and immature timber. What is tallied is nearly mature timber. The country thru this forty is very open with young pine reproduction in groups; but many little parks. Clear length of timber about one log; best use is saw logs; virgin timber.no damage done by fire apparently; very fungus disease.	none	n/a	n/a	none	fungous	high	groups
26313510	Pond Pine	Mostly mature in the upper age classes, which are limited to yellow pine and incense cedar. Clear length 1 log saw timber. Virgin stand. Little fire damage.	low	n/a	n/a	low (understory)	none	high	excluded
26313511	Pond Pine	Clear length runs one log; saw logs, virgin no damage by fire, about 1 % diseased	none	n/a	n/a	none	fungus	high	excluded
26313512	MC Ave	Good deal of nearly mature cedar timber - clear length not even 10' beyond the long fire scars. Fire scars very numerous and reach to 10'-15' height on cedar. Best use for timber is saw logs. Virgin stand. Severely damaged by fire. Little insect and fungous disease present. Little open places but they are few and small and so sheltered that ground is bare. There much oak present, too.	moderate	n/a	n/a	high	fungus, insect	moderate	fairly dense
26313513	Pond Pine	Timber tallied - of larger D class nearly mature and of about 16' of clear length. Best use saw logs. Virgin stand. Even the young cedar trees about 3"-5" in D have been scortched. The merchantable timber has been badly fire scarred at the base, especially the cedar. There a few scattered oak around here.	low	n/a	n/a	low	none	high	excluded
26313514	Pond Pine	Clear length two logs; saw timber; virgin stand; damage by fire, none; insect damage 1%.	none	n/a	n/a	none	insect	high	excluded
26313515	Pond Pine	Yellow pine very mature clear length averaging 1 log - virgin stand. Very limby but straight. The stand is very open being park like with only a tree here and there. 55-100' apart.	none	n/a	n/a	none	none	moderate	open
26313516	Pond Pine	Chaparral scattered in the first 8 chains and no underbrush thru the last 12 chains. Very little timber; clear length about one log. Best use is for saw logs; no damage from fire and very little damage from insects. Timber is virgin. There is much young pine reproduction.	none	n/a	n/a	none	insect	high	excluded
26313601	Pond Pine	The timber tallied near maturity; very very little seedling reproduction thru S.W. exposure as the ground is extremely dry and exposed. Clear length of the nearly mature timber nearly 16' long. Best use for the timber is saw logs. Virgin stand. Mature timber little damaged at the butt by fire. Seems to be considerable moss on limbs and trunk of the nearly mature trees. Much oak mixed along with the pine. Also a little fir comes in here	low	n/a	n/a	high	moss	low	excluded
26313602	Pond Pine	Most of the yel. Pine timber far from maturity as tallied. To W a little stream sprung from ground near end of forty. There some pine of 28"D about 140' ht. no clear length as country too open; saw logs best use for timber. Virgin stand. Timber tallied shows a little fire damage - badly marked on a few trees. Fungus and insects - little damage. found many oak trees in the open park places of 15-22" d.	low	n/a	n/a	moderate	fungus, insect	moderate	open

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26313603	Pond Pine	Few nearly mature timber and few of pole stage and more of the younger reproduction. Mostly of young pine; fir just beginning to come in. Clear length is about one log; best use for timber is saw logs. Virgin stand; fungous disease slight and insect disease not very apparent. few old trees badly fire scarred (Yel Pines – butts only) [from logging factors notes] ...the country thru this forty very open and much parkland...	low	n/a	n/a	none	fungus, insect	moderate	open
26313604	Pond Pine	Young cedar and fir seedlings closely matted together. Most of the timber calipered not reached maturity. No clear length. Best use for timber from saw logs - virgin stand. No damage by fire apparent, mistletoe, moss present in small quantities on pine and cedar. Very little open or park land, it being mostly fair density of young reproduction.	high	immature timber not damaged by fire	20	none	mistletoe, moss	high	dense reproduction
26313605	Pond Pine	Timber tallied near maturity – found a few Jeffery pine along the strip. Clear length hardly a 16' log on the average. The much cedar and pine between 8-12" in D. about as much pine reproduction as cedar reproduction, timber virgin and used best for saw logs. No damage by fire visible. Insect damage only apparent on 1-2 mature trees. Trees between 8-12" very healthy and growing well.	none	n/a	n/a	none	insect	moderate	excluded
26313606	Pond Pine	Nearly mature timber has about one log of clear length. There are a great deal of timber of the pole type about 12" and over in D. virgin timber. Here and there on the old timber are found fair traces of fire scars but none on the moderately young timber. There a little moss and mistletoe on the mature timber reaching the end of the forty just beginning to strike a little fir with yel. Pine.	low	n/a	n/a	none	mistletoe, moss	high	excluded
26313607	Pond Pine	Timber nearly mature that is tallied. Length clear about one log, best use for timber is saw logs. Little fire damage. Little fungus and insect disease present. The country is rather open with fir in abundance along the creek that we crossed when about 10 chains in the forty. There much oak present.	low	n/a	n/a	moderate	fungus, insect	moderate	patchy
26313608	Pond Pine	The timber tallied is nearly mature and clear length about 1 16' log. Best use for timber is saw logs. Virgin stand. The stand is very open with considerable pine seedlings between 10-20 yrs old. Mostly open park land and easily passed thru. Little fire damage to the old mature trees. Fungus and insect disease present with a rather steep slope to the E. there is considerable oak scattered thru the 40	low	n/a	n/a	moderate	fungus, insect	moderate	open
26313609	Pond Pine	The nearly mature timber has about 16' log of clear length. There much young seedling maturing [??], more than pole type and merchantable type. Virgin stand. Best use saw logs. Considerable damage done by fire and insects and also a fungus disease. Considerable oak mixed with the pine. The last 10 or 12 chains enter a much denser wooded area of pine and little oak than in the first 10 chains which more open.	low	n/a	n/a	moderate	fungus, insect	high	patchy
26313610	Pond Pine	Hardly a 16' of clear length for tallied timber. Timber tallied is near maturity; best use is saw logs; virgin stand; considerable damage from fire markedly shown on the nearly mature timber. Found off at one side many nearly mature trees killed this last year and now sound.	low	n/a	n/a	none	none	low	excluded

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26313611	Pond Pine	very few trees above 20" in D. here much timber (very much about pole stage and around 12" in D. Clear length of tree above 20" about one log virgin stand very little damage by fire – only one large tree on S side has deep scar. Very fungus + insect	low	n/a	n/a	none	fungus, insect	high	excluded
26313612	Pond Pine	Most of timber tallied is mature; there is much timber bet D. 6-12" to acre. About a clear length of 16'. Best use of timber is saw logs; virgin timber, no damage by fire apparent. Very little insect visible and also very little mistletoe present	none	n/a	n/a	none	mistletoe, insect	moderate	excluded
26313613	Pond Pine	Timber is near maturity (before get to chaparral – 1st 12 chains). Clear length about 16' log. Best use saw logs; virgin stand; no damage by fire apparent and no insect damage very noticeable, fungus has bothered trees very slightly (the pine trees).	none or high	chaparral (edge of timber line)	12	none	fungus, insect	moderate	patchy
26313614	Pond Pine	Timber not yet reached maturity that is tallied. large amt of small young stuff of the pole stage and not much younger reproduction. No clear length as the lower limbs persist on the timber. Virgin stand; no damage by fire; no insect injury or fungous diseases as timber is young (the majority of it). [from logging factors notes] Good logging conditions as the ground is gently rolling after the chaparral has been passed (11 chains from the beginning of the 1/4 section)...	none or high	chaparral (edge of timber line)	11	none	none	low	patchy
26313615	Pond Pine	Some nearly mature timber. Most is of young reproduction between ages 10-20 yrs; Few poles. At 11.60 chains there a good road. Clear length not a log as big timber more or less open; best use is saw timber. Considerable damage by fire; also infested (old trees) with insects and fungus. There is a little oak intermixed in with the pine.	low	n/a	n/a	low	fungus, insect	high	excluded
26313616	Pond Pine	Timber near maturity that tallied. Clear length about 1 16' log. Best use is saw logs. Virgin stand. Quite a little fire damage to old timber as butts are badly burned. The country is extremely open there only been a few trees of seedling stage, pole stage and merchantable type present growing. There much scattered oak and open grass land and there it excellent grazing ground.	low	n/a	n/a	moderate	none	low	open
26320402	MC Ave	Timber is nearly mature and ought to be cut; no clear length. Best use is saw logs. Virgin stand. A little moss found growing on the bark and limbs of the trees. Considerable fire damage to all nearly mature trees. There a little bl. Oak scattered here and there thru forty (first part of forty especially).	low	n/a	n/a	low	moss	none	excluded
26320403	MC High	Timber nearly mature and ought to be cut to give cedar reproduction a chance. Clear length to the pine is about 16'. Best use for logs - saw logs. Much fire damage done to all timber at the butts shown by bad large fire scars. Much moss growing on the cedar boughs as well as the fir boughs. A little oak scattered here and there. mature timber shades the ground in good shape thru almost the whole forty	moderate	n/a	n/a	low	moss	moderate	fairly dense
26320404	MC Ave	Most of timber nearly mature and ought to be cut. It is more or less scattered in groups. No clear length to any as fire damage has played havoc with the timber clear of limbs. Very little moss found growing on the bark and boughs of the trees. There is more or less young oak scattered here and there.	moderate	n/a	n/a	low	moss	moderate	groups

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26320405	MC Ave	Missing back datasheet	excluded	n/a	n/a	excluded	excluded	excluded	excluded
26320406	MC Ave	The timber is very much scattered with clear length of pine about 16' (both sug and yel). Timber tallied of good form and nearly mature. Very little damage by fire apparent on the mature timber. Also trees are very free from moss, insect disease. A good deal of very young oak scattered in the many more or less open places.	low	n/a	n/a	moderate	none	moderate	scattered
26320407	MC Ave	Thru first 10 chains S the timber nearly mature and uniform but going West thru middle of forty strike more small timber far from maturity but merchantable. Clear length to pine 16'. None to fir. A little moss found growing on the bark and boughs of cedar and fir. Little black oak scattered here and there. As for fire damage all slightly scortched but no really very bad fire scars.	high	patch of immature timber (crosses small ridge)	10	low	moss	moderate	patchy
26320501	MC Ave	Most of timber is nearly mature and ought to be cut. There is no clear length to any of timber as all have low stubbs. Best use is for saw logs. Virgin stand. Very much damaged by fire but not scarred very far up from the butt. Very little insect and moss growing on the trees. Country more or less open with much cedar reprod in the open spots. A little Bl. [oak] Scattered here and there.	low	n/a	n/a	low	moss, insect	moderate	patchy
26320502	MC Ave	Timber is scattered more or less in groups. Clear length to pine about 16'. There is more or less fire damage done to all timber tallied. Little moss growing on the fir and cedar trees. A little bl. Oak and live oak scattered here and there. Oak comes in more at the end of forty.	low	n/a	n/a	low	moss	high	groups
26320503	MC Ave	Timber on the average is very uniform but not dense. There is clear length to the cedar of about 16'. The timber shows much fire damage and especially the cedar. No roads or streams (driveable) present. At ten chains came to open spot where there were two streams which a little farther down jointed. Oak scattered here and there.	moderate	n/a	n/a	low	none	moderate	uniform
26320504	Pond Pine	[from underbrush notes] none until top of the ridge is reached. Then come to some chaparral which extends N for about 3 chains when come to more timber. [end, and continue with condition of timber notes] it is more or less scattered. A good deal of it is mature enough to be cut. Cedar has clear length of about 16'. Trees are damaged by fire but not very badly. Considerable moss found growing on the nearly mature timber. A very little scattered oak over the first part and last part of the forty.	high	chaparral (along ridge)	3	low	moss	low	scattered
26320505	MC Ave	Much of timber near maturity. It ought to be cut. It has been badly fire scarred but there is clear length on the pine and cedar to height of about 16'. Much moss growing on the bark and boughs of the fir and cedar trees. Little oak scattered here and there. The cedar reprod. about pole stage is not very abundant.	low	n/a	n/a	low	moss	moderate	excluded
26320506	MC Ave	Much of the timber near maturity. It is not a very dense stand as the sun comes streaming in in many open places. Clear length to the cedar about 16' but it is very badly fire scarred. There is much moss growing on the bark and boughs of the timber. There is much oak but it very immature.	low	n/a	n/a	high	moss	low	open

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26320507	MC Ave	Timber is more or less scattered. Pine has good clear length. Both pine and cedar are pretty well fire scarred. Not much moss present on the pine trees but there plenty of it growing on the cedar bark and boughs. A little live oak scattered here and there.	low	n/a	n/a	low	moss	moderate	scattered
26320508	MC Ave	Most of the timber tallied is ready to cut but it is so scattered that it ought to be left to seed up the open areas which are sparsely seeded up with cedar reproduct. Clear length to the pine is about 16'. All the timber is very little fire scarred at the butts, though there been a pretty bad fire thru here. Very fungus and insect disease present. Much young bl. oak and little scrub live oak.	low	n/a	n/a	high	fungus, insect	moderate	scattered
26320510	MC Ave	Timber is very much scattered but nearly mature. No clear length. Considerable fire damage done to the nearly mature trees. There are many open places where a little oak and weeds and fern. Not much mistletoe or moss.	low	n/a	n/a	moderate	mistletoe, moss	moderate	scattered
26320511	MC Ave	Timber is extremely scattered leaving the ground much exposed and the scrub live oak and little manzanita has crept in. most of the timber is nearly mature. There is very little reproduction – but there a fair number of trees about the pole size (cedar, fir and little sug p.). No clear length for any of timber. Considerable fire damage done to all timber. Moss also present. Much scattered live oak.	low	n/a	n/a	low	moss	low	scattered
26320512	MC Ave	Some of the timber fairly mature but most is yet very immature; there very much young reproduction of cedar and about the pole stage. There has been a little fire present in the past. Very little moss growing on the fir trees and also on the cedar trees. Very little oak scattered here and there.	low	n/a	n/a	low	moss	high	excluded
26320513	MC Ave	Most of the timber is yet immature. It is very much scattered. Clear length on cedar about 16'; even though it slightly damaged by fire. Best use is for saw logs. Considerable damage by fire. Little moss growing on the cedar and fir. Little oak scattered here and there.	low	n/a	n/a	low	moss	moderate	scattered
26320514	MC Ave	It very much scattered in groups leaving many places more or less open where bl. And live oak have crept in. clear length to pine about 16' cedar and fir have no clear length. The cedar as well as other trees have very bad fire scars at butts. Much moss growing on the trees. Many of the fir trees are stag headed but apparently growing and alive.	low	n/a	n/a	moderate	moss	scarce	groups
26320515	Pond Pine	The timber is near maturity but very much scattered. There a few digger pines found along the first of forty. Clear length of pine and cedar about 16'. Not much fungous disease present. Fire damage present on all butts of trees tallied. Much black oak and live oak present.	low	n/a	n/a	high	fungous	low	scattered
26320601	Pond Pine	No timber to speak of thru first 15 chains except a good deal of scattered cedar which is very much stunted in growth and scattered in the very large open places. Fir shows sigh of fire damage and up considerable distance from the butt of the tree. No clear length to fir. Best use is saw logs. Virgin stand. Little moss growing on the fir boughs and limbs and bark. Country very open with stunted cedar scattered here and there.	low	n/a	n/a	none	moss	low	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26320602	MC Ave	Thru the first 7 chains the timber near maturity and ought to be cut. No clear length to the fir, but about 16' clear length to P. best use - saw logs. Virgin stand. Little moss covers the fir trees and also to certain extent the pine. There is a little oak scattered thru the last 13 chains. No timber to speak of thru the last 13 chains. Country more or less open. [from logging factors notes] Prerty rough as the stones are thick and numerous down the steep slope. Slope is to the South and very steep... the timber seen and tallied thru the first 7 chains can be logged down the slope to the N or NW.	none or high	no timber on steep rocky slope	13	low	moss	low	patchy
26320603	MC High	Timber is mature and ought to be cut. No clear length to fir. Quite a little fire damage to all trees. Little moss present on boughs and bark.	low	n/a	n/a	none	moss	moderate	excluded
26320604	MC Ave	Timber ought to be cut. Pine has about usual clear length, 16'. All trees badly fire scarred but not running up the trunk far. Little moss covers the boughs and bark of trees.	low	n/a	n/a	none	moss	moderate	excluded
26320606	Pond Pine	Very much scattered and mature. Fire damage little. Clear length of pine 16'. Very little moss growing on mature timber. Little oak.	low	n/a	n/a	low	moss	moderate	excluded
26320607	Pond Pine	The pine tallied near maturity and 16'; of clear length. The fir tallied nearly mature but no clear length. Best use of timber is for saw logs. Virgin stand. Considerable damage done by fire to fir and pine butts. The country very open and the timber widely scattered with oak of immature growth found scattered here and there.	low	n/a	n/a	low	none	low	scattered
26320608	Pond Pine	Very very little pine and very much scattered. The cedar is very immature and the large cedars are very much stunted in their growth because of the south slope and the very dryness of the slope. No clear length. Virgin stand. Little to no fire damage. Little moss present on few large cedar trees. Much oak but most of it is very immature but good for cordwood.	low	n/a	n/a	high	moss	moderate	scattered
26320609	Pond Pine	Timber ought to be cut as along the first 10-12 chains the timber is of sufficient size and density to pay to have it cut, no clear length. Best use for timber is saw logs. Virgin stand. Little insect and fungous disease (moss growing on cedar and fir boughs and bark). Little oak scattered but very little and it is far from being mature. Country over the last 8 chains is more or less open with cedar reproduction	high	reproduction patch (changes from W to S facing slope, at edge of study area)	8	low	fungus, moss, insect	moderate	patchy
26320613	MC High	Much of the timber tallied nearly mature and ought to be cut to give way to the young reproduction. No clear length except about 16' for the sug p. best use for timber is for saw logs. Virgin stand. The timber is very much damaged by fire and especially to the cedar. Moss is not in much abundance on the forty. The timber is more or less uniform through this forty.	low	n/a	n/a	none	moss	moderate	uniform

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26320614	MC High	[from underbrush notes] at 8 chains we pass thru a stretch of chaparral which extend a considerable distance up the slope (S) but only about a chain to N. when reach meadow. [end, and continue with condition of timber notes] the fir is nearly mature and ought to be cut. No clear length. Best use of timber is for saw logs. Virgin stand. Considerable damage done by fire, it being more apparent on the cedar. Much moss found growing on the trunk and boughs of both cedar and fir. In places the timber fairly dense but at 8 chains cross a strip of chaparral about 2 chains long and extending some distance up the hill (S).	low or high	chaparral patch (bottom of canyon along meadow)	2	none	moss	moderate	patchy
26320616	MC High	Timber is of good development much of it ready to be cut. No clear length to cedar or fir. Best use for timber is for saw logs. Virgin stand. Very much damage done by fire to cedar and fir, running right up the cedar trunks to considerable ht. very little oak scattered here and there. The timber fairly dense not allowing any grass or weeds to grow on the ground. Moss found growing on the cedar and fir boughs and trunks.	moderate	n/a	n/a	low	moss	moderate	fairly dense
26320701	MC High	Timber is nearly mature and it ought to be cut. There is no clear length of either fir or cedar. The cedar is very badly fire scarred and the fir a little. Best use is for saw logs. Virgin stand. Moss covers the bark and boughs of the cedar and fir. There is a little oak scattered here and there but very scarce. The country is not terribly dense there being a few open places.	low	n/a	n/a	low	moss	moderate	fairly dense
26320702	MC High	The cedar and fir ought to be cut as it is so dense that the canopy completely shades the ground preventing reproduction. No clear length except perhaps 16' for cedar. The cedar very badly fire scarred much worse than the mature fir. Best use for timber is for saw logs. Virgin stand. Much moss growing on the bark and boughs of the nearly mature trees.	low	n/a	n/a	none	moss	moderate	dense
26320703	Pond Pine	[from underbrush notes] thru the centre of forty for first 10 chains run N all there was was chaparral of chinquapin. [continue with timber notes] the timber, running East the last ten chains is fairly dense. It consisted mostly of fir of good development but no clear length and the same for the cedar. But both are large enough to cut. Best use is saw logs. Virgin stand. There not much damage by fire apparent but the ground in fair condition for a fire with so many dead logs and boughs lying on ground. Much young oak along the last 10 chains.	high	chaparral patch	10	moderate	none	scarce	patchy
26320704	MC High	Timber ought to be cut, clear length not 16' of cedar or fir. Best use is saw logs. Virgin stand. Very much damaged by fire, especially the cedar and the fir to a certain extent at the butt. There is much moss on the bark and libs of both cedar and fir. There much oak thru the last 5 chains of the forty. But most of this oak is very young and growing and immature.	low	n/a	n/a	moderate	moss	high	excluded
26320705	MC High	Timber ought to be cut as it near maturity. Clear length none. Best use for saw logs. Virgin stand. Considerable damage by fire. Also moss grows prolifically on the bark and boughs. The timber is fairly dense shading the ground so that just a little cedar is coming up.	low	n/a	n/a	none	moss	moderate	fairly dense

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26320707	MC High	Most of the timber needs to be cut in order to open up the canopy to allow reproduction to get a chance. No clear length to fir but there to cedar and pine about 16' clear length. The nearly mature timber is a little damaged by fire but cedar is the worst. Best use for timber is for saw logs. Virgin stand. Much moss growing on the bark and limbs of the coniferous trees. A very little bl. oak.	low	n/a	n/a	low	moss	moderate	fairly dense
26320708	MC High	Much of this timber ought to be cut to give room and light for young reproduction. No clear length to fir or cedar. Bad fire has scarred the butts of fir and especially the cedar. Best use for timber is for saw logs. Virgin stand. Moss found growing on the bark and boughs of the fir and cedar trees. The country not terribly dense but enough so that ground is well sheltered.	low	n/a	n/a	none	moss	moderate	fairly dense
26320709	Pond Pine	Much of timber in 1st 14 chains ought to be cut to give the young reproduction a chance. No clear length. Best use of timber for saw logs. Virgin stand. Much damage by fire to the fir and cedar. Much moss found growing on the limbs and boughs of the coniferous trees. Oak is quite prevalent in the forty. The last 6 chains of the forty are very open with no very mature timber.	low or high	open patch (timber line)	6	high	moss	moderate	patchy
26320710	MC Ave	Much of the timber (cedar and fir) is ready to be cut but it is more or less scattered in groups and not uniform thru forty. No clear length of either species. Best use - saw logs. Virgin stand. Considerable damage done by fire but it not so apparent on fir as on the cedar. Country is more or less open with weeds growing in the very frequent open places.	low	n/a	n/a	none	none	moderate	groups
26320711	Pond Pine	The timber is not very plentiful but seems to be in groups. No clear length to timber. Best use for timber is saw logs. Virgin stand. There considerable damage done to the fir and cedar trees by fire and they extend quite a distance up the tree from the butts. Also much moss growing on the fir and cedar bark and boughs. The oak is mostly immature. [from logging factors notes] ...the country is very open but very barren in the open park like places.	low	n/a	n/a	low	moss	moderate	groups
26320712	Pond Pine	Timber has good development and ought to be cut. (We do not strike the fir until the last 5 chains. No clear length. Best use for timber is saw logs. Virgin stand. Much moss growing on the bark and on the boughs of the fir trees. Much damage done to these trees through fire.	high	no timber until last 5 ch	15	none	moss	scarce	patchy
26320713	Pond Pine	[from ground cover] over the first 13 chains more or less ferns scattered in open places...[continue with timber notes] no timber until the last 7 chains (there fir of good merchantable length and ought to be cut.) no clear length. Best use saw logs. Considerable fire damage apparent over the last 7 chains. Many dead and decaying fir logs found lying on the ground over last 7 chains.	high	open patch with ferns and no timber	13	none	none	scarce	patchy
26320714	MC High	Most of the timber ought to be cut to give a chance for young reproduction. Fairly good clear length to the cedar and pine. All the trees are more or less fire scarred. Best use is for saw logs. Virgin stand. Cedar more or less damaged by fire as well as the fir. There is a little oak scattered here and there in the forty. Most of forty very dense with timber.	low	n/a	n/a	low	none	high	dense

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26320715	Pond Pine	Timber is very much scattered and more or less in groups and mostly young and immature but there is a fair amt. of timber of fairly good size that could be cut. The cedar only has good clear length. Best use is for saw logs. Virgin stand. The fir and cedar and the pine (a little) all show that a bad fire has been here some time ago. There is a little bl. oak scattered thru the last few chains but most of it is very immature. [from logging factors note] ...can be logged...the timber is, however, very much scattered and there is much country open but mostly bare with a few cedar (young trees) and a few turned over logs decaying in the dirt.	moderate	n/a	n/a	low	none	low	groups
26320716	Pond Pine	Timber is very sparsely scattered. Almost the timber line being pass at 14 chains in the previous forty run [26320709]. The trees are very widely scattered and little fire damaged to these standing trees. No clear length, except perhaps 16' of clear length for the cedar. Moss covers the bark and boughs of these trees. Oak (very young and immature) is scattered promiscuously here and there thru the forty (mostly live oak with little bl.)	low or high	chaparral (beyond edge of timber line)	20	low	moss	low	scattered
26321804	MC Ave	A good deal of timber - fir and cedar ought to be cut as it is nearly mature. There is no clear length. Reproduction would be better of the fir if the stand was opened. No clear length; best use is saw logs. Virgin stand. Considerable damage done by fire and especially to the cedar trunks (only very little to fir) a fairly dense stand of timber passed thru.	low	n/a	n/a	none	none	low	fairly dense
26321805	MC Ave	Most of the timber is young in immature but merchantable. No clear length. Best use is saw logs. Virgin stand. There is considerable damage done especially to the cedar and then there no clear length. Considerable moss growing on the limbs and boughs of the fir and cedar trees. Country fairly densely timbered. No oak present.	low	n/a	n/a	none	moss	moderate	fairly dense
26321806	MC Ave	No Notes	excluded	n/a	n/a	excluded	excluded	excluded	excluded
26321810	Pond Pine	Practically all of the timber is far from maturity, no clear length; best use for saw logs. Virgin stand. Little damage done by fire to young reproduction, shown on the scortched cedar bark. Fungus and insect disease present. Country not very dense and there is a little scattered bl. oak scattered here and there.	low	n/a	n/a	low	fungus, insect	low	fairly dense
26321811	MC Ave	Most of the timber is fairly young but the few pines (large ones) have clear length of about 16'. Cedar or fir no good clear length. Best use for saw logs. Virgin stand. Little damage to cedar by fire. There is quite a bit of fallen timber which is well under way to decay. Country not very dense.	low	n/a	n/a	none	none	low	fairly dense
26321812	MC Ave	The timber (dense timber) is located more to the northern 1/2 of the forty and there is no good clear length on any of the species all being more or less badly fire scarred. Best use is for saw logs. Virgin stand. Considerable damage done by fungous and insect disease as there is moss and trees with dead tops. Country in south 1/2 more or less open. Much timber lying on the ground and rotten.	moderate	n/a	n/a	none	fungus, moss, insect	moderate	patchy

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26321813	MC Ave	Most of the timber yet very immature and more or less scattered; no clear length. Best use is for saw logs. Virgin stand. Fungous or insect disease not very abundant. Fire damage apparent but has not damaged the timber very much. There much timber lying on the ground and have decayed. Country more or less open; much oak scattered here and there.	low	n/a	n/a	moderate	fungus, insect	low	open
26321814	MC Ave	Most of the fir and cedar tallied is of good size and development, but no clear length. Best use is saw logs. Virgin stand. Little damage by fire apparent but the mature timber seems but little affected. The country more or less open with a little oak scattered here and there.	low	n/a	n/a	low	none	high	open
26321815	Pond Pine	Most of the pine is in good condition and near maturity. The cedar is of fair clear length but badly fire scarred. Clear length of pine about 16'. None for fir or cedar. Best use for the timber is saw logs. Considerable damage by fire scarring the butts from the base for a distance of several feet. There fungous and insect disease present as there are a few trees killed just this year. Country more or less open with a little oak scattered here and there. Oak very immature.	low	n/a	n/a	low	fungus, insect	moderate	open
26323003	MC Ave	Fair stage of development; pine has fair clear length but very badly fire scarred (pine as well as cedar). Best use saw logs. Considerable damage to young trees thru insect and fungous disease (mistletoe.) There is considerable oak intermixed with coniferous trees but most of it is immature and growing.	moderate	n/a	n/a	moderate	mistletoe, insect	low	excluded
26323004	Pond Pine	Pine has good development and has clear length of about 16'. There is a good deal of both Jeffery and yel. p. which ready to be cut. Fir clings to down branches but has good straight form and much of it nearly mature. Best use of logs is for saw timber. Virgin stand. Many dead trees found thru first 10 chains. Last 10 chains in low valley with very little pine reproduct. Good meadow land.	none	n/a	n/a	none	none	low	excluded
26323005	Pond Pine	The pine is of good development and has a clear length of about 16'. Best use is for saw logs. Virgin stand - it badly (pine and fir) scarred by fire. There a little oak scattered here and there but it is very young and immature. The country is more or less open except in a spot near end of forty where reproduct of fir dense.	moderate	n/a	n/a	low	none	moderate	patchy
26323006	MC Ave	Timber tallied yet quite immature and ought not to be cut yet. There very good clear length on the pine but on fir none. Little damage done by fire but not amount to much. Fungus and insect disease. Also much oak of fair good age.	low	n/a	n/a	high	fungus, insect	scarce	excluded
26323009	Pond Pine	All of timber tallied is very sparse and of not very good form being stunted more or less. No clear length. Best use for the every few trees is for saw logs. Virgin stand. Considerable damage done by fire and insect depredation. Country very open and the soil is very very coarse and extremely dry.	low	n/a	n/a	low (understory)	insect	moderate	open
26323010	Pond Pine	Timber of fair form but the pine holds to its lower branches and on the average no clear length. Most of the timber (very sparse at that except plentiful reproduction) is young and growing. The country very open but good reproduction and timber coming up. No damage by fire.	high	immature timber not damaged by fire	20	low (understory)	none	moderate	dense reproduction

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26323011	MC Ave	Timber more or less scattered but of fairly good development with exception of pine and fir being very badly fire scarred to 10-15 feet in some cases from butt of tree (more in pine than fir). No clear length on av for either. There also good deal of moss growing on bark and limbs of fir. Little very immature oak scattered here and there.	moderate	n/a	n/a	low	moss	scarce	scattered
26323012	Pond Pine	Pine has good development (yel. p) but there is considerable Jeff. Pine which does not clear itself (same as the fir). Yel p. clear length none. Best use of timber saw logs. Very much fire damage done to pine and fir. Much oak scattered an in groups. Most of it rather immature.	moderate	n/a	n/a	moderate	none	low	excluded
26323013	Pond Pine	Good development is the pine and about 16' of clear length but the pine is badly scarred at the base. The fir holds to its lower branches so there no clear length. Best use for timber is saw logs. Virgin stand. There is considerable oak of good form and merchantable size	low	n/a	n/a	moderate	none	low	excluded
26323014	MC Ave	Good development but only the yel p and sug p has a clear length of about 16'. Best use for saw logs. Virgin stand. Very much damaged by fire and gutted at the base of the pine trees (mature timber) especially. Little moss and mistletoe found on the nearly mature trees. Little scrub oak and little very immature oak timber.	low	n/a	n/a	low	mistletoe, moss	low	excluded
26323015	Pond Pine	Most of timber far from maturity but growing and in good form. The few mature timber tallied has good clear length but it is very very scarce. No damage by fire to speak of. The country is more or less open and the soil is very soft and dry. Some black oak as well.	none	n/a	n/a	low	none	moderate	open
26323016	MC Ave	Not very plentiful and so badly fire scarred is the pine and blown to the E by the N.W. wind that it of poor development. Fir is the same. There a good deal of young timber about 12' in D but it is stunted in growth owing to dryness and wind and poor Q. of soil. Country very open and there is any quantity of scrub live oak. A little also of the black oak, but it not do well here: much dying pine this year shown by the russet leaves.	moderate	n/a	n/a	low	none	low	open
26323102	Pond Pine	In good stage of development; most of it not yet reached maturity although of good size and clear length about 16'. The pine is badly fire scarred at the butt. Fir holds its branches. Much oak of good merchantable size and plenty of it. The stand rather open and very easy running. The young pine about 10 yrs of age seem to be dying perhaps from drought.	low	n/a	n/a	high	none	low	open
26323103	Pond Pine	Stage of development good for pine and very near maturity with a good deal of reproduction coming along. Clear length is about 20' but some bad fire scars and also near end of forty some trees dying shown by the reddish color of the leaves still on the trees. There a fungous on such trees. Best use for timber saw logs. Virgin stand. Much oak but most of it young yet. Country more or less open.	low	n/a	n/a	high	fungous	moderate	open
26323104	Pond Pine	Most of the timber very immature but at the beginning of forty some good timber (reached about maturity and good clear length of 16'). Much Jeffery Pine with the yel. p. best use of timber for saw logs. Virgin stand. Much oak of good size intermixed with the coniferous timber. Many open, park like places where very very good grazing for cattle.	none	n/a	n/a	high	none	scarce	open

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26323105	Pond Pine	Timber being so open and not close together that the lower branches persist. There quite a bit of large, nearly mature timber and quite a bit of timber of fair size nowhere near maturity. Timber, especially the nearly mature timber badly fire scarred - cedar, fir and pine. Best use for timber is saw logs. Virgin stand. Much oak of good size scattered and many open park like places.	low	n/a	n/a	high	none	low	open
26323106	Pond Pine	The pine has very good development but the fir even the large ones keep their branches even to the ground. Clear length of yel p. 16' and little over. Best use is for saw logs. Considerable damage done to the mature timber by fire and it noticeable in the pine trees especially. Many oaks of good size here and there. The country is very open but the many fir and pine trees shade the ground.	low	n/a	n/a	moderate	none	moderate	open
26323107	Pond Pine	Most of the timber yet quite immature but of good development. Nearly mature timber has a clear length of 16'. But the fir has no clear length. Saw logs best use for the timber. Virgin stand. Very little damage done to pine and fir by fire. There a good deal of oak timber of good size. The country is very open.	low	n/a	n/a	moderate	none	moderate	open
26323110	Pond Pine	Timber of fair development by yet quite immature and because of scattered condition holds to lower branches. No clear length either of pine or fir. Best use - saw logs. Very little damage done by fire apparent. Also trees apparently free from insect or fungous diseases. The country is very open. Much oak both of good merchantable size and growing timber.	low	n/a	n/a	high	none	low	scattered
26323111	Pond Pine	The nearly mature timber is scattered in groups and on average about 16' of clear length. The best use saw logs. Virgin stand. There much oak of good merchantable size. The country is very open and many very wide open places where it is excellent grazing ground with a few pine trees (10-40).	none	n/a	n/a	high	none	moderate	groups
26323112	Pond Pine	There is a little timber of nearly merchantable size but for an average there is no clear length. Much young pine between diameters 6" to 12". Virgin stand. Much damage by fire shown on the oak and pine. Much oak of good size and development. The country passed thru is very flat for several chains on either side with a gradual ascent on both sides.	low	n/a	n/a	high	none	low	excluded
26323113	Pond Pine	Timber of good development of nearly mature size but it only occurs in small groups. Clear length about 16'. Best use of timber is for saw logs. Virgin stand. Considerable damage done to mature timber and for several feet from the butt. There is quite a good deal of oak. The country continues flat for a few chains on either side of the centre of the forty where the country very level.	low	n/a	n/a	moderate	none	low	groups
26323114	Pond Pine	The nearly mature timber is very much scattered but of good form and clear length of about 16'. It is, however, a little fire scarred at the butt. Best use of timber is for saw logs. Virgin stand. Very much damaged by fire. Several standing trees on forty dead due probably to insect depredation. Much oak scattered about and it of good size. The country very open.	low	n/a	n/a	high	insect	low	scattered

Table A1. Continued.

Lot_id	K-means group	Survey notes	Fire class	High reason	High size (ch)	Oak class†	Disease	Regen class	Distrib class
26323115	Pond Pine	Most of timber yet very immature. No clear length to speak of. Virgin stand. Little or no damage done by fire. There a good deal of live oak - it being very scrubby. Also a little black oak but not of good merchantable size. The country is very very open with coniferous trees scattered sparsely here and there. This forty marks the E. timber boundary as chaparral a little farther to the east.	low	n/a	n/a	low	none	low	scattered
27310202	Pond Pine	very very little timber and most of it retaining lower limbs. Best use saw logs. Virgin stand. No damage by fire. There is quite a good deal of oak for cordwood. Logging conditions good as there little or no very steep slope. For first 2 chains we in meadow. Country all through here is more or less open.	none	n/a	n/a	moderate	none	low	open
27310203	Pond Pine	Considerable dead timber scattered thru the forty. The pine has good form and clear length of about 16'. Cedar and fir - cedar badly fire scarred and fir clings to limbs and also a little hollow butted. Best use for timber is saw logs. Virgin stand. Bad fire damage. Insect and fungous disease present.	low	n/a	n/a	none	fungus, insect	moderate	excluded
27310204	Pond Pine	Very little timber but the pine that is present is of good development and clear length of about 16'. Best use saw logs. No damage by fire or none apparent to insect of fungous disease. A number of good oak trees on strip tallied for cordwood in another book.	none	n/a	n/a	moderate	none	low	excluded
27310205	Pond Pine	Beginning the forty struck much pine reproduction about 3"-6" D for 3 chains and then 10 chains of open ground with grazing grass and scattered cordwood oak. The last few chain brings us into cedar reproduct (of pole type mostly). Very few old pine trees, scattered far between. No fire damage.	high	immature timber not damaged by fire (adjacent to meadow, at edge of timber line)	20	low	none	low	patchy
27310206	Pond Pine	Pine has good development and also the fir but it (fir) holds to the lower limbs. Cedar is badly fire scarred. Best use for the timber is saw logs. Virgin stand. After open space is reached after 10 chains there seems to be a great amount of oak with a good deal of ground cover of wild pea and	moderate	n/a	n/a	moderate	none	moderate	patchy
27310211	Pond Pine	The nearly mature pine in good condition and 16' of clear length. Apparently not damaged by fire. Virgin stand. Plenty of oak scattered around thru the forty.	none	n/a	n/a	moderate	none	none	excluded
27310212	Pond Pine	Timber is very scattered but pine tallied has good development about 1 16' log. No damage by fire and not much by insects or fungous diseases as the pines appear very healthy. There is a good deal of black oak and live oak of cordwood age.	none	n/a	n/a	moderate	fungus, insect	none	excluded
27310213	Pond Pine	Missing back datasheet	excluded	n/a	n/a	excluded	excluded	excluded	excluded
27310214	Pond Pine	Pine in good condition and clear length of 16'. Best use is saw logs. Virgin stand. No damage by fire.	none	n/a	n/a	none	none	none	excluded

† Where indicated, oak prevalence was assessed based on its presence recorded in notes on transect understory.