Ecological Characteristics of Old Growth in California Mixed Subalpine Forests

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INTRODUCTION

The Chief, Forest Service, has directed all Regions to prepare quidelines which define old growth for major forest types. These guidelines have been prepared in response to that direction. In Region 5 of the Forest Service an effort is also currently underway to classify these forests into Ecological Types for purposes of management and research. Since many of the samples taken for this project were in late seral stands of the mixed subalpine type, they were examined to determine which characteristics could be used to describe older mixed subalpine forests. This paper describes the features of these forests useful in such a characterization, and it provides guidelines that can be used to define old growth stands that lie in the California mixed subalpine cover type (256) recognized by the Society of American Foresters (1980). Results are summarized in Tables 1 to 5 beginning on page 24.

DISTRIBUTION

The California mixed subalpine type occurs primarily in the Sierra Nevada, but it is found from the Klamath mountains through the Cascades and into the Penninsular Ranges of southern California. It lies at elevations above 7,500 feet in the north to nearly 8,500 feet in the south, and it is characterized by several species growing singly or in mixture in small to moderate sized, open stands. Species commonly associated in the type are western white pine (<u>Pinus monticola</u>), whitebark pine (<u>Pinus albicaulis</u>), mountain hemlock (<u>Tsuga mertensiana</u>), red fir (<u>Abies magnifica</u> and <u>Abies magnifica var. shastensis</u>), western juniper (<u>Juniperus occidentalis</u>), Jeffrey pine (<u>Pinus Jeffreyii</u>), and white fir (<u>Abies concolor</u>). Quaking aspen (<u>Populus tremuloides</u>) is the most commonly associated hardwood. Foxtail pine (<u>Pinus Balfouriana</u>) is a component of this type in a fairly restricted region around the upper South Fork of the Kern River Drainage in the Sierra Nevada and further to the north in scattered stands in the Klamath Mountains. Jeffrey pine, white fir, and aspen communities are common on the east side of the Sierra Nevada, and mountain hemlock does not occur south of northern Tulare county.

METHODS

Samples came from data collected as part of the Ecological Type Classification being conducted by Region 5 of the Forest Service (Allen, 1987). They were intended to be used for classification purposes. The basic unit of sample was a stand, and no limits were placed on size of stand for sampling purposes. Stands were selected based on their appearance as relatively undisturbed habitats with homogeneous species composition in late seral condition. The concept used to select stands was to sample from a range of aspects, elevations, species composition, soil types, community structure, and site index. No attempt was made to include or exclude stands because of features suspected of describing old growth characteristics. For this reason, the samples selected are felt to represent conditions on the majority of stands in the California mixed subalpine type. Variation in species composition, cover values, structural diversity, and habitat was sought rather than indications of the aging process.

Data collection followed the procedures described in the Region 5 Ecosystem Classification Handbook and the Region 5 Timber Management Plan Inventory Handbook. In each stand a 1/10 acre circular plot was used to sample information on species composition, cover values, abundance and environmental setting. One tenth acre and 1/2 acre circular plots were used to obtain information on snags and logs. A 3 point "cluster" was used to establish variable radius plot centers as the basis for determining tree species composition, stand structure, basal area, and volume. Determination of site index came from a sample of height and age of dominant or codominant trees on each point in the cluster. Diameters were recorded in classes for purposes of data analysis. The diameter classes used were: 1-5.9", 6-10.9", 11-17.9", 18-24.9", 25-29.9", 30-39.9", and 40"+.

In the California mixed subalpine type, different species may occur in pure stands almost next to each other or in intimate mixtures within a stand. It is known from classification work in these forests (Potter, unpublished) that the presence of each of these species above a threshold level generally indicates different environmental conditions. This classification was therefore used as the basis for selecting samples that were used to describe the type. For purposes of old growth description samples were screened and separated in three steps. First, those containing more than 10% of the basal area stocking in western white pine, whitebark pine, mountain hemlock, western juniper, and quaking aspen were selected from the data set. These samples were screened again, and those containing more than 25% lodgepole pine, or more than 50% Jeffrey pine, or more than 50% white fir were removed and assigned to other types. A final screen removed samples which contained only red fir in combination with Jeffrey pine or white fir. The remainder were assigned to the California mixed subalpine type and arranged into the following associations for analysis: western white pine, mountain hemlock, white fir-Jeffrey pine, western juniper, and quaking aspen.

To date, 740 stands have been sampled for classification purposes in the region from Lake Tahoe south to the Sequoia National Forest. Among them a subset of 191 stands met the criteria for California mixed subalpine type and were selected as the data set to be used in the analysis. The mountain hemlock association contained 43 samples; western white pine contained 52 samples; western juniper contained 21 samples; the Jeffrey pine-white fir association contained 44 samples, and quaking aspen contained 31 samples. The following National Forests and National Parks were represented in the sample: the Eldorado, Stanislaus, Sierra, Sequoia, Inyo, Lake Tahoe Basin Management Unit, and Toiyabe National Forests and Yosemite and Sequoia-Kings Canyon National Parks. As noted, these samples were taken on undisturbed sites.

Stand ages were based on the age of the oldest tree measured on each site. Samples used for classification purposes usually had three dominant or codominant trees measured per site. In many cases, because of species or size differences, additional trees were measured. No attempt was made; however, to fully age each stand through a complete sample of all size classes. To attempt to report on ages from stands with skewed and irregular structures, as many of these are, could also be misleading. Therefore it was decided to use the age of the oldest tree. This is in agreement with investigators doing work in associated red fir (Schumacher 1928) as well as other types.

Forty nine variables were examined. They emphasized 5 areas of concern: the effects of species composition, changes in cover values, stand structure, biomass accumulation over time, and stand size. The analysis proceeded in two parts. First, information on stand structure, trees and snags per acre by diameter group, species composition and site index were determined for each sample using R5*FS.FIA_SUMMARY and R5*FS.FIA-MATRIX part of a series of Region 5 timber inventory and data expansion programs. Each sample was also processed through PROGNOSIS, a stand growth and yield simulation model developed by Stage and others (Stage 1973) to determine values for quadratic mean diameter, stand density index, mean annual increment, and total cubic foot volume. Values from these programs were combined into a single data set for further analysis. Cover values for shrubs, forbs, and grasses were obtained from data sets developed for the classification project. A separate data set for logs had been developed for the classification effort, and it was used to derive values reported for logs. Samples were then aggregated into two site index groups: Region 5 site index 0 to 3 representing high sites, and Region 5 site index 4 and 5 representing low sites. To examine stand size, existing data bases on each of the National Forests in the study area were queried for number of stands that existed in certain size classes in these forested areas. The size classes examined were 0-10 acres, 10-20 acres, 20-30 acres, 30-50 acres, 50-100 acres, and those exceeding 100 acres.

Variables were tested for normality and transformed as necessary for statistical analysis. The analysis then proceeded using regression techniques to explore diameter, height, and age relationships of individual trees by species and site group. This was followed by examining survivorship curves for individual species and stands. Scatter plots and linear regression were used to explore relationships among variables over time, and time series was also used to look in detail at the data through time. The results of this analysis became the framework for which an Analysis of Variance to isolate variables correlated with broad differences in age was performed. The ability of those variables to differentiate between age groupings were tested using Discriminant Analysis techniques. Finally, Chi square was used to evaluate differences in stand size.

RESULTS

The data set for the California mixed subalpine type is not large for younger stands. Consequently, clear patterns of stand development over long time periods could not be fully determined. However, based on work in red fir, which is a common associate in these forests, it would appear that similar patterns of stand development through time are present. Red fir develops features characteristic of older stands in approximately 150 years on sites 0 to 3 and 200 years on sites 4 to 5. The analysis done for this type indicates similar patterns.

Height-diameter relationships indicate that western white pine, and mountain hemlock are smaller in diameter and shorter in height than associated species such as red fir at comparable ages. While stands may appear younger due to smaller diameters, they are not necessarily different in age. The oldest western white pine sampled was 726 years while the oldest mountain hemlock was 496 years. This compares with the oldest Jeffrey pine sampled of 660 years, and the oldest red fir of 586 years. Survivorship curves show steady but sustained mortality over a relatively long period in each of the associations. This would appear to indicate that early losses in stands are due to natural thinning, but eventually environmental factors such as fire, drought, insects, disease, or wind become major contributors to mortality.

Time series analysis showed consistent variation in biomass accumulation by site class in older stands. This was correlated with changes in the distribution of trees by size class, and reflected steady mortality in large trees with concurrent recruitment of small trees through time. Examination of stand structures over time illustrated these patterns well. They showed that at some point in time stands assume an irregular structure and many size classes are occupying sites simultaneously. Older stands are characterized by moderate regeneration, the presence of trees in several size classes, and a significant component of large trees. These same patterns have been observed in associated types such as red fir and lodgepole pine.

Quaking aspen and western juniper are two species that do not fit the general picture above. Both of these species are difficult to age in the field; however, from sanded cores and cutoff ends it was possible to establish a general picture of ages. Aspen appears to be a very short lived species, at least as far as individual trees are concerned. Clones may be able to persist for long periods. Individual tree ages above 120 to 130 years are doubtful, and survivorship curves indicates substantial mortality in trees beginning around 60 to 70 years. The oldest aspen measured was 135 years old. Diameters and heights are generally smaller than conifer species in this association. Aspen stands usually have high densities, and they have an irregular structure which results from the presence of conifers that are predominant residuals from an earlier stand or individuals that are currently invading the stand. The aspen component by itself often appears to have a normal distribution characteristic of an even-aged structure.

Western juniper appears to be a long lived species. Several samples in excess of 700 to 800 years were encountered, and it may be ages can exceed 1000 to 1500 years. Western juniper is a short tree, with a large diameter. Stands generally have low densities, and they tend to be quite open. These stands also have an irregular structure due to the presence of a substantial number of large, very old juniper.

On high sites the picture that emerges from the analysis is similar to that of red fir. In red fir stands relatively high numbers of trees occupy stands at some point after a major stand replacing event. This is followed by significant losses due to natural thinning early in the life of the stand, and it is followed still later by a stabilized condition characterized by a constantly changing structure in which many size classes are present on a site simultaneously. This last condition results as small gaps and openings are created in a mature overstory in response to environmental conditions such as fire, wind, or drought. Regeneration becomes established in these openings, grows, self thins, and matures. In time, several size classes, including a substantial portion of larger trees, are represented,and the stand exhibits an irregular structure. The hypothesis forwarded here, is that as stands occupy sites for longer and longer periods, environmental factors become increasingly important in developing stand structures that characterize old growth conditions. These same factors continue to be important in maintaining old growth conditions until the site suffers a stand replacing event, and the cycle renews. By ages of 150 years on sites 0 to 3, these patterns appear to be established in the California mixed subalpine type.

On low sites the same patterns do not emerge. First, many of these stands are very open with low tree densities. Except for sites with a high shrub component, it is difficult to imagine enough fuel to carry a stand replacing fire. Nor is it reasonable to expect that other events such as insects or disease would replace entire stands. Avalanche would appear to be the one environmental factor capable of such an event, and while common in certain areas, they are not widespread. Second, in all of the California mixed subalpine type no stand on low sites was found that was less than 200 years old. This confirms similar results in red fir and lodgepole pine stands associated with these mixed subalpine stands. Very few stands less than 200 years old are present on low sites. This implies that many of these stands do not cycle through a stand initiation phase in which high numbers of trees originate more or less simultaneously and progress through time as cohorts. Rather, stand development appears to be sporadic as opportunities arise in response to disturbance levels. Small patches or stands may react similar to better sites with simultaneous stand origin, followed by crown closure, self thinning, and stand opening as gaps are created. However, in most cases, it appears stand initiation is a prolonged process with many aborted attempts. Stand development occupies considerable periods of time, and during these long periods the probability is high that an environmental event will impact the stand and recycle portions back to an earlier period. Inevitably, some individuals escape environmental damage and mature into larger members of the stand. In time, the stand takes on a very open appearance with an irregular stand structure dominated by large trees which are the survivors of many stand altering events. Thus, these stands arrive at a structure similar to better sites but with lower densities and through a different process of development. Other than in early stages of stand initiation, mortality appears to be responding to environmental circumstance more than competition.

Variables that could be used to distinguish between age groups in each of the associations were examined by One-way Analysis of Variance and Discriminant Analysis techniques. In most cases small numbers of samples in younger age stands that were further subdivided by site made meaningful comparisons between age groups difficult. For example, in the western white pine association there were only 2 samples less than 150 years old on sites 0 to 3, and there were no samples less than 200 years old on sites 4 to 5. Snag and log numbers were also highly variable and reliable transformations of the data could not be made for comparison using analysis of variance and Discriminant Analysis. The analysis that was made using regression, suvivorship curves, examination of stand structures, and time series indicated the stands in the California mixed subalpine type are behaving similarly to older stands in red fir, lodgepole pine, and Jefrey pine for which analysis of variance and Discriminant Analysis could be used. Knowledge of the environmental factors acting on these sites allows development of a hypothesis of stand dynamics that fits the information developed and stand patterns in other associated forest types. Therefore, the descriptions report on values that have been used in describing old growth conditions in other types and that can be easily applied in the field.

Chi Square analysis of the distribution by size class confirms what had been observed in the field: the California mixed subalpine forest is a mosiac of different size stands intertwined with non-forested areas. Distributions toward smaller size stands were significant. Thus, the number of stands smaller than 20 acres is higher than might be expected, and the number of stands greater than 100 acres is smaller than might be expected. This would probably also be true in smaller sizes except that most forest data bases do not track stands smaller than 10 acres. Comparisons were made with roaded and unroaded areas and between forested and non-forested areas (shrub stands) with similar results. Thus, the California mixed subalpine forest appears as a spatially complex ecosystem with a general pattern of relatively small to middle size stands.

DISCUSSION

Models of stand dynamics in old growth forests are not abundant. Foresters commonly use the culmination of mean annual increment to define the point at which stands are considered mature. In California yield tables have not been developed for most of the species in the California Mixed Subalpine Type. The only associated species for which such work has been done is red fir. In red fir forests, available yield tables (Schumacher, 1928) indicates the culmination of mean annual increment to be around 140 years. The age at which stands assume old growth characteristics is unclear using this guide.

The Society of American Foresters cover types provide a description of vegetation existing on sites at the moment. They convey little insight into the change of vegetation over time. Conceptual models such as successional change, climax conditions, or potential natural vegetation that may be useful in gaining insights into old growth conditions are not a part of these descriptions. They do not, for example, explore the variation in species composition, stand structure, or ecosystem functioning that links particular plant communities to specific habitats over time. They do, however, provide a practical tool that can be used in large scale inventory and cross regional comparisons.

Vegetation in the forests occupied by the California mixed subalpine type have been stabilizing over long periods of time. In the Sierras, for example, the last major glacial advance appears to have ended around 10,000 years ago, and the vegetaion on vacated sites has been sorting itself out ever since. In other areas volcanism or climatic shifts have been creating similar conditions. Time in these forests is a continum of which human perception catches only a glimpse. Few stands originate within a specific period, develop as cohorts, and die simultaneously. Stand destroying fires do occur in this type, but this does not appear to be a widespread or large scale phemomenon.

Neither are blowdown, insects, disease, lightning, or avalanche. Records (Potter, unpublished) indicate that all of these factors are operating in these forests continuously, but on a small scale. This results in a constantly changing species composition and structure within a stand as individuals and small groups of trees and other vegetation are cycled into and out of the stand in different amounts at different times. This makes it difficult to define the age of a stand other than in a general sense, but it does focus attention on characteristics other than age which are suggestive of the passing of time within a particular stand.

A model felt to be applicable to these forests, and one which seems to fit observations in the field on better sites, is that outlined by Peet and Christiansen (1987) and developed initially by Oliver (1981). Under this model four phases of stand development are recognized: establishment, thinning, transition, and the steady state. Competition-induced mortality is a key feature of stands in the thinning phase, which can last for relatively long time periods; however, the transition and steady state phases are of most interest here. During the transition phase mortality becomes independent of stand density, gaps in the canopy occur, and these are filled with young age classes. This phase may last for several decades. The steady state forest is then typified by an uneven age or irregular structure composed of relatively small even age patches. This pattern cycles over time as younger patches become established, thin themselves, and form gaps. All three of the earlier phases are present simultaneously. This stage is most likely terminated by a stand replacing disturbance such as fire. As noted earlier, this model does not fit all cases on lower sites. The model described in the Results section seems to provide better agreement with field observations; nevertheless, the steady state forest does seem to develop essentially the same general structure over time. It appears this form can be used to define old growth forests of the mixed subalpine, and that is the approach used here.

The distinction between transition and steady state is not sharp, and as noted, may cover several decades. Therefore, attention was focused on identifying variables that could be used to approximate the age at which stands developed features typical of a transition phase. Once this age was identified it was assumed that older stands would be in the transition or steady state condition if they continued to exhibit characteristics such as an irregular structure or presence of larger trees. No attempt was made to differentiate between the transition and steady state phases since forests in both phases have similar characteristics.

The point at which a period of increasing Quadratic Mean Diameter in developing younger stands is followed by a significant decrease was one feature that might suggest the beginning of the transition phase. A decrease in Quadratic Mean Diameter would imply the stand was breaking up. This decrease would be expected to coincide with an increase in regeneration and smaller size classes (saplings and poles). This would indicate the formation of gaps in the canopy that could not be filled by crown closure and therefore became available for regeneration. The presence of large numbers of these smaller trees reduces the Quadratic Mean Diameter. Stand density index would be expected to increase at this time as well. As noted earlier, the data set for these forests contains few samples in early seral condition, and the point at which Quadratic Mean Diameter increases substantially and is followed by a sharp decline was not obvious. What is clear from the data is that these stands have apparently already arrived at a condition that can be described as old growth. Considerable variation in productivity, Quadratic Mean Diameter, and density is occuring, and this variation is reflected in the structure of the stands. Many size classes are present including regeneration and small trees. This indicates the opening of the stand and establishment of younger age classes has already occurred.

Development of larger size trees is a trait that progresses over time, and this can often be used to indicate advancing stand age. Generally, at the point of transition the number of larger trees increases to levels that are typical from that point on. This is usually further substantiated when the number of trees in the smaller size class decreases significantly at the same time. This decrease results from both growth of smaller size classes into larger classes as well as a response to competition-induced mortality which thins suppressed individuals of this size class. As noted above, the data set for the California mixed subalpine type does not provide a picture of early stand development, and most of the stands in the sample are felt to already be in an old growth condition. What can be observed is that larger trees are present in somewhat stable numbers. They vary over time in response to environmental conditions, but they have essentially become permanent features of the stand.

Generally, mortality becomes independent of density as stands age. This does seem to be the case for these forests. Time series for most of the stands in the data set show mortality of larger size classes to be somewhat uncorrelated with density. Survivorship curves on both high and low sites show a steady decline in individuals over time. This would also indicate that at least some mortality is occuring which is independent of density.

Under the model presumed to describe these forests, an irregular or uneven age structure would be present in stands past the transition phase. This structural pattern has been noted elsewhere as characteristic of "old growth" (Assman,1970; Baker,1962; Veblen,1985; Parker,1985; Taylor,1991). Profiles of diameter distributions in these stands indicate structures skewed to the right. Few of the samples fit an ideal "reverse J" pattern of an optimally distributed uneven age stand, but an irregular structure in which large size classes are overrepresented and regeneration is generally underrepresented is common. The California mixed subalpine type is apparently also distinguished from associated types by having fewer trees in size classes below 25" Dbh. In most stands at least 3 size classes do appear to be present. While there are many patches that exhibit the "normal" distribution of even age stands, they generally do not cover large, continuous areas. Trees from different size classes tend to be distributed randomly or in small patches within a stand. Quaking aspen differs from the general pattern described above. It often fits and even age or two storied structure. Aspen stands will often appear to have distinctly uniform distribution of stems in the field. This pattern is obvious in diagrams of tree distribution by size class. Many aspen stands have a large component of trees between 8 and 18" Dbh. However, there are often conifer trees in size classes above 18" Dbh. This is what gives these stands the characteristic irregular structure overall, while the aspen component alone is distinctly even aged. If the general structure was irregular or uneven age in appearance with dominants in at least 3 size classes then it was presumed this condition had been satisfied and the stands were in the transition or steady state phase.

Decadence as reflected in broken and missing tops, scars, the presence of bole, root, and foliage disease, group kills, and lack of crown vigor is an important component of these forests. Equally important is the presence of decay fungi, and other organisms involved in the decomposition of woody material. The occurance of broken and multiple tops or the frequency and severity of disease related mortality as stands age may have important ramifications in seed production and dissemination and eventual species compostion and site occupancy. These characteristics were not sampled in the initial phases of the classification project, however, and they must remain as general observations at this time.

The mixed subalpine forest cannot be viewed apart from its general setting. The characteristics used to describe these forests are representative of only a portion of the forest. Specifically, only stands with greater than 10% crown cover were sampled and described. These forests are an ecosystem, however, wherein non-forested areas are equally a part of the landscape and fulfill important roles in the overall functioning of that ecosystem. To describe only older stands of trees neglects the "totality" of the california mixed subalpine forest. Thus, when using these guides it must be realized that only forested areas are described. The old growth California Mixed Subalpine Type is larger than a simple summary of old growth stands.

Linked to the general view of the California mixed subalpine forest outlined above is the consideration of size. Size of stands that function as ecological units is important in understanding these ecosystems. Whatever our preconceptions are as to the "optimal" size they must fit with the patterns these forests have evolved over a long period of time. Obviously, these forests are spatially complex with a range of stand sizes. It is not uncommon to observe undisturbed stands smaller than 5 acres in the field, and stands smaller than 1 acre are not uncommon in these forests. Such stands appear to be complete components of the surrounding ecosystem with full complements of flora and fauna. The guides presented here are intended to be used in stands of all sizes.

Another important consideration in old growth forests is the amount of disturbance these stands have undergone. The stands sampled for this analysis were late seral with as little disturbance as possible. However, as noted earlier, timber harvest has been increasing for the past 40 years, and several stands sampled had logging adjacent to them. Grazing also has been a factor in these forests since the middle to late 1800's. This activity peaked in the early part of the 1900's, but most stands continue to be grazed. Fire suppression activities started to become effective in the 1930's, and mining activity was important in localized situations. More recently, air quality is being reduced over many areas by the current activities of man. Of course wind, fires, insects and disease, cutting by indigeneous pre-European populations, and browsing by herbivores has been present over long periods. Thus, old growth forests in the California mixed subalpine type are not in an undisturbed condition, nor have they been particularly free of broad ranging effects of man for many decades. For practical purposes, however, the stands described have been undisturbed except for natural phenomenon, fire suppression, and grazing. Timber harvest has not been a part of the stand history.

These guides were developed from and intended for use in stands that became established and developed for long periods under naturally occuring processes (except for grazing). These processes include: natural fires, insect and disease activity, browsing by indigeneous herbivores, wind, avalanches, climatic cycles, lightning, competition, and species selection processes. Establishment has been the result of natural distribution of seed from parents generally in close proximity to a stand. Stand density, diameter distribution, spacing, growth patterns, and vertical arrangement are generally the result of these naturally occuring processes.

CONCLUSION

From the analysis it appears most forests in the California mixed subalpine type begin to assume old growth characteristics around 150 to 200 years. These ages correspond to the ages other associated types such as red fir and lodgepole pine assume old growth characteristics, and they are a reflection of the passage of a substantial period of time in which stands have been exposed to environmental hazards. The same ages are used in the california mixed subalpine associations except for Quaking Aspen. This species appears to be short lived by comparison with associates. Few stands were sampled less than 80 years, and an age of 100 years was simply used in the description for this species. These ages were used to separate candidate old growth stands from others.

The descriptions that follow are based on examination of older stands in these forests. Since old growth forests are too complex for simple descriptions to be useful, multiple characteristics are used. Variables which were felt to be readily observed on the ground but could not be statistically compared are also included in the descriptions. Numbers of snags, number of logs, and stand structure are examples. Most have been used by others in describing old growth forests. Judgement will be necessary when using the guides since overlaps occur, and not all characteristics will be present in any one stand or area at any one time. The general setting and characteristics of surrounding stands must be considered as well as the stand under examination. The variables that are used to describe old growth characteristics in this type are: species composition, age, height of dominant trees in the stand, stand structure, canopy layering, stems and basal area per acre of live trees in larger size classes, stems and basal area per acre of dead trees in larger size classes, and number of logs in larger size classes.

DESCRIPTIONS

The following outlines the characteristics and significant observations of old growth forests in the California mixed subalpine cover type. They are arranged by association and summarized in Tables 1 through 5 beginning on page 24. To many, the variation in some of the basic attributes may seem unsettling. They would prefer simpler, more concrete definition. Such definition, however, often raises more questions than it answers. Variation is a fundamental feature of nature, and it must be recognized. Consequently, the mean, standard deviation, and range are shown where appropriate. In addition, where possible, probability statements are included which define the lower limits at a specified level of probability. It was felt this would be more useful to a variety of users in different settings and give a clearer picture of the characteristic over a range of samples. The mean ± one standard deviation will capture the expected values in most situations, and the range will alert one to extreme values that may be outliers. Interpretations can then legitimately be made by users. Regeneration layers are not used in stand structure descriptions. All values are given on a per acre basis.

California Mixed Subalpine - SAF Cover Type (256)

Western White Pine Association

Sites 0 to 3

1.Species composition: Conifer tree cover is moderate on these sites. The mean tree cover is 53%. The standard deviation is 18%. Values range from 15 to 77%. Western white pine constitutes 30% of the stand. Red fir constitutes 61%. Other conifer species constitute 9%.

2.Age: Stands on these sites assume old growth characteristics at approximately 150 years.

3.Tree height: Dominant Western white pine on the site will have attained 75 feet.

4.Stand Structure: An irregular structure is most common on these sites. Regeneration and trees smaller than 11" are underrepresented while trees larger than 30" are overrepresented. Different size classes are distributed in patches throughout the stand. At least 3 size classes must be present. Trees ≥30"DBH or ≥150 years old are present as indicated below.

5.Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Conifer trees ≥30"DBH

Number of trees -	The average number of trees per acre in these size classes is 20.8. The standard deviation is 11.9. Values range from 2.0 to 41.1. At the 90% probability level more than 5.6 trees per acre ≥30" DBH will be present.
Basal Area -	The average basal area per acre in these size classes is 177.5. The standard deviation is 98.1. Values range from 13.3 to 480.0. At the 90% probability level more than 52.0 square feet per acre will be present in trees ≥30" DBH.

7.Snags:

Conifer snags ≥30"DBH

Number of snags	The average number of snags per acre in these size classes is 1.2. The standard deviation is 1.6. Values range from 0 to 5.6.
Basal Area	The average basal area per acre in these size classes is 14.8. The standard deviation is 21.4. Values range from 0 to 80.0.

8.Logs:

Conifer logs ≥30" large end

Number of logs	The average number of logs in these size classes is 2.0. The standard deviation is 2.0. Values range from 0 to 4.0.

Sites 4 to 5

1.Species composition: Conifer tree cover is moderate on these sites. The mean tree cover is 54%. The standard deviation is 19%. Values range from 20 to 88%. Western white pine constitutes 35% of the stand. Red fir constitutes 55% of the stand; other conifer species constitute 10%.

2.Age: Stands on these sites assume old growth characteristics at approximately 200 years.

3.Tree height: Dominant trees on the site will have attained 65 feet.

4.Stand Structure: An irregular structure is most common on these sites. Regeneration and trees <11" are commonly underrepresented while trees larger than 30" are overrepresented. Different size classes are distributed in patches or singly throughout the stand. At least 3 size classes must be present. Trees $\geq$30"DBH or $\geq$200 years old are present as indicated below.

5.Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Conifer trees $\geq$30"DBH

Number of trees - The average number of trees per acre in these size classes is 16.5. The standard deviation is 7.0. Values range from 4.7 to 29.8. At the 90% probability level more than 7.6 trees per acre $\geq$30" will be present.

Basal Area - The average basal area per acre in these size classes is 132.2. The standard deviation is 59.8. Values range from 40.0 to 240.0. At the 90% probability level more than 55 square feet per acre will be present in trees $\geq$30" DBH.

7.Snags:

Conifer snags $\geq$30"DBH

Number of snags The average number of snags per acre in these size classes is 1.8. The standard deviation is 1.8. Values range from 0 to 5.1.

Basal Area The average basal area per acre in these size classes is 14.9. The standard deviation is 16.1. Values range from 0 to 40.0.

8.Logs:

Conifer logs $\geq$30"

Number of logs The average number of logs in these size classes is 1.7. The standard deviation is 2.3. Values range from 0 to 6.

Mountain Hemlock Association

Sites 0 to 3

1.Species composition: Conifer tree cover is high on these sites. The mean tree cover is 73%. The standard deviation is 9%. Values range from 48 to 88%. Mountain Hemlock constitutes 44% of the stand. Red fir constitutes 41%. Other conifer species constitute 15%.

2.Age: Stands on these sites assume old growth characteristics at approximately 150 years.

3.Tree height: Dominant Mountain Hemlock on the site will have attained 85 feet.

4.Stand Structure: An irregular structure is most common on these sites. Regeneration and trees smaller than 11" are underrepresented while trees larger than 30" are overrepresented. Different size classes are distributed in patches throughout the stand. At least 3 size classes must be present. Trees ≥30"DBH or ≥150 years old are present as indicated below.

5.Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Conifer trees ≥30"DBH

Number of trees -	The average number of trees per acre in these size classes is 22.3. The standard deviation is 10.6. Values range from 0 to 44.0. At the 90% probability level more than 8.7 trees per acre ≥30" DBH will be present.
Basal Area -	The average basal area per acre in these size classes is 191.6. The standard deviation is 86.5. Values range from 0 to 386.7. At the 90% probability level more than 80.9 square feet per acre will be present in trees ≥30" DBH.

7.Snags:

Conifer snags ≥30"DBH

Number of snags	The average number of snags per acre in these size classes is 1.7. The standard deviation is 2.0. Values range from 0 to 7.2.
Basal Area	The average basal area per acre in these size classes is 17.2. The standard deviation is 21.5. Values range from 0 to 80.0.

8.Logs:

Conifer logs ≥25" large end

Number of logs — The average number of logs in these size classes is 3.6. The standard deviation is 5.0. Values range from 0 to 10.0

Sites 4 to 5

1.Species composition: Conifer tree cover is moderate on these sites. The mean tree cover is 49%. The standard deviation is 17%. Values range from 22 to 69%. Mountain Hemlock constitutes 41% of the stand. Western white pine constitutes 28% of the stand. Red fir constitutes 20%, and other conifer species constitute 11%.

2.Age: Stands on these sites assume old growth characteristics at approximately 200 years.

3.Tree height: Dominant trees on the site will have attained 65 feet.

4.Stand Structure: An irregular structure is most common on these sites. Regeneration and trees <11" are commonly underrepresented while trees larger than 30" are overrepresented. Different size classes are distributed in patches or singly throughout the stand. At least 3 size classes must be present. Trees ≥30"DBH or ≥200 years old are present as indicated below.

5.Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Conifer trees ≥30"DBH

Number of trees - The average number of trees per acre in these size classes is 13.3. The standard deviation is 7.3. Values range from 5.1 to 26.5. At the 90% probability level more than 4.0 trees per acre ≥30" will be present.

Basal Area - The average basal area per acre in these size classes is 112.3. The standard deviation is 65.8. Values range from 40.0 to 226.7. At the 90% probability level more than 28.1 square feet per acre will be present

7. Snags:

Conifer snags ≥30"DBH

Number of snags	The average number of snags per acre in these size classes is 1.4. The standard deviation is 1.3. Values range from 0 to 3.6.
Basal Area	The average basal area per acre in these size classes is 12.7. The standard deviation is 13.2. Values range from 0 to 40.0.

8. Logs:

Conifer logs ≥25"

Number of logs	The average number of logs in these size classes is 2.0. The standard deviation is 2.5. Values range from 0 to 6.

White fir - Jeffrey pine Association

Sites 0 to 3

1. Species composition: Conifer tree cover is moderate on these sites. The mean tree cover is 64%. The standard deviation is 22%. Values range from 16 to 93%. White fir constitutes 44% of the stand. Red fir constitutes 23%; Jeffrey pine averages 22%. Other conifer species constitute 1%.

2. Age: Stands on these sites assume old growth characteristics at approximately 150 years.

3. Tree height: Dominant White fir on the site will have attained 95 feet.

4. Stand Structure: An irregular structure is most common on these sites. Regeneration and trees smaller than 11" are underrepresented while trees 18 to 25" and 30 to 40" are overrepresented. Different size classes are distributed in patches throughout the stand. At least 3 size classes must be present. Trees ≥30"DBH or ≥150 years old are present as indicated below.

5. Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6. Live Trees:

Conifer trees ≥30"DBH

Number of trees -	The average number of trees per acre in these size classes is 20.6. The standard deviation is 10.6. Values range from 7.8 to 49.3. At the 90% probability level more than 7.1 trees per acre ≥30" DBH will be present.

Basal Area - The average basal area per acre in these size classes is 187.8. The standard deviation is 101.0. Values range from 64.0 to 493.3. At the 90% probability level more than 58.6 square feet per acre will be present in trees $\geq$30" DBH.

7.Snags:

Conifer snags $\geq$30"DBH

Number of snags The average number of snags per acre in these size classes is 2.8. The standard deviation is 2.7. Values range from 0 to 9.5.

Basal Area The average basal area per acre in these size classes is 24.5. The standard deviation is 24.4. Values range from 0 to 80.0.

8.Logs:

Conifer logs $\geq$30" large end

Number of logs The average number of logs in these size classes is 4.0. The standard deviation is 4.8. Values range from 0 to 16.0.

Sites 4 to 5

1.Species composition: Conifer tree cover is moderate on these sites. The mean tree cover is 47%. The standard deviation is 23%. Values range from 18 to 81%. White fir constitutes 33% of the stand. Red fir constitutes 36% of the stand, and Jeffrey pine averages 21%. Other conifer species constitute 10%.

2.Age: Stands on these sites assume old growth characteristics at approximately 200 years.

3.Tree height: Dominant trees on the site will have attained 75 feet.

4.Stand Structure: An irregular structure is most common on these sites. Regeneration and trees <11" are commonly underrepresented while trees in the 11 to 25" classes and 30 to 40" classes are significantly overrepresented. Different size classes are distributed in patches or singly throughout the stand. At least 3 size classes must be present. Trees $\geq$30"DBH or $\geq$200 years old are present as indicated below.

5.Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Conifer trees $\geq$30"DBH

Number of trees - The average number of trees per acre in these size classes is 12.8. The standard deviation is 7.8. Values range from 5.0 to 24.9. At the 90% probability level more than 2.8 trees per acre $\geq$30" DBH will be present.

Basal Area - The average basal area per acre in these size classes is 97.6. The standard deviation is 60.8. Values range from 53.3 to 200.0. At the 90% probability level more than 19 square feet per acre will be present in trees $\geq$30" DBH.

7.Snags:

Conifer snags $\geq$30"DBH

Number of snags The average number of snags per acre in these size classes is 2.4. The standard deviation is 2.1. Values range from 0 to 5.9.

Basal Area The average basal area per acre in these size classes is 19.2. The standard deviation is 15.0. Values range from 0 to 40.0.

8.Logs:

Conifer logs $\geq$30"

Number of logs There was only 1 sample on sites 4 to 5 in this association. Values will not be reported for this variable.

Western Juniper Association

All sites combined

1.Species composition: Conifer tree cover is low on these sites. The mean tree cover is 29%. The standard deviation is 13%. Values range from 4 to 61%. Western juniper constitutes 58% of the stand. Jeffrey pine constitutes 14%, red fir averages 9%, and lodgepole pine constitutes 9%. Other species average 10%

2.Age: Stands on these sites assume old growth characteristics at approximately 200 years.

3.Tree height: Dominant western juniper on the site will have attained 30 feet.

4.Stand Structure: An irregular structure is most common on these sites. Regeneration and size classes between 11 and 25" are underrepresented while trees larger than 30" are overrepresented. Different size classes are distributed randomly throughout the stand. At least 3 size classes must be present. Trees ≥30"DBH or ≥200 years old are present as indicated below.

5.Canopy Layering: canopy layers coincide with diameter distributions. Rarely do stands approach an even age structure. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Conifer trees ≥30"DBH

Number of trees -	The average number of trees per acre in these size classes is 11.0. The standard deviation is 5.6. Values range from 2.6 to 23.1. At the 90% probability level more than 3.8 trees per acre ≥30" DBH will be present.
Basal Area -	The average basal area per acre in these size classes is 102.5. The standard deviation is 49.9. Values range from 29.0 to 186.7. At the 90% probability level more than 38.7 square feet per acre will be present in trees ≥30" DBH.

7.Snags:

Conifer snags ≥30"DBH

Number of snags	The average number of snags per acre in these size classes is 1.2. The standard deviation is 1.1. Values range from 0 to 3.6.
Basal Area	The average basal area per acre in these size classes is 13.3. The standard deviation is 11.3. Values range from 0 to 40.0.

8.Logs:

Conifer logs

Number of logs	The average number of logs is 2.0. The standard deviation is 1.9. Values range from 0 to 4.0.

Quaking Aspen Association

Sites 0 to 3

1.Species composition: Tree cover is high on these sites. The mean tree cover is 76%. The standard deviation is 10%. Values range from 49 to 91%. Quaking aspen constitutes 62% of the stand. Red fir constitutes 23%; white fir averages 10%. Other conifer species constitute 5%.

2.Age: Stands on these sites assume old growth characteristics at approximately 80 years.

3.Tree height: Dominant Aspen on the site will have attained 65 feet.

4.Stand Structure: An irregular structure is most common on these sites, but they commonly appear as even aged or 2 storied stands. The aspen component exhibits an even-aged structure with most stems centered around 10 to 18 inch diameter trees. Aspen regeneration tends to be high due to the sprouting characteristics of this species. Trees larger than 25" are generally conifers that have invaded these sites in the past. They impart a bimodal structure to the stand. Different size classes are distributed randomly throughout the stand. At least 3 size classes are present.

5.Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Aspen trees >18-25"<

Number of trees - The average number of aspentrees per acre in these size classes is 17.7. The standard deviation is 12.1. Values range from 0 to 43.6. At the 80% probability level more than 7.5 trees per acre between 18 and 25 inches DBH will be present.

Basal Area - The average basal area per acre for aspen in these size classes is 47.0. The standard deviation is 32.3. Values range from 0 to 106.7. At the 90% probability level more than 19.0 square feet per acre between 18 and 25 inches DBH will be present.

Conifer trees $\geq$30"DBH

Number of trees - The average number of trees per acre in these size classes is 6.4. The standard deviation is 6.6. Values range from 0 to 22.3. At the 75% probability level more than 2.0 trees per acre $\geq$30"DBH will be present.

Basal Area - The average basal area per acre in these size classes is 60.2. The standard deviation is 55.6. Values range from 0 to 173.4. At the 80% probability level more than 13.6 square feet per acre will be present in trees $\geq$30" DBH.

7.Snags:

Aspen snags >18-25"<	
Number of snags	The average number of aspen snags per acre in these size classes is 2.5. The standard deviation is 4.4. Values range from 0 to 16.3.
Basal Area	The average basal area per acre for aspen in these size classes is 6.2. The standard deviation is 10.7. Values range from 0 to 40.0.
Conifer snags ≥30"DBH	
Number of snags -	The average number of snags per acre in these size classes is 0.8. The standard deviation is 1.1. Values range from 0 to 3.6
Basal Area -	The average basal area per acre in these size classes is 8.2. The standard deviation is 12.5. Values range from 0 to 40.0.

8.Logs:

Logs all species ≥18" large end	
Number of logs	The average number of logs in these size classes is 10.0. The standard deviation is 8.5. Values range from 4.0 to 16.0.

Sites 4 to 5

1.Species composition: Aspen tree cover is moderate on these sites. The mean tree cover is 64%. The standard deviation is 19%. Values range from 33 to 81%. Quaking aspen constitutes 64% of the stand. Western juniper constitutes 15% of the stand. Red fir constitutes 9%, and lodgepole pine averages 7%. Other conifer species constitute 5%.

2.Age: Stands on these sites assume old growth characteristics at approximately 80 years.

3.Tree height: Dominant trees on the site will have attained 40 feet.

4.Stand Structure: An irregular structure is most common on these sites, but they commonly appear as 2 storied stands. The Aspen component exhibits an even-aged structure with most stems centered approximately around a 16 inch diameter tree. Aspen regeneration tends to be high due to the sprouting characteristics of this species. Trees larger than 25" are generally conifers that have invaded these sites in the past. They impart a bimodal structure to the stand. Different size classes are distributed randomly throughout the stand. At least 3 size classes are present as indicated below.

5.Canopy Layering: canopy layers coincide with diameter distributions. In those stands which approach an even age structure, a single canopy layer predominates. In stands with several diameter classes, several canopy layers are present.

6.Live Trees:

Aspen trees >18-25"<

Number of trees - The average number of trees per acre in these size classes is 7.6. The standard deviation is 7.3. Values range from 0 to 21.8. At the 90% probability level more than 1.5 trees per acre between 18 and 25 inches DBH will be present.

Basal Area - The average basal area per acre in these size classes is 18.7. The standard deviation is 17.8. Values range from 0 to 53.3. At the 90% probability level more than 7.2 square feet per acre will be present.

Conifer trees $\geq$30"DBH

Number of trees - The average number of trees per acre in these size classes is 5.9. The standard deviation is 7.0. Values range from 0 to 18.9. At the 75% probability level more than 1.2 trees per acre $\geq$30"DBH will be present.

Basal Area - The average basal area per acre in these size classes is 56.7. The standard deviation is 72.5. Values range from 0 to 200.0. At the 75% probability level more than 48.6 square feet per acre will be present in trees $\geq$30" DBH.

7.Snags:

Aspen snags >18-25"DBH

Number of snags The average number of snags per acre in these size classes is 0.4. The standard deviation is 1.0. Values range from 0 to 2.7.

Basal Area The average basal area per acre in these size classes is 1.0. The standard deviation is 2.5. Values range from 0 to 6.7.

Conifer snags $\geq$30"DBH

Number of snags - The average number of snags per acre in these size classes is 0.4. The standard deviation is 0.8. Values range from 0 to 2.0.

Basal Area - The average basal area per acre in these size classes is 3.0. The standard deviation is 5.4. Values range from 0 to 13.3.

8. Logs:

Logs all species >18" large end

Number of logs	The average number of logs per acre in these size classes is 2.0. The standard deviation is 3.5. Values range from 0 to 6.0.

TABLE 1

CHARACTERISTICS OF OLD GROWTH
CALIFORNIA MIXED SUBALPINE FORESTS

WESTERN WHITE PINE ASSOCIATION

	R5 SITE CLASS 0-3	R5 SITE CLASS 4-5
1. SPECIES COMPOSITION	PERCENT COVER IN WESTERN WHITE PINE IS 30% ± 17%	PERCENT COVER IN WESTERN WHITE PINE IS 35% ± 18%
2. AGE	≥150 YEARS	≥200 YEARS
3. HEIGHT OF DOMINANTS	WESTERN WHITE PINE DOMINANTS ≥75 FEET	WESTERN WHITE PINE DOMINANTS ≥65 FEET
4. STAND STRUCTURE	IRREGULAR. AT LEAST 3 DIAMETER CLASSES PRESENT	IRREGULAR. AT LEAST 3 DIAMETER CLASSES PRESENT
5. CANOPY LAYERING	MULTILAYERED. LAYERS CORRESPOND TO DIAMETER DISTRIBUTION	MULTILAYERED. LAYERS CORRESPOND TO DIAMETER DISTRIBUTION
6. LIVE TREES ≥30" DBH		
NUMBER	20.8 ± 11.9 90% OF STANDS: ≥5	16.5 ± 7.0 90% OF STANDS: ≥7
BASAL AREA (SQ FT)	177.5 ± 98.1 90% OF STANDS: ≥52	132.2 ± 59.8 90% OF STANDS: ≥55
7. SNAGS ≥30" DBH		
NUMBER	1.2 ± 1.6	1.8 ± 1.8
BASAL AREA (SQ FT)	14.8 ± 21.4	14.9 ± 16.1
8. LOGS ≥30" LARGE END		
NUMBER	2.0 ± 2.0	1.7 ± 2.3

TABLE 2

CHARACTERISTICS OF OLD GROWTH
CALIFORNIA MIXED SUBALPINE FORESTS

MOUNTAIN HEMLOCK ASSOCIATION

	R5 SITE CLASS 0-3	R5 SITE CLASS 4-5
1.SPECIES COMPOSITION	PERCENT COVER IN MOUNTAIN HEMLOCK IS 44% ± 26%	PERCENT COVER IN MOUNTAIN HEMLOCK IS 41% ± 28%
2.AGE	≥150 YEARS	≥200 YEARS
3.HEIGHT OF DOMINANTS	MOUNTAIN HEMOLCK DOMINANTS ≥85 FEET	MOUNTAIN HEMLOCK DOMINANTS ≥65 FEET
4.STAND STRUCTURE	IRREGULAR. AT LEAST 3 DIAMETER CLASSES PRESENT	IRREGULAR. AT LEAST 3 DIAMETER CLASSES PRESENT
5.CANOPY LAYERING	MULTILAYERED. LAYERS CORRESPOND TO DIAMETER DISTRIBUTION	MULTILAYERED. LAYERS CORRESPOND TO DIAMETER DISTRIBUTION
6.LIVE TREES ≥30" DBH		
NUMBER	22.3 ± 10.6 90% OF STANDS:≥8	13.3 ± 7.3 90% OF STANDS: ≥7
BASAL AREA (SQ FT)	191.6 ± 86.5 90% OF STANDS: ≥80	112.3 ± 65.8 90% OF STANDS: ≥55
7.SNAGS ≥30" DBH		
NUMBER	1.7 ± 2.0	1.4 ± 1.3
BASAL AREA (SQ FT)	17.2 ± 21.5	12.7 ± 13.2
8.LOGS ≥25" LARGE END		
NUMBER	3.6 ± 5.0	2.0 ± 2.5

TABLE 3

CHARACTERISTICS OF OLD GROWTH
CALIFORNIA MIXED SUBALPINE FORESTS

WHITE FIR-JEFFREY PINE ASSOCIATION

	R5 SITE CLASS 0-3	R5 SITE CLASS 4-5
1.SPECIES COMPOSITION	PERCENT COVER IN WHITE FIR 44% ± 24% JEFFREY PINE 22% ± 17%	PERCENT COVER IN WHITE FIR 33% ± 27% JEFFREY PINE 21% ± 14%
2.AGE	≥150 YEARS	≥200 YEARS
3.HEIGHT OF DOMINANTS	WHITE FIR OR JEFFREY PINE DOMINANTS ≥95 FEET	WHITE FIR OR JEFFREY PINE DOMINANTS ≥75 FEET
4.STAND STRUCTURE	IRREGULAR. AT LEAST 3 DIAMETER CLASSES PRESENT	IRREGULAR. AT LEAST 3 DIAMETER CLASSES PRESENT
5.CANOPY LAYERING	MULTILAYERED. LAYERS CORRESPOND TO DIAMETER DISTRIBUTION	MULTILAYERED. LAYERS CORRESPOND TO DIAMETER DISTRIBUTION
6.LIVE TREES ≥30" DBH		
NUMBER	20.6 ± 10.6 90% OF STANDS: ≥7	12.8 ± 7.8 90% OF STANDS: ≥3
BASAL AREA (SQ FT)	187.8 ± 101.0 90% OF STANDS: ≥58	97.6 ± 60.8 90% OF STANDS: ≥20
7.SNAGS ≥30" DBH		
NUMBER	2.8 ± 2.7	2.4 ± 2.1
BASAL AREA (SQ FT)	24.5 ± 24.4	19.2 ± 15.0
8.LOGS ≥30" LARGE END		
NUMBER	4.0 ± 4.8	NOT OBSERVED

TABLE 4

CHARACTERISTICS OF OLD GROWTH
CALIFORNIA MIXED SUBALPINE FORESTS

WESTERN JUNIPER ASSOCIATION

	ALL SITE CLASSES
1. SPECIES COMPOSITION	PERCENT COVER IN: WESTERN JUNIPER 58% ± 28% JEFFREY PINE 14% ± 17%
2. AGE	≥200 YEARS
3. HEIGHT OF DOMINANTS	WESTERN JUNIPER DOMINANTS ≥30 FEET
4. STAND STRUCTURE	IRREGULAR. AT LEAST 3 DIAMETER CLASSES PRESENT
5. CANOPY LAYERING	MULTILAYERED. LAYERS CORRESPOND TO DIAMETER DISTRIBUTION
6. LIVE TREES ≥30" DBH	
NUMBER	11.0 ± 5.6 90% OF STANDS: ≥4
BASAL AREA (SQ FT)	102.5 ± 49.9 90% OF STANDS: ≥39
7. SNAGS ≥30" DBH	
NUMBER	1.2 ± 1.1
BASAL AREA (SQ FT)	13.3 ± 11.3
8. LOGS ALL SIZES	
NUMBER	2.0 ± 1.9

TABLE 5

CHARACTERISTICS OF OLD GROWTH
CALIFORNIA MIXED SUBALPINE FORESTS

QUAKING ASPEN ASSOCIATION

	R5 SITE CLASS 0-3	R5 SITE CLASS 4-5
1.SPECIES COMPOSITION	PERCENT COVER IN QUAKING ASPEN 62% ± 25%	PERCENT COVER IN QUAKING ASPEN 64% ± 21% WESTERN JUNIPER 15% ± 20%
2.AGE	≥100 YEARS	≥100 YEARS
3.HEIGHT OF DOMINANTS	QUAKING ASPEN DOMINANTS ≥65 FEET	QUAKING ASPEN DOMINANTS ≥40 FEET
4.STAND STRUCTURE	IRREGULAR. AT LEAST 2 DIAMETER CLASSES PRESENT	IRREGULAR. AT LEAST 2 DIAMETER CLASSES PRESENT
5.CANOPY LAYERING	MULTILAYERED. COMMONLY 2 STORIED. LAYERS CORR-ESPOND TO DIAMETER DISTRIBUTION	MULTILAYERED. COMMONLY 2 STORIED. LAYERS CORR-ESPOND TO DIAMETER DISTRIBUTION
6.ASPEN TREES 18-25" DBH		
NUMBER	17.7 ± 12.1 90% OF STANDS: ≥2	7.6 ± 7.3 90% OF STANDS: ≥1
BASAL AREA (SQ FT)	47.0 ± 32.3 90% OF STANDS: ≥19	18.7 ± 17.8 90% OF STANDS: ≥7
7.ASPEN SNAGS 18-25" DBH		
NUMBER	2.5 ± 4.4	0.4 ± 1.0
BASAL AREA (SQ FT)	6.2 ± 10.7	1.0 ± 2.5
8.LOGS ≥18" LARGE END		
NUMBER	10.0 ± 8.5	2.0 ± 3.5

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