

MIKE LANDRAM
USDA Forest Service
Pacific Southwest Region
San Francisco, California

13

*Status of Reforestation on
National Forest Lands
Within the Sierra Nevada
Ecosystem Project Study
Area*

ACKNOWLEDGEMENTS

Many people were involved in this effort. I would like to thank John Tappeneir and John Fiske for asking the questions and for guidance. The mapping and inventory products used in this report were produced by the Forest Service Remote Sensing Lab and Pacific Meridian Resources in Sacramento. Refining and interpreting that information would not have been possible without Ralph Warbington's program support, Deborah Nicoll's computer support, and many a helpful session with Kevin Casey, Kama Kennedy, Mark Rosenberg and Eric Spry. Analysis of the mapping and inventory products was made possible by the people at SNEP GIS; I want to thank Karen Gabriel and Russ Jones for periodic assistance and most especially John Gabriel, creator of GIS map products and queries that became the heart of this analysis. Additional thanks goes to Richard Teck of the Timber Management Support Center in Fort Collins for help with the visualization graphics and FVS support, Chris Riper of SNEP for the graphics work on current plantation condition, Larry Wilson (contractor) for programming and graphics display of the variation among sample points, Chuck Stadelman of the Regional Office for programming Stand Record System reports, the Silviculture Development Unit in Redding (Gary Fiddler, Walt Leonard, Eric Yerkes, and crew) for field inventories, and Bill Hay of the Regional Office for computer support with the document. Those that provided peer reviews added immeasurably to the final product. For those reviews, I would like to thank John Helms, John Fiske, Bob Rogers, Dave Bakke, Ralph Warbington, Doug Leisz, and 3 SNEP reviewers whose identity is unknown to me.

ABSTRACT

The reforestation program on national forest lands within the SNEP Study Area is successful; stocking objectives are achieved in the near term (within 5 years of harvest or planting) on 80% to 90% of the land where reforestation is needed depending on the method used to evaluate success. Older plantations are growing at rates sufficient to meet the modelled expectations in forest plans. Four-percent of the total forestland consisted of plantations in 1991 (estimated at 5% in 1995). Inventory statistics for 170,000 acres planted before 1981 are provided. Current declining survival rates, reductions in workforce size, potential reduction in workforce skill, decline in funds, decline in organizational consensus to reforest, and a plethora of often competing objectives converging on areas that need reforestation all increase risks of reforestation failures in the near term. The likelihood of inadequate plantation maintenance is increasing with reduced funding and workforce size.

Keywords: reforestation, wood, wildlife, wildfire, vegetation management, fuel management, thinning, shrubs, databases

TABLE OF CONTENTS

	<u>Page</u>
Purpose, Conclusions, and Outlook for the Future.....	1
Introduction.....	3
Findings (Questions, Answers, Methods, and Discussion)	
Question 1.....	7
Quesiton 2.....	11
Question 3.....	13
Quesiton 4.....	14
Question 5.....	15
Quesiton 6.....	17
Question 7.....	18
Quesiton 8.....	19
Question 9.....	20
Quesiton 10.....	21
Question 11.....	22
Quesiton 12.....	22
References.....	23
Appendix A - Reforestation Success Rate Calculations	
Appendix B - Status of Reforestation after Final Harvest	
Appendix C - Older Plantation Projected Average Volume at Age 55	
Appendix D - Land Area Table	
Appendix E - Status of Plantation Inventories	
Appendix F - Wildlife Habitat Relationships Stages	
Appendix G - Current Plantation Condition Graphics	
Appendix H - Variation Among Inventory Sample Points	
Appendix I - Traditional Program Indicators	

PURPOSE

This report was commissioned by John Tappeiner for the Sierra Nevada Ecosystem Project. Its purpose is to develop information about reforestation on national forests within the study area. The National Forests included are the Modoc, Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Inyo, Sierra, and Sequoia. The following set of questions were asked and have been answered in this report:

1. How successful is the Forest Service reforestation program?
2. Is plantation tree growth sufficient to meet Forest Service wood production objectives in forest plans?
3. What is the extent of plantations on the national forests?
4. Over what period of time has plantation acreage accumulated?
5. What are the number, size, and acreage characteristics of plantations planted after fire compared to after harvest?
6. How much older plantation acreage is in each of the various forest types?
7. What kind of wildlife habitats are provided by the older plantations?
8. What is the proportion of different tree species in the older plantations?
9. How does shrub cover compare to tree cover in the older plantations, and what are the most common shrub species?
10. What are the mortality trends in the older plantations?
11. What is the average plantation structure in older plantations?
12. How variable are the older plantations?

CONCLUSIONS AND OUTLOOK FOR THE FUTURE

The knowledge, skills, organization, and desire to reforest lands that have been burned, harvested, or otherwise denuded is evidenced by the substantial inventory of plantations established since about 1960 (over 300,000 acres). The Forest Service has successfully reforested most locations where it set out to do so (80%-90% near term depending on method used to evaluate). Current declining survival rates (variety of causes), reductions in workforce size, potential reduction in workforce skill, decline in funds, decline in organizational consensus to reforest, and a plethora of often competing objectives converging on areas that need reforestation all increase risks of reforestation failures in the near term. The likelihood of inadequate plantation maintenance is increasing with reduced funding and workforce size.

The proportion of forest land affected by the reforestation program to date is small and current rates of treatment are declining as regeneration harvesting declines. The annual acreage planted will soon return to the average level experienced in the 1970s. Regeneration harvests are changing both in type and in quantity. Most of the anticipated near term reforestation will occur on burned lands that have been harvested. The eastern portions of the Plumas and Tahoe National Forests and the south end of the Stanislaus National Forest have the largest burned areas in need of reforestation.

The fire hazard effected by the current condition of plantations established in the 1960s and 1970s is a concern. Shrub removal, dead and down fuel removal, and pruning of lower tree limbs would lower the hazard. Funding available for investments in hazard reduction is not likely on a large scale. As tree crowns close and intertree competition affects more acreage, combined thinnings and reduction of shrub densities would lower the hazard. This will likely happen as trees attain a merchantable size. It will happen sooner in locations that have a market for small sized material.

The knowledge, skills, organization, and desire to monitor and report on the status of reforestation is less evident than the reforestation itself. Available maps and records contain some inaccuracies, making assessment and disclosure problematic. The techniques developed and results described in this report represent state of the art, yet accuracy remains limited. The outlook for substantial improvements in this area is neutral because improvements in availability of Geographic Information Systems (GIS) and other technology will be offset with reductions in skilled and experienced employees, available field time, and opportunities to manage more complete and accurate databases.

INTRODUCTION

The reforestation program in the Pacific Southwest Region of the Forest Service, like most forest management programs, has experienced increasing scrutiny in the 1990s. Reforestation success is a primary current issue. Although substantial investments in monitoring for tree survival, stocking, and release needs have been made on each planted stand; the need to ascertain and communicate reforestation success in a comprehensive way, addressing the entire landbase, is relatively new. Consequently, efforts to do just that are also relatively new. This report is another step toward fulfilling that need.

Reforestation practices are generally well understood and documented (Schubert, 1971. USDA-FS, 1983. Hobbs, 1992). The last major Region 5 Forest Service assessment of the program dealt with its vegetation management aspects (USDA-FS, 1988). Additional information on reforestation, or regeneration, is contained in Helms and Tappenier, 1995.

Terms and Definitions

Afforestation - The establishment of trees on an area from which they have always been absent in modern history.

Artificial reforestation - The purposeful collection of tree seed that is subsequently distributed elsewhere in the forest or that is grown into seedlings in a nursery and subsequently planted.

Basal area - The cross sectional area (expressed in square feet per acre) of tree stem measured at a point 4 1/2 feet above the ground surface; a measure of density.

Forest land - Land that is now or is naturally capable of being occupied by more than a 10% cover of trees.

Natural reforestation - The reliance on seed falling from trees that reside on or near the location where reforestation is desired.

Quadratic mean diameter - The diameter of a tree of average basal area.

Reforestation - The establishment of trees on an area from which they were present but have been removed.

Reforestation success - There is no one generally accepted definition for this term. The term generally refers to the characteristics of new tree establishment that satisfy owner objectives. These characteristics typically include measures of tree condition at points in time at levels of cost. This report will look at "success" in a variety of ways.

Stocked - As used in this report, stocked means the area of interest contains a level of stocking

that meets or exceeds objectives. In practice, objectives vary from stand to stand in response to the variety of multiple uses for which plantations are managed. This report, by necessity, simplifies criteria to facilitate analysis at the SNEP study area scale.

Stocking - As used in this report, stocking refers to the quantity of trees of desirable species and condition on an area of interest.

Reforestation History

Artificial Reforestation - Little was known about either artificial or natural reforestation in California when the Forest Service began experimenting around 1905 (Ayers, 1958). An unknown quantity of land, extensive enough to attract attention, had been burned or logged and was occupied by vegetation other than the desired trees. Experiments in artificial reforestation were conducted off and on from about 1905 to 1930, by which time enough had been learned about seeding, nursery practices, planting techniques, and subsequent care that investments in operational-scale reforestation (hundreds of acres per year) seemed justified. Seeding experiments had generally unreliable results, so further efforts focused primarily on planting. Planting on an operational scale occurred from 1930 to 1945. About 6,000 acres of plantations from this time period persist today. Overall success remained fairly low, however (Fowells, 1948). Operational problems with nursery management, control of competing vegetation, and animal damage were paramount. The seeding done during this period once again proved generally unsuccessful. Efforts continued from 1945 to 1960 in similar fashion, resulting in another 20,000 acres that persist today. Most of the earlier operational problems were overcome during this period (Buck, 1974). Large wildfires during the period also served to elevate the need to reforest. Regeneration harvesting (creates openings that need reforestation) designed for artificial reforestation began operationally in the 1960s, increased slowly in the 1970s, rapidly in the 1980s, and is now in decline. The combination of ability to reforest, the increasing acreage in openings created by harvest and wildfires, and a desire to grow more wood led to plans calling for an increase in the amount of reforested land. The rate of reforestation increased during the 1960s, decreased in the 1970s, increased again in the 1980s, and is now decreasing as regeneration harvesting declines.

Natural Reforestation and Cutting Practices - The total acreage reforested through natural seeding following harvest, wildfire, or other disturbances is unknown. Emphasis and dependence on natural reforestation varied significantly on Forest Service lands. The following discussion describes policies, cutting practices, and what we know about the results for four periods: 1905-1945, 1945-1960, 1960-1990, and 1991-present.

Tree harvests under Forest Service administration were conducted from about 1905 to 1945 in such a way to encourage natural reforestation (Buck, 1974). About 40% to 80% of the merchantable volume was cut, the most healthy individuals being left to parent the next generation; species or individuals with low market value were often left (Buck, 1974. Dunning, 1923). These harvests occurred on an undetermined amount of land but probably

covered less than 5% of the forest land in total (less than 400,000 acres). In modern silviculture terminology, these harvests were shelterwood seed cuts. Generally, slash was burned after harvests and no further action was taken. No attempt to monitor results in a systematic fashion was made. Subsequent natural establishment of tree seedlings was highly variable, extremely successful in places and extremely unsuccessful in others. No formal reforestation records were kept. These land areas are spatially-lost in history. Most likely, these areas appear in one of several current inventoried conditions. Some probably failed to reforest, have never been planted, and are now mapped as sparsely stocked forest land. Some were probably planted and are now mapped as plantations. Some were probably successful and are now mapped as well stocked natural stands. Some were probably partially successful and are now mapped as poor to medium- stocked natural stands.

From 1945 to 1960, the creation of openings with a natural reforestation objective was de-emphasized in favor of salvage of timber over large land areas that would otherwise become unmerchantable; construction of a road system was desired and financed by this type of cutting (Buck, 1974). About 15% to 30% of the merchantable volume was cut, concentrating on individuals with the poorest health or form. In modern silviculture terminology, these harvests were a combination of thinnings, sanitation, and salvage cuttings. Thousands of acres were cut during this period in this fashion; some of which had been acquired from private owners after removal of the best quality trees.

From 1960 through 1990, various combinations of thinning, salvage, and increasing amounts of even-aged regeneration harvests (clearcuts and seed cuts; mostly followed by artificial reforestation) were employed. Delineation of land areas (stands) that could be mapped, treated, and monitored became increasingly common place, especially where regeneration harvests occurred. Harvest levels reached a peak in the late 1980s. Reliance on natural reforestation declined steadily through the 1960s, reaching the stable and low level in the 1970s which persists today. Rarely relied on in planting operations today, natural seedlings commonly supplement stocking of planted seedlings.

From 1991 to date, even-aged regeneration harvests have been de-emphasized in favor of uneven-aged regeneration harvests (selection cuts or group selection cuts) and thinnings. Salvage after fire or drought induced insect mortality is increasing. Total harvest levels are declining. Natural reforestation remains a supplemental practice.

Assessing the Reforestation Program

Program Level Indicators - This report is limited by the data available at a regional office. Knowledge that would improve its accuracy exists in Ranger district offices but is impractical to access.

Traditional Regional indicators (Appendix I) used to manage the program are:

- A set of annual reports that disclose seedling survival, acreage accomplishments (planting, associated treatments), certification of success, and future reforestation needs (USDA-FS, 1956-1965. USDA-FS, 1966-1994). These reports have been analyzed in this effort. They are not spatial (they do not report on individual plantations; maps are kept in district offices) and do not link to events of prior years.
- Funding levels, both appropriated by Congress and retained from timber sale proceeds under authority of the Knudson-Vandenburg Act (KV).
- Funding requests by the Forests to the Region for the various reforestation treatments.
- Unit costs (the cost per acre to accomplish a given reforestation treatment).

Evolving present and future indicators are:

- Stand records, which have been automated and available to program managers since 1989 (USDA-FS, 6/95, SRS). Although they are not currently linked to computerized Geographic Information Systems (GIS) which are spatial, they do have spatial characteristics and events are partly linkable to events of prior years. These records are the current source for the annual reports mentioned above. The reforestation aspects of these records have been analyzed in this effort.
- Vegetation mapping and inventory for the entire SNEP Study Area, using consistent methodology and including plantations (USDA-FS, 6/95, FIA), became available in GIS for the first time in 1995; part of an increasingly sophisticated inventory program that was accelerated in response to emerging bioregional issues, primarily the California Spotted Owl. The new inventories have been analyzed in this effort.

Stand Level Indicators - Section 4 (d)(1) of the National Forest Management Act (NFMA) states "that all forested lands...shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans." It goes on to require that "All...lands treated...shall be examined after the first and third growing seasons and certified...as to stocking rate".

The Region 5 certification criteria (USDA-FS, July, 1991), applied at the stand level, are:

- A minimum number of established commercial trees per acre by forest type and site class.
- At least 50 percent stocked plots. "Stocked" means meets the minimum number criterium.
- Stocking well distributed over the area.

The minimum numbers and distribution criteria are assigned by silviculturists on a stand by stand basis, given overall forest plan and project level management direction.

FINDINGS

Question 1 - How successful is the Forest Service reforestation program?

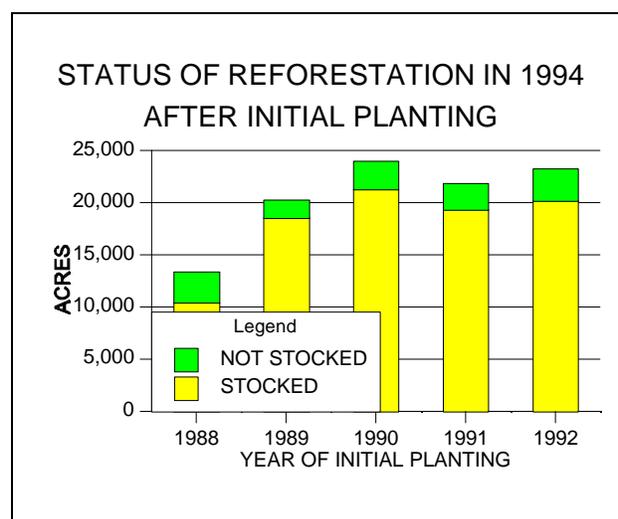
Answer: The program is about 80% to 90% successful, depending on the method used to evaluate success.

Methods and Discussion:

There is no one generally accepted professional standard for defining, measuring, or describing success of an entire reforestation program. Three methods are offered here.

Method 1

This method considers *year of planting* as a beginning point. About 90% of the acres initially planted between 1988 and 1992 were stocked at time of last survey. The success rate after harvest is about the same as it is after fire (Appendix A).



The automated Stand Record System (SRS) provided the basis for these statements (USDA-FS, 6/95, SRS). Each ranger district maintains a computer database of historical, current, and planned future events for each stand where such events are being tracked. There are 37 ranger districts, and therefore 37 databases, within the SNEP study area. The databases are physically located in Kansas City, Missouri; they are accessed remotely. The system was installed in 1989; since record keeping priorities emphasize the present over the past, it is more likely that the record of events is more complete and accurate from 1989 on than from prior years. The contents of the databases change daily at the discretion of district employees. Mylar maps indicating the location of stands are kept at the district offices; they are not available electronically.

Initial planting is defined as the first time an area is planted during reforestation. The initial planting records also contain, as an *option*, the ability to identify the disturbance that caused the need to reforest (usually fire or harvest). All plantings subsequent to the initial planting are referred to as replantings.

Stocking surveys are required by law at the end of the first and third growing seasons after

planting. The stocking survey records in SRS contain, at local *option*, the ability to store an estimate of the number of *trees per acre* found. Another *option* on those records indicates that conditions are *progressing* toward meeting objectives for quantity, distribution, and quality of desired tree species.

When objectives are ensured without further treatments, a record that "*certifies*" reforestation is stored in SRS. Those that make the decisions to certify have a conservative bias. There is a tendency to withhold certification until the likelihood of tree persistence is virtually certain. Even low risks of fire, insect damage, animal damage, or dessication from moisture competition with competing vegetation are often viewed as cause to withhold certification. As a result, compliance with the policy of making certification determinations and documenting those determinations is sporadic.

Given the above, the 37 databases were queried for places initially planted between 1988 and 1992. Queries for early years were made; records in the database from earlier years are not sufficiently present for this analysis. The years 1993 and 1994 were excluded because insufficient time has passed to conduct a third-year survey.

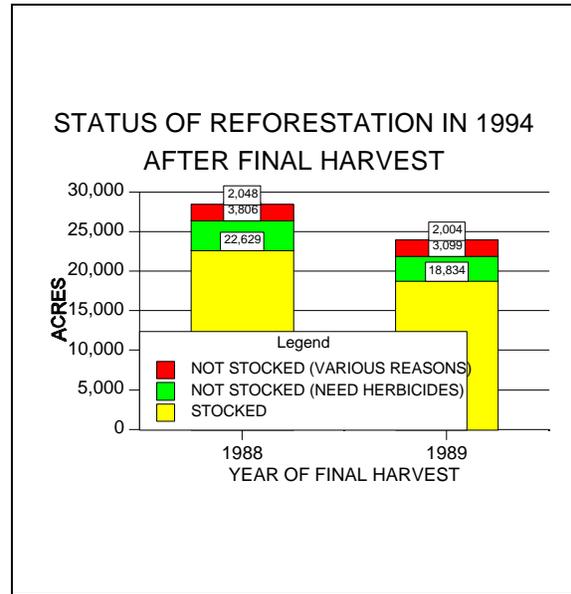
For purposes of this analysis, the term "stocked" is defined as:

1. A record of certification exists, or
2. A record of survey indicating a progression toward certification exists, or
3. The total trees per acre on the last survey date exceed 149, which is the standard used for mixed conifer type in Regional scale planning .

The result was 89,789 stocked acres out of 102,771 planted acres, indicating a success rate of 87%. Separating the areas between those where fire created the reforestation need and those where harvest created the need, did not indicate any significant difference in success. Appendix A contains supporting data tables. No effort was made to quantify why 13% of the total do not meet the "stocked" criteria. In some cases, no record of survey exists on the databases. In other cases, additional treatments are planned but have not been carried out.

Method 2

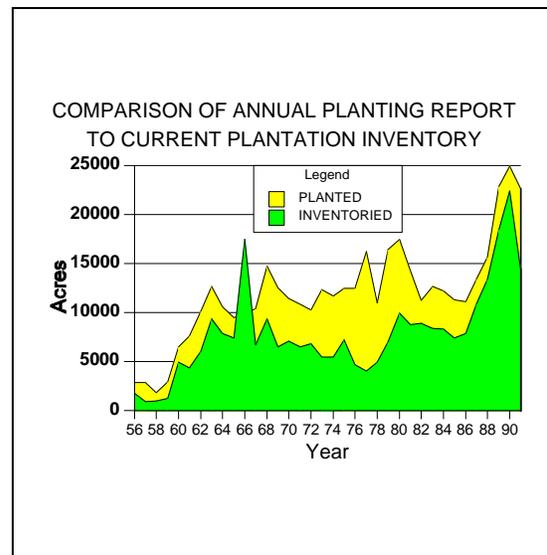
This method considers *year of harvest* as a beginning point. Seventy-nine percent of the area that received regeneration harvests (including fire salvage) in 1988 and 1989 were stocked at the end of 1994. Thirteen percent of the area had not been planted pending availability of herbicides to control competing vegetation. Several reasons account for delay on 7% of the area, which is scheduled for planting or replanting. 1% of the area is not stocked and no further attempt to reforest is anticipated due to a change in land allocation (Appendix B). *Note:* It is typical for an area to be planted one or more years after the year in which it was harvested.



These results come from recent attempts (1993-1994) by the Forest Service to standardize reporting of reforestation status after harvest. The automated stand record system has been helpful, but not completely reliable, due to missing data or acreage imbalances on the records. The general results (see Appendix B) are reliable.

Method 3

Comparing historic reports of acres planted in a particular year to current inventory of acres that originated in that same year implies a lower than intuitive success rate and indicates difficulties with available information; this comparison is unreliable as an indicator of success.



The current inventory of plantation acres is based on GIS plantation layers that have been incorporated into the Pacific Southwest Region's forest mapping program; they are available as part of comprehensive vegetation maps. These plantation layers were constructed by ranger district employees, using local records and 1991 imagery that shows openings in the forest. Most of them were constructed in late 1991, and include areas planted in that year. Each stand is labeled with a year of plantation origin corresponding to the year of planting. The accuracy of historic information with which to prepare and label these maps varies; they represent the best available information on location and age of plantations.

The annual planting reports, on file in the Regional Office, disclose acreage planted by year; however, these acres have no locations associated with them.

An adequate comparison of the mapped acres with the acres reported as reforested was impossible for the following reasons:

- Planting reports mix initial planting and replanting (sometimes done because of failure, to increase stocking; or to add new species) together and should, therefore, be reduced by the amount of replanting before making a comparison. There is no way to determine how much of the total planting is replanting for most of the period. *Note:* it is possible to make that split from 1988 forward. For the period 1988 through 1991, replanting accounted for 8% of the total.
- The year of origin on the plantation maps is not always the year of initial planting. Where site preparation had to be repeated, the year of replanting is recorded as the year of origin.
- The minimum mapping size for the plantation maps is 5 acres, but smaller reforested areas were included in the reports. There is no way to determine how much of the total planting was done on areas less than 5 acres in size for most of the period. *Note:* It is possible to make that split from automated stand records from about 1988 forward. For the period 1988 through 1991, areas less than 5 acres accounted for about 3% of the total.
- Some plantations have burned. The acreage is not known but is likely less than 3%.
- Some older plantations, having developed sufficient crown closure and crown diameter resembling natural stands, are no longer identified as plantations on the plantation maps. The extent of area in this condition is unknown, but is likely not significant.

Question 2 - Is plantation tree growth sufficient to meet Forest Service wood production objectives in forest plans?

Answer: Yes.

The 170,000 acres reforested before 1981, based on projection of current inventory, will exceed cubic foot per acre volumes used in forest plan modeling (Appendix C).

AGE (yrs)	PROJECTED VOLUME (merch. cu. ft./ac.)	FOREST PLAN VOLUME (merch. cu. ft./ac.)
55	3,600	3,400

* Forest Vegetation Simulator projection of current inventory

** RAMPREP bare-ground projection

Methods and Discussion:

Forest Plan Volume

The planned yield of 3,400 cubic feet per acre at age 55 is based on planning records on file in the Regional Office. The current forest plans in the SNEP study area were developed during the 1980s. A computer projection model named RAMPREP was used to forecast timber yields (Levitan, 1991). Estimates were made for regenerated stands on every national forest, by forest vegetation type and site class. These yield tables predict total volume per acre by decade (10 year increments). The time when trees attain an average diameter of 13 inches was estimated to be the first time that a commercial harvest could be made. That time varies with site quality, level of stocking, and species. In the SNEP study area, there is more plantation acreage in the Mixed Conifer Type than any other, and the average site quality is R-5 Site Class III. Forest plan modeling assumed Site Class III areas would attain an average diameter of 13 inches at age 55. In the planning process, yield tables functioned as input to an optimizing routine called FORPLAN, which schedules harvests of different types on different land areas subject to different constraints. The time scheduled by FORPLAN for harvest in regenerated stands varies from forest to forest. Not all forest plans schedule harvest (thinnings) in plantations at age 55. For purposes of this comparison, that complexity is ignored; if yields can meet RAMPREP, they will also meet any delayed entry scheduled by FORPLAN. Most of the RAMPREP regenerated yield tables are on file in the Regional Office; values from them are:

RAMPREP VOLUME AT AGE 55 FOR SITE CLASS III MIXED CONIFER	
FOREST	NET CUBIC FOOT YIELD PER ACRE
MODOC	2,880
LASSEN	3,310
PLUMAS	2,930
TAHOE	2,910
ELDORADO	3,340
STANISLAUS	3,490
SEQUOIA	4,250
SIMPLE AVERAGE	3,372

Note: The yields projected in forest planning serve as a checkpoint to test whether a given even-aged stand is meeting land management planning timber growth criteria. Whether there would be a commercial thinning in a particular stand at age 55, or any other age, is determined by a site-specific silvicultural prescription, not by the plan.

Projected Volume

The projected yield of 3,600 cubic feet per acre is based on the current inventory of actual performance to date (average age 23), projected to age 55. Region 5 Forest Inventory data were used (USDA-FS, June, 1995, FIA). Those are the most consistent, comprehensive inventory data available. A summary of the inventory is provided in Appendix E.

There are 85 mapped plantation strata within the SNEP study area. Strata delineations are based on national forest, forest type, and plantation year of origin year when the trees were planted).

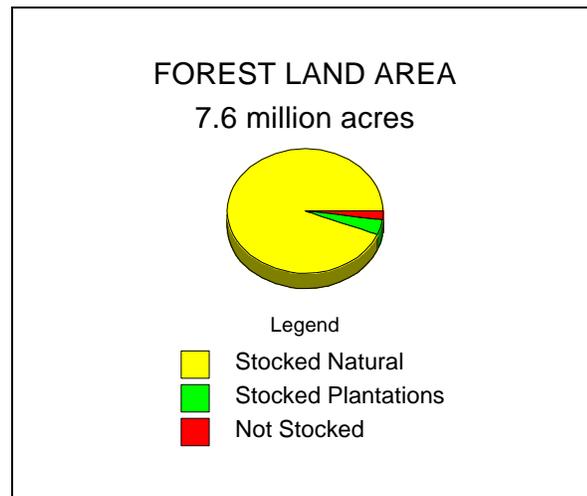
With some exceptions, plantations whose year of origin is 1981 or later were considered one age class. The 25 strata in this age class have *not* been inventoried; investment in an inventory was not deemed prudent because conditions in young plantations can change more rapidly than in older ones and because reforestation work (stocking surveys, release treatments, animal damage control, precommercial thinnings) is ongoing.

With some exceptions, plantations whose year of origin is 1980 or sooner were mapped in one of three age classes (1971-1980, 1961-1970, before 1961). The 60 strata in these age classes, occupying about 170,000 acres, *have* been inventoried. Inventory data from each of these 60 strata were projected into the future using the Forest Vegetation Simulator (FVS, formerly PROGNOSIS). FVS is a commonly used individual tree, distance-independent growth model (Wykoff, 1982). The SORNEC variant of the model was used to project plantations on the Modoc and Lassen National Forests. The WESSIN variant was used for all others. Summary statistics for the 60 strata were averaged together weighted by the acreage in each stratum. Appendix C displays the average statistics table from the projections.

Question 3 - *What is the extent of plantations on the national forests?*

Answer: Through 1991, about 300,000 acres (4% of the forest land) were plantation. About 80,000 additional acres have been planted since then.

There are about 7.6 million acres of forest land (land that is now or is naturally capable of being occupied by trees) in the study area (Appendix D). Through 1991, about 4% of the forest land is occupied by trees that were planted. About 2% of the forest land is not stocked (either unplanted, or failed and need replanting), most of which burned in large fires on the Stanislaus and Plumas National Forests in 1987.



Methods and Discussion:

These land area statistics were calculated by the SNEP GIS lab using Region 5 Forest Service Forest Inventory GIS Vegetation Layers. A combination of remote sensing, photogrammetry, and field data collection techniques was employed to produce the maps (USDA-FS, June, 1995, FIA). Each national forest was mapped separately. The smallest unit of mapping is a polygon. Within a national forest, polygons of similar forest type, tree size, and tree density are grouped into a stratum, an area to be field sampled and described as a statistical population. Many strata are defined on each forest (USDA-FS, 1994).

The source for the plantation portion of the maps is ranger district records. The source imagery upon which plantation boundaries were drawn dates to 1991 (either ortho photos, color infrared photos, or spot 10 meter imagery). Instructions were to draw boundaries only for plantations where openings are visible on the 1991 imagery. Openings created after 1991 are not included. Plantation map coverage is complete through 1991 and incomplete from 1992 on. District employees transferred plantation boundaries onto mylar registered to 7 1/2 minute USGS quadrangles for geographic referencing in GIS (letter of instruction dated 9/9/91). These plantation updates were done in different years (see Appendix E) but 1991 imagery was used by all. Each plantation has been labeled with the major forest type within which it occurs, and with its year of origin (the year it was initially planted or the replant year if poor survival necessitated another site preparation). All acreage with origin prior to 1992 is accounted for because the imagery upon which plantation boundaries were drawn dates to 1991. The acreage accounting for origin after 1991 is a partial accounting. Only plantations where openings were created prior to 1992 with subsequent planting occurring before year of update are included. The plantation

information supercedes the remotely sensed description that it overlaps.

Stocked plantations are assigned to strata based on the forest type in which they occur and the age of the plantation. Some areas that received shelterwood seed cuts (seed trees remain) and some areas that received overstory removals (removal of the largest size class in natural stands that are stocked with trees of a younger age class) were included as stocked plantations in these maps, but the acreage in these categories is insignificant and has not been included in acreage statistics. Future mapping will not label these areas as plantations unless they have been planted.

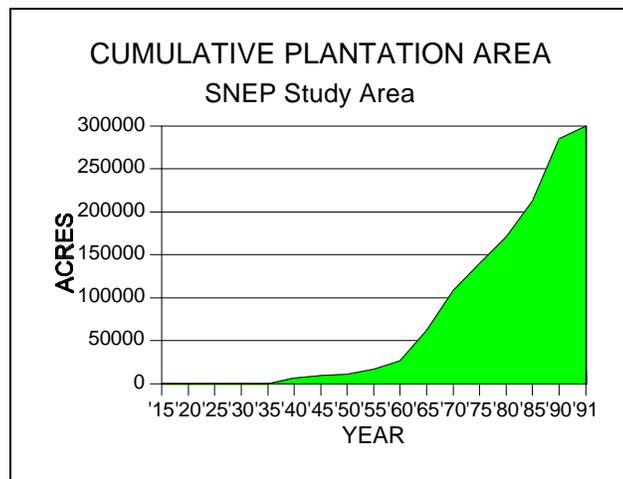
The not-stocked category applies to land areas that have been harvested but not yet planted (site preparation pending), areas where plantings to date have failed and additional work is needed, and areas that have burned but are not yet planted.

Identification of all remaining forestland (natural origin) is done by remote sensing.

Question 4 - Over what period of time has plantation acreage accumulated?

Answer: 1935 to present.

Through 1991, the most recent year for which regional level plantation maps are available, plantations cover about 300,000 acres; about 170,000 acres were planted prior to 1981 (forest inventory available, Appendix E); about 130,000 acres were planted from 1982 through 1991 (forest inventory not conducted, 1st and 3rd year survival exams provide stand level inventory). An estimated 80,000 additional acres have been planted since 1991.

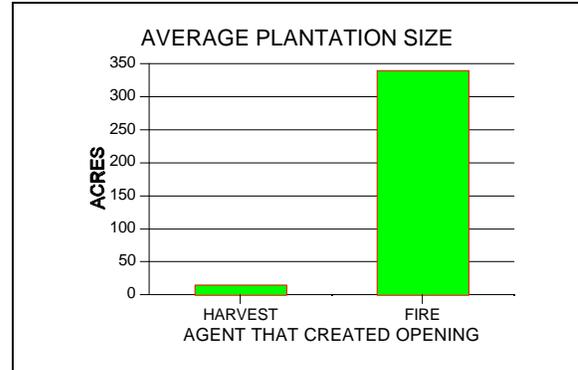
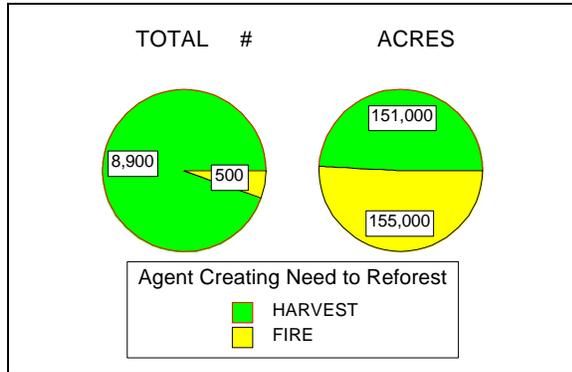


Methods and Discussion:

These figures were calculated in GIS from the vegetation layers. Appendix E discloses acreage by forest, forest type, and stratum designation. The reason for separating acreage planted prior to 1981 is that a forest inventory using consistent inventory design has been done on those areas; a comparative inventory has not been done on the younger plantations, those planted after 1980 (various local inventories and stocking surveys exist for the younger plantations, they are located in district offices, sample designs vary, and area coverage is incomplete; for these reasons, they have not been used in this assessment). The estimate of additional acreage planted since 1991 is not map based, it comes from annual reports for the period.

Question 5 - What are the number, size, and acreage characteristics of plantations planted after fire compared to after harvest?

Answer: The number of plantations following harvests greatly exceeds the number following fires. Half the acres in plantations were created following harvests, the other half following fire. Plantations following harvest average about 15 acres in size. Plantations following fire average about 340 acres in size.



Methods and Discussion:

The method used to make these estimates utilized two GIS layers: the vegetation layer discussed earlier and a layer that contains the outer perimeter boundary of all wildfires (over 500 acres) that have occurred from about 1920 to present. The fire boundary layer was created recently from historic maps, primarily fire history atlases kept on ranger districts; boundaries are approximate. The accuracy of acreage estimates in this analysis is limited by that approximation.

First, using just the vegetation layer, the interior boundaries of all adjacent plantation polygons were eliminated, creating single plantation polygons surrounded by non-plantation polygons.

Second, using only the vegetation layer and a size criterion of 40 acres, a calculation was made of number of polygons, acreage, and average size for all plantations less than 41 acres and for all plantations over 40 acres.

Third, using only the vegetation layer and a size criterion of 80 acres, a calculation was made of number of polygons, acreage, and average size for all plantations less than 81 acres and for all plantations over 80 acres.

Fourth, the fire history and vegetation layers were compared and the total plantation acreage within the fire boundaries and outside the fire boundaries was calculated.

These calculations yielded the following:

	ASSUMED CAUSED BY HARVEST			ASSUMED CAUSED BY FIRE		
METHOD	TOTAL NUMBER	TOTAL ACRES	AVG. SIZE	TOTAL NUMBER	TOTAL ACRES	AVG. SIZE
Fire Layer Compared to Vegetation Layer		151,000 acres outside fire history boundaries			155,000 acres inside fire history boundaries	
40 Acre Criterion	8,245 polygons less than 41 ac.	105,000 acres less than 41 ac.	13 acres	1109 polygons more than 40 ac.	201,000 acres more than 40 ac.	181 acres
80 Acre Criterion	8,870 polygons less than 81 acres	139,000 acres less than 81 ac.	16 acres	484 polygons more than 80 acres	166,000 acres more than 81 ac.	344 acres

In terms of total area in plantation caused by fire, the values determined by comparing the fire and vegetation layers seem more reliable. This method assumes that all plantations inside a fire boundary are the result of a fire and that all plantations outside those boundaries are the result of a harvest. Neither assumption is completely accurate. The 40-acre criterion method assumes that all plantations less than 41 acres are the result of harvest. Knowing that clearcuts in the Sierras did not begin to any great extent until the late 1960s, and knowing that they were restricted to a 40-acre maximum by policy (later written into regulation), this assumption is attractive. However, the practice only applied to events within a single timber sale; subsequent cuts adjacent to previous ones have resulted in plantations over 40 acres.

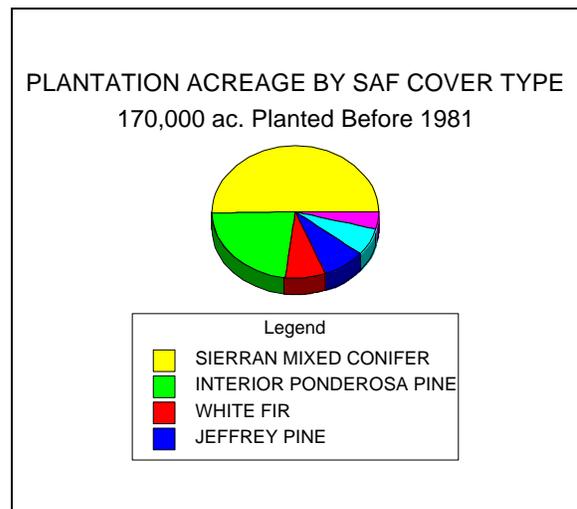
Because the 80-acre criterion yielded a total area split more closely comparing to the vegetation/fire layer comparison method, it is used as an estimate of the split in number of plantations and average plantation size. Notice that average size caused by harvest is relatively insensitive to the method used while the average size caused by fire is relatively sensitive.

Question 6 - How much older plantation acreage is in each of the various forest types?

Note: Plantations planted before 1981 (hereafter called "older plantations") have been inventoried using a consistent methodology (Appendix E; USDA-FS, 6/95, FIA). The remainder of these findings apply to these lands only (about 170,000 acres). Because these plantations were over 10 years old at time of inventory, the following information portrays the kind of conditions that exist after reforestation treatments are completed and stands begin to develop forest structure. Many of these areas have been precommercially thinned (no resulting wood product). Most of them have *not* been commercially thinned, but many may be in the next 10 to 20 years. The lack of consistent, comprehensive inventory for plantations planted after 1980 is a limitation of this report. It cannot be assumed that they will attain conditions similar to the following.

Answer:

Plantations occur in SAF forest cover types (Eyre, 1980) Sierra Nevada mixed conifer (85,000 acres), Interior ponderosa pine (38,000), white fir (14,000), Jeffrey pine (14,000), Pacific ponderosa pine (11,000), and red fir (7,000). See Appendix E.



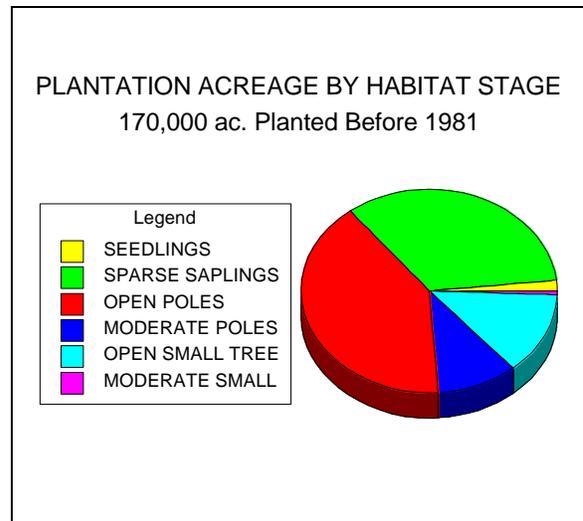
Methods and Discussion:

These calculations were made in GIS using the vegetation layer. Appendix E discloses the forests and strata that comprise them. Since roughly half the acreage is in the Mixed Conifer Type, average statistics for the entire study area are strongly influenced by conditions in the mixed conifer plantations.

Question 7 - *What kind of wildlife habitats are provided by the older plantations?*

Answer:

The habitats provided in 1991 by these plantations were primarily sparse closure sapling size and open closure pole size habitats (Mayer, 1988).



Methods and Discussion:

The inventory data for each stratum were analyzed with the Forest Vegetation Simulator using decision rules developed for the California Spotted Owl EIS (USDA-FS, January, 1995) to assign a Wildlife Habitat Relationships Stage (Mayer, 1988). For the most part, plantations are currently providing habitat for those species that prefer sparse closure sapling size and open closure pole size tree conditions. The range in habitats provided tends to increase as plantations age. Notice the variation in habitat ratings between the three ages in the mixed conifer type (Appendix F).

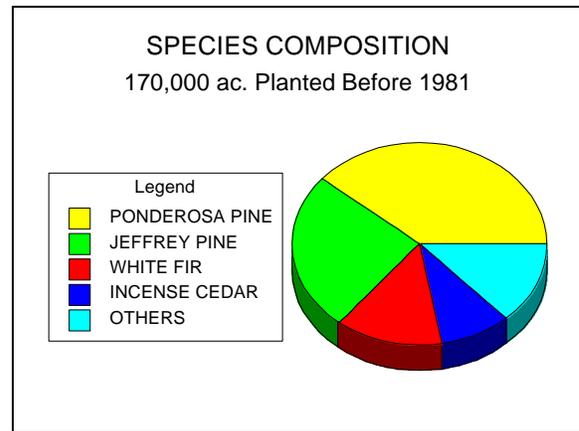
Question 8 - What is the proportion of different tree species in the older plantations?

Answer:

About 65% of all trees are either ponderosa pine or Jeffrey pine. White fir and incense-cedar are seeding in naturally underneath the planted pines in some cover types (Appendix G).

Note: About 2% of all trees are sugar pine, a species of special interest because blister rust is a threat.

Note: About 2% of all trees are hardwoods, all of natural origin, primarily California black oak.



Methods and Discussion:

Tree per acre statistics were calculated for each stratum using either Region 5 Forest Inventory software (USDA-FS, June, 1995) or the Forest Vegetation Simulator (Wykoff, 1982). Strata statistics were averaged proportional to acreage, first by major forest type, then for the entire SNEP study area.

Pines (Ponderosa and Jeffrey) have been favored in the Mixed Conifer Type because it is more economical to use them (they are easier to grow in nurseries and survive better in the field), because they have historically had a higher timber value, and because there was a desire to offset the shift in species composition away from fir that is dominating in many natural stands.

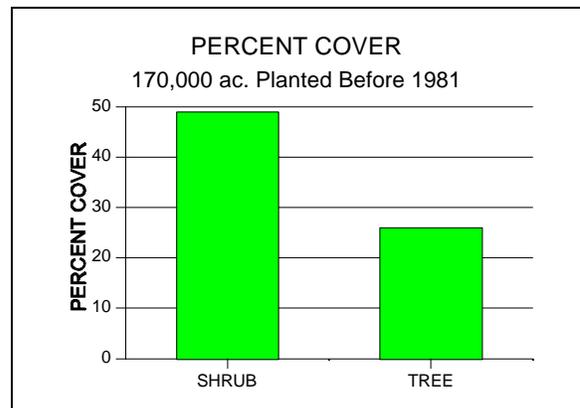
The magnitude of incense-cedar and white fir natural regeneration that has occurred after planting is adequate enough to be evident in entire study area averages, showing up most notably in the seedling and sapling size classes (Appendix G).

Species of particular interest such as sugar pine and most hardwoods are present in small numbers; sugar pine probably at significantly lower than historic levels because of blister rust disease, early emphasis on cutting sugar pine for high market values, and difficulties with producing large quantities of reliable high quality nursery stock.

Question 9 - How does shrub cover compare to tree cover in the older plantations, and what are the most common shrub species?

Answer:

Average shrub cover is twice as great as tree cover (average tree age is 23 years). Greenleaf manzanita and mountain whitethorn are the most common shrub species (Appendix G).



Methods and Discussion:

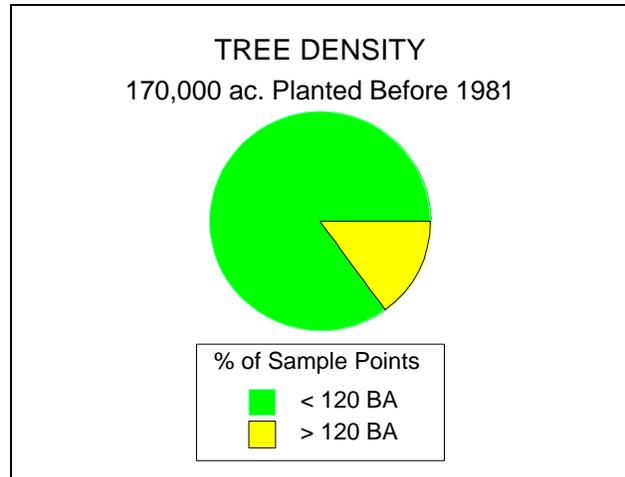
Individual sample points were installed in the field during forest inventory to sample conditions within a stratum. Cover estimates shown in Appendix G were obtained for each stratum from inventory software (FIA) outputs, then acre-weighted averages were developed by forest type, then overall.

Overall shrub cover of about 50% is about twice that of the trees. Most of these plantations began with very little shrub cover. Most of them received some type of release treatment intended to temporarily reduce competition between shrubs and trees, thus insuring establishment of trees. The resilient nature of many shrub species is evident. Their presence now, as these plantations grow through poletimber sizes, is of greatest concern from a fire hazard standpoint. The hazard will not decline until the stands get older.

Question 10 - What are the mortality trends in the older plantations?

Answer:

Tree mortality risk from inter-tree competition is low (about 85% of the 3,091 sample points had less than 120 square feet of basal area at time of inventory, see Appendix H). This risk will increase significantly as density increases over the next 10 to 20 years unless thinnings are done. The combined effect of shrub and tree competition increases overall tree mortality risk, especially on low quality sites.



Methods and Discussion:

Individual sample points were installed in the field during forest inventory to sample conditions within a stratum. New programming was done to obtain point-level statistics shown in Appendix H.

Inter-tree competition is low in most areas as evidenced by several measures of density (basal area, number of trees, cover; see Appendix H) The breakpoint of 120 ft² was chosen as an indicator based on general observations of when pines experience bark beetle caused mortality. As crowns close and intertree competition increases, commercial thinnings will be possible if markets are favorable for small diameter material. The thinnings will lower density related mortality risk.

Question 11 - *What is the average plantation structure in older plantations?*

Answer: The average plantation structure (in 1991) was 23 years old, 277 trees per acre, 47 square feet of basal area per acre, tree height of 20 feet (1"+ dbh trees only), and a quadratic mean diameter (all trees) of 5.4 inches at breast height. See the first graph in Appendix G.

Methods and Discussion:

Individual sample points were installed in the field during forest inventory to sample conditions within a strata. Statistics shown in Appendix G were obtained for each stratum from inventory software (FIA or FVS) outputs, then acre-weighted averages were developed by forest type, then overall. Note in the Appendix G graphic for the entire study area that the diameter class 5 to 10.9 inches is the one that characterizes the whole. It has the most density in basal area terms and is accumulating the most volume. Trees in that class will average about 10 inches in diameter by the year 2000. Also note in the Appendix C projection that the growth rate (for the period 1996 through 2005) is estimated at about 90 cubic feet per acre per year and rising.

Question 12 - *How variable are the older plantations?*

Answer: It depends on the statistic of interest and the scale of consideration.

Methods and Discussion: Consider variation in 3 ways:

Variation among forest types - There are differences in average age (18 to 26 years old), productivity (R-5 Site Class 2 to 4), species composition (4 to 7 tree species per stratum), and structure (180 to 430 tpa, 24 to 58 basal area per acre, 14 to 23 feet tree height, 3.1 to 5.7 qmd) among forest types.

The following table was developed from Appendices G and H:

Type	# of Sample Points	Age (yr)	Site (R-5 Site Class)	Tree Species per Stratum	Trees per Acre	Basal Area (ft ² /ac)	Height of trees > 1" dbh (feet)	QMD of all trees (in)
Pacific Ponderosa Pine	244	24	3	5	339	56	23	5.4
Sierra Mixed Conifer	877	23	3/2	7	314	58	21	5.5
White Fir	567	26	3	7	243	47	21	5.7
Red Fir	472	18	3	5	431	26	14	3.1
Interior Ponderosa Pine	484	23	4	4	190	32	19	5.5
Jeffrey Pine	447	21	4	4	182	24	17	4.9
Entire Study Area	3091	23	3	6	277	47	20	5.4
Range across all sample points	n/a	n/a	n/a	0-7	0-700	0-140+	0-175	0-30+

Variation within a stratum - There is variation among cluster plots within an individual stratum. The Appendix G visualization is intended as an example of this variation. Notice the variation in cover in particular (upper right-hand perspective in the graphs). The visualization graphs were prepared from inventory data using software called *Stand Visualization System* and the *Forest Vegetation Simulator*. Species composition, density, and height are drawn to scale. The distribution of stems is random, assigned by the software.

Variation among sample points - There are 3,091 sample points of data providing the basis for characterization of older plantations. The range of variation among these sample points is displayed in Appendix H for several sample statistics. The variation among sample points is much larger than the variation in averages among forest types.

REFERENCES

Ayers. 1958. History of Timber Management in the California National Forests 1850 to 1937. Unpublished file report. USDA-FS, Washington, DC.

Buck. 1974. History of Division of Timber Management, U.S. Forest Service, Region 5, California. Unpublished file report. USDA Forest Service, San Francisco, CA.

Dunning, D. 1923. Some Results of Cutting in the Sierra Forests of California. USDA Department Bulletin No. 1176. Washington, D.C.

Eyre, F.H., editor. 1980. Forest cover Types of the United States and Canada. Society of American Foresters, Washington, D.C.

Fowells, H.A. and Duncan Dunning. 1948. A Survey of National Forest Planting in California Since 1930, third draft. Unpublished file report. USDA Forest Service, San Francisco, CA.

Helms, J.A. and Tappener, J.C. 1995. Silvicultural Systems for the Sierra Nevada. in: SNEP Volume II. Davis, CA.

Hobbs, S.D., et. al. (editors). 1992. Reforestation Practices in Southwestern Oregon and Northern California. Forest Research Laboratory, Oregon State University, Corvallis, OR.

Levitan, Jack S.. 1991. The RAMPREP Timber Growth and Yield Model. Unpublished file report. USDA Forest Service, San Francisco, CA.

Mayer, K.E., and Laudenslayer, W.F., Jr. (editors). October, 1988. A Guide to Wildlife Habitats of California, California Department of Forestry and Fire Protection, Sacramento, CA.

Schubert, G.H., and Adams, R.S. 1971. Reforestation Practices for Conifers in California. State of California, Division of Forestry, Sacramento, CA.

USDA-Forest Service, December, 1983. Silviculture Systems for the Major Forest Types of the United States. Agriculture Handbook No. 445. Washington, D.C.

USDA-Forest Service, Region 5. 1956-1965. Annual Planting and Stand Improvement Report. Unpublished file report. USDA Forest Service, San Francisco, CA.

_____. 1966-1994. Annual Reforestation and Timber Stand Improvement Report. Unpublished file report. USDA Forest Service, San Francisco, CA.

_____. December, 1988. Final Environmental Impact Statement, Vegetation Management for Reforestation. San Francisco, CA.

_____. July, 1991. Reforestation Handbook. R-5 FSH 2409.26b. San Francisco, CA.

_____. December, 1994. Forestland and Resource Data Base, GIS and ORACLE Data Dictionary. Unpublished. On file at USDA Forest Service, Remote Sensing Lab, Sacramento, CA.

_____. June, 1995. R5 Stand Record System User's Guide. Unpublished file report. USDA Forest Service, San Francisco, CA.

_____. June, 1995. Forest Inventory and Analysis User's Guide. Unpublished file report. USDA Forest Service, Remote Sensing Lab, Sacramento, CA.

_____. January, 1995. Draft Environmental Impact Statement for Managing California Spotted Owl habitat in the Sierra Nevada, an Ecosystem Approach. San Francisco, CA.

Wykoff, Crookston, and Stage. 1982. User's Guide to the Stand Prognosis Model. USDA-FS Intermountain Forest and Range Experiment Station. General Technical Report INT-133. Ogden, UT.

APPENDIX A

Success Rate Calculations

Success Rate Calculations

source: Stand Record System

TABLE 1 OF 4											
CRITERIA FOR "ACRES STCKD".....CERTIFIED OR PROGRESSING TOWARD CERTIFIED OR <u>>=150 TPA</u>											
		1988		1989		1990		1991		1992	
Forest	District	ACRES PLNTD	ACRES STCKD	ACRES PLTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD
MOD	53	0	0	161	161	0	0	62	62	84	84
	54	201	201	759	728	865	848	718	698	724	678
	55	423	214	124	108	38	38	282	282	566	566
	56	0	0	98	13	352	352	278	278	236	136
Subtotal		624	415	1142	1010	1255	1238	1340	1320	1610	1464
Percent Success		67		88		99		99		91	
Overall Rate		91									
LAS	51	138	67	1636	1507	973	899	930	850	1209	1098
	53	505	3	1165	947	2592	1731	1971	1238	2095	1373
	58	599	80	274	274	993	430	653	639	444	441
Subtotal		1242	150	3075	2728	4558	3060	3554	2727	3748	2912
Percent Success		12		89		67		77		78	
Overall Rate		72									
PLU	51	403	389	340	340	591	581	656	640	1022	1019
	52	0	0	3	3	626	567	570	486	415	364
	53	207	207	755	673	670	662	589	584	398	391
	54	48	48	92	67	139	132	335	309	247	238
	55	577	371	513	513	1915	1915	1604	1604	1573	1476
	56	274	267	395	383	301	259	472	442	579	487
Subtotal		1509	1282	2098	1979	4242	4116	4226	4065	4234	3975
Percent Success		85		94		97		96		94	
Overall Rate		95									
TAH	53	1122	1106	1586	1533	1549	1529	1160	1160	513	507
	54	596	592	499	499	911	911	730	730	778	769

	55	351	351	837	819	1003	981	490	487	909	828
	56	652	16	624	394	349	349	266	228	84	84
	57	329	329	287	225	282	281	276	276	292	53
Subtotal		3050	2394	3833	3470	4094	4051	2922	2881	2576	2241
Percent Success		78		91		99		99		87	
Overall Rate		91									
ELD	51	316	303	591	566	631	620	376	360	103	69
	53	631	620	840	799	690	689	293	244	282	280
	55	639	639	343	342	304	302	365	363	257	257
	56	1212	1212	1897	1869	1484	1484	546	514	370	344
Subtotal		2798	2774	3671	3576	3109	3095	1580	1481	1012	950
Percent Success		99		97		100		94		94	
Overall Rate		98									
STA	51	114	72	1008	960	76	66	1837	1343	1532	1249
	52	38	38	311	311	591	575	487	475	376	373
	53	385	318	318	265	175	142	301	275	0	0
	54	588	464	1024	850	764	683	876	636	797	771
Subtotal		1125	892	2661	2386	1606	1466	3501	2729	2705	2393
Percent Success		79		90		91		78		88	
Overall Rate		85									
INY	51	29	29	0	0	228	228	475	475	129	88
	52	97	97	251	251	258	185	0	0	204	162
Subtotal		126	126	251	251	486	413	475	475	333	250
Percent Success		100		100		85		100		75	
Overall Rate		91									
SIE	51	448	429	416	416	367	294	519	466	582	554
	53	470	383	757	669	1120	988	1020	887	961	918
	54	361	131	362	336	426	426	528	495	517	447
	55	312	305	496	492	531	529	448	427	557	508
Subtotal		1591	1248	2031	1913	2444	2237	2515	2275	2617	2427
Percent Success		78		94		92		90		93	
Overall Rate		90									

SEQ	51	306	206	454	356	865	478	561	461	684	571
	52	86	86	8	8	224	153	66	66	342	209
	53	593	551	299	229	210	197	241	212	1747	1735
	54	53	48	261	169	251	251	269	217	750	698
	56	267	239	478	469	652	545	613	424	922	376
Subtotal		1305	1130	1500	1231	2202	1624	1750	1380	4445	3589
Percent Success		87		82		74		79		81	
Overall Rate		80									
Bioregion Total		13370	10411	20262	18544	23996	21300	21863	19333	23280	20201
Percent Success		78		92		89		88		87	
Total Acres Planted			102771			Total Acres Stocked			89789		
Overall Rate 1988-1992		87									
Overall Rate 1989-1992		89									

TABLE 2 OF 4

CRITERIA FOR "ACRES STCKD".....CERTIFIED OR PROGRESSING TOWARD CERTIFIED OR \geq 75 TPA

		1988		1989		1990		1991		1992	
		ACRES PLNTD	ACRES STCKD	ACRES PLTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD
MOD	53	0	0	161	161	0	0	62	62	84	84
	54	201	201	759	728	865	848	718	698	724	678
	55	423	326	124	108	38	38	282	282	566	566
	56	0	0	98	13	352	352	278	278	236	136
Subtotal		624	527	1142	1010	1255	1238	1340	1320	1610	1464
Percent Success		84		88		99		99		91	
Overall Rate		93									
LAS	51	138	67	1636	1507	973	899	930	850	1209	1098
	53	505	3	1165	947	2592	1744	1971	1243	2095	1373
	58	599	80	274	274	993	430	653	639	444	441
Subtotal		1242	150	3075	2728	4558	3073	3554	2732	3748	2912
Percent Success		12		89		67		77		78	
Overall Rate		72									
PLU	51	403	389	340	340	591	581	656	640	1022	1019
	52	0	0	3	3	626	567	570	486	415	364
	53	207	207	755	673	670	662	589	584	398	391
	54	48	48	92	67	139	132	335	309	247	238
	55	577	371	513	513	1915	1915	1604	1604	1573	1476
	56	274	267	395	383	301	259	472	442	579	487
Subtotal		1509	1282	2098	1979	4242	4116	4226	4065	4234	3975
Percent Success		85		94		97		96		94	
Overall Rate		95									
TAH	53	1122	1109	1586	1538	1549	1529	1160	1160	513	507
	54	596	592	499	499	911	911	730	730	778	769
	55	351	351	837	819	1003	992	490	487	909	828
	56	652	16	624	518	349	349	266	228	84	84

	57	329	329	287	225	282	281	276	276	292	53
Subtotal		3050	2397	3833	3599	4094	4062	2922	2881	2576	2241
Percent Success		79		94		99		99		87	
Overall Rate		92									
ELD	51	316	303	591	566	631	620	376	360	103	69
	53	631	620	840	799	690	689	293	244	282	280
	55	639	639	343	342	304	302	365	363	257	257
	56	1212	1212	1897	1887	1484	1484	546	514	370	344
Subtotal		2798	2774	3671	3594	3109	3095	1580	1481	1012	950
Percent Success		99		98		100		94		94	
Overall Rate		98									
STA	51	114	72	1008	960	76	66	1837	1373	1532	1376
	52	38	38	311	311	591	575	487	475	376	373
	53	385	318	318	265	175	142	301	301	0	0
	54	587	465	1024	850	764	683	875	635	797	771
Subtotal		1124	893	2661	2386	1606	1466	3500	2784	2705	2520
Percent Success		79		90		91		80		93	
Overall Rate		87									
INY	51	29	29	0	0	228	228	475	475	129	88
	52	97	97	251	251	258	185	0	0	204	162
Subtotal		126	126	251	251	486	413	475	475	333	250
Percent Success		100		100		85		100		75	
Overall Rate		91									
SIE	51	448	443	416	416	367	317	519	478	582	582
	53	470	383	757	669	1120	988	1020	899	961	918
	54	361	137	362	336	426	426	528	495	517	447
	55	312	305	496	492	531	529	448	448	557	508
Subtotal		1591	1268	2031	1913	2444	2260	2515	2320	2617	2455
Percent Success		80		94		92		92		94	
Overall Rate		91									
SEQ	51	306	217	454	361	865	491	561	461	684	571

	52	86	86	8	8	224	153	66	66	342	288
	53	593	551	299	233	210	205	241	222	1747	1743
	54	53	48	261	172	251	251	269	217	750	698
	56	267	239	478	469	652	545	613	424	922	376
Subtotal		1305	1141	1500	1243	2202	1645	1750	1390	4445	3676
Percent Success		87		83		75		79		83	
Overall Rate		81									
Bioregion Total		13369	10558	20262	18703	23996	21368	21862	19448	23280	20443
Percent Success		79		92		89		89		88	
Total Acres Planted			102769			Total Acres Stocked			90520		
Overall Rate 1988-1992		88									
Overall Rate 1989-1992		89									

TABLE 3 OF 4 (**PLANTED AFTER WILDFIRE**)

CRITERIA FOR "ACRES STCKD".....CERTIFIED OR PROGRESSING TOWARD CERTIFIED OR >= <u>150 TPA</u>											
		1988		1989		1990		1991		1992	
		ACRES PLNTD	ACRES STCKD	ACRES PLTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD
MOD	53	0	0	0	0	0	0	0	0	0	0
	54	117	117	56	56	0	0	308	308	317	317
	55	0	0	0	0	0	0	0	0	0	0
	56	0	0	0	0	0	0	0	0	0	0
Subtotal		117	117	56	56	0	0	308	308	317	317
Percent Success		100		100		??		100		100	
Overall Rate		100									
LAS	51	0	0	0	0	0	0	0	0	0	0
	53	209	0	354	314	33	33	344	344	949	308
	58	0	0	0	0	0	0	7	0	0	0
Subtotal		209	0	354	314	33	33	351	344	949	308
Percent Success		0		89		100		98		32	
Overall Rate		53									
PLU	51	120	120	26	26	3	3	41	25	668	665
	52	0	0	0	0	0	0	12	12	203	203
	53	0	0	0	0	0	0	0	0	0	0
	54	0	0	0	0	0	0	0	0	12	12
	55	464	258	422	422	249	249	1365	1365	1434	1337
	56	0	0	0	0	0	0	0	0	12	12
Subtotal		584	378	448	448	252	252	1418	1402	2329	2229
Percent Success		65		100		100		99		96	
Overall Rate		94									
TAH	53	515	515	884	879	845	827	584	584	200	199
	54	47	47	0	0	0	0	0	0	0	0
	55	0	0	0	0	2	0	0	0	0	0

	56	0	0	20	20	0	0	8	8	0	0
	57	0	0	0	0	48	48	37	37	100	25
Subtotal		562	562	904	899	895	875	629	629	300	224
Percent Success		100		99		98		100		75	
Overall Rate		97									
ELD	51	0	0	0	0	0	0	0	0	0	0
	53	0	0	0	0	2	2	0	0	0	0
	55	37	37	0	0	0	0	0	0	0	0
	56	0	0	0	0	0	0	0	0	0	0
Subtotal		37	37	0	0	2	2	0	0	0	0
Percent Success		100		??		100		??		??	
Overall Rate		100									
STA	51	26	26	837	789	0	0	1334	979	1174	905
	52	0	0	0	0	30	30	0	0	0	0
	53	0	0	0	0	0	0	0	0	0	0
	54	257	148	485	361	764	683	872	632	754	747
Subtotal		283	174	1322	1150	794	713	2206	1611	1928	1652
Percent Success		61		87		90		73		86	
Overall Rate		81									
INY	51	0	0	0	0	0	0	0	0	0	0
	52	56	56	258	185	0	0	0	0	0	0
Subtotal		56	56	258	185	0	0	0	0	0	0
Percent Success		100		72		??		??		??	
Overall Rate		77									
SIE	51	0	0	0	0	0	0	40	0	13	13
	53	0	0	0	0	5	4	35	32	74	42
	54	0	0	0	0	0	0	0	0	0	0
	55	0	0	0	0	0	0	0	0	0	0
Subtotal		0	0	0	0	5	4	75	32	87	55
Percent Success		??		??		80		43		63	
Overall Rate		54									
SEQ	51	33	33	5	0	15	0	144	125	15	15

	52	0	0	0	0	0	0	0	0	0	0
	53	12	12	4	0	0	0	176	163	1637	1637
	54	0	0	0	0	0	0	0	0	0	0
	56	65	65	98	98	409	409	0	0	13	10
Subtotal		110	110	107	98	424	409	320	288	1665	1662
Percent Success		100		92		96		90		100	
Overall Rate		98									
Bioregion Total		1958	1434	3449	3150	2405	2288	5307	4614	7575	6447
Percent Success		73		91		95		87		85	
Total Acres Planted			20694			Total Acres Stocked			17933		
Overall Rate 1988-1992		87									
Overall Rate 1989-1992		88									

TABLE 4 OF 4 (***PLANTED AFTER HARVEST***)

CRITERIA FOR "ACRES STCKD".....CERTIFIED OR PROGRESSING TOWARD CERTIFIED OR >= <u>150 TPA</u>											
		1988		1989		1990		1991		1992	
		ACRES PLNTD	ACRES STCKD	ACRES PLTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD	ACRES PLNTD	ACRES STCKD
MOD	53	0	0	93	93	0	0	62	62	77	77
	54	10	10	116	116	650	650	304	286	148	148
	55	10	10	0	0	38	38	282	282	396	396
	56	0	0	5	5	0	0	227	227	199	99
Subtotal		20	20	214	214	688	688	875	857	820	720
Percent Success		100		100		100		98		88	
Overall Rate		95									
LAS	51	105	56	861	831	222	201	930	850	1200	1089
	53	30	0	160	80	37	21	88	74	74	74
	58	514	0	0	0	158	122	521	514	266	263
Subtotal		649	56	1021	911	417	344	1539	1438	1540	1426
Percent Success		9		89		82		93		93	
Overall Rate		81									
PLU	51	24	10	2	2	74	72	388	388	247	247
	52	0	0	3	3	18	4	513	448	212	161
	53	96	96	94	71	0	0	579	574	398	391
	54	0	0	0	0	35	28	296	270	196	187
	55	100	100	0	0	49	49	239	239	88	88
	56	149	146	15	8	264	256	400	370	480	418
Subtotal		369	352	114	84	440	409	2415	2289	1621	1492
Percent Success		95		74		93		95		92	
Overall Rate		93									
TAH	53	472	469	483	483	395	395	409	409	302	302
	54	470	466	18	18	118	118	730	730	766	757
	55	0	0	64	64	133	122	477	474	894	828

	56	532	0	43	43	90	90	258	220	41	41
	57	0	0	8	8	0	0	239	239	192	28
Subtotal		1474	935	616	616	736	725	2113	2072	2195	1956
Percent Success		63		100		99		98		89	
Overall Rate		88									
ELD	51	260	247	417	392	448	437	376	360	103	69
	53	0	0	58	58	94	94	254	222	257	257
	55	237	237	29	29	7	5	227	225	255	255
	56	228	228	14	14	73	73	546	514	370	344
Subtotal		725	712	518	493	622	609	1403	1321	985	925
Percent Success		98		95		98		94		94	
Overall Rate		95									
STA	51	0	0	0	0	17	17	503	364	358	344
	52	13	13	99	99	16	16	473	461	376	373
	53	0	0	0	0	0	0	301	275	0	0
	54	169	156	342	342	0	0	0	0	19	0
Subtotal		182	169	441	441	33	33	1277	1100	753	717
Percent Success		93		100		100		86		95	
Overall Rate		92									
INY	51	29	29	0	0	228	228	475	475	82	41
	52	41	41	251	251	0	0	0	0	204	162
Subtotal		70	70	251	251	228	228	475	475	286	203
Percent Success		100		100		100		100		71	
Overall Rate		94									
SIE	51	45	45	8	8	56	33	444	431	418	390
	53	331	268	59	59	205	205	737	658	698	698
	54	361	131	303	277	304	304	522	495	478	447
	55	93	93	212	212	99	99	407	386	365	326
Subtotal		830	537	582	556	664	641	2110	1970	1959	1861
Percent Success		65		96		97		93		95	
Overall Rate		91									
SEQ	51	114	69	335	313	493	350	356	284	585	493

	52	0	0	0	0	0	0	61	61	212	160
	53	253	253	9	9	97	92	59	43	110	98
	54	53	48	149	92	128	128	227	197	750	698
	56	43	30	82	82	0	0	538	402	909	366
Subtotal		463	400	575	496	718	570	1241	987	2566	1815
Percent Success		86		86		79		80		71	
Overall Rate		77									
Bioregion Total		4782	3251	4332	4062	4546	4247	13448	12509	12725	11115
Percent Success		68		94		93		93		87	
Total Acres Planted			39833			Total Acres Stocked			35184		
Overall Rate 1988-1992		88									
Overall Rate 1989-1992		91									

APPENDIX B

Status of Reforestation after Final Harvest

DATE 1/15/95

ANNUAL REFORESTATION AND TIMBER STAND IMPROVEMENT
 ACCOMPLISHMENT REPORT
 TABLE 22 - STATUS OF REFORESTATION AFTER FINAL HARVEST
 REGION 05
 FISCAL YEAR 1994

COLUMN NUMBER	1		2		3		4		5		6	
	FINAL HARVEST REPORTED IN 1988	ADJUSTMENTS TO DATE	REVISED FINAL HARVEST	ADEQUATELY STOCKED		NOT ADEQUATELY STOCKED		NOT ADEQUATELY STOCKED NO FURTHER TREATMENTS				
FOREST	ACRES	ACRES	ACRES	ACRES	%	ACRES	%	ACRES	%			
01	0	0	0									
02	0	0	0									
03	3,768	-956	2,812	2,686	96	119	4	7	0			
04	2,156	-1518	638	565	89	73	11					
05	4,658	-804	3,854	3,596	93	258	7	0	0			
06	11,137	-7,258	3,879	3,828	99	51	1	0	0			
07	0	0	0									
08	4,346	+550	4,896	4,675	95	221	5	0	0			
09	6,816	-5993	823	823	100	0	0	0	0			
10	3,274	+71	3,345	3,276	98	69	2	0	0			
11	0	+6,258	6,258	5,404	86	854	14	0	0			
12	0	0	0									
13	2,258	-1,227	1,031	635	62	395	38	1	0			
14	2,897	+4	2,901	2,901	100	0	0	0	0			
15	0	+1,296	1,296	1,129	87	167	13	0	0			
16	1,338	5,664	7,002	3,196	45	3,806 *	55	0	0			
17	5,722	-958	4,764	4,363	92	389	8	12	0			
18	7,944	-204	7,740	7,303	94	153	2	284	4			
19	5	-5	0									
TOTAL	56,319	- 5,080	51,239	44,380	87	6,555	13	304	<1			

* These acres are delayed for reforestation until herbicides can be used. Environmental documents are currently being prepared for site preparation, planting, and release. Hamm-Hasloe EIS has been signed and is through the NEPA process.

557

DATE 1/15/95

ANNUAL REFORESTATION AND TIMBER STAND IMPROVEMENT
 ACCOMPLISHMENT REPORT
 TABLE 22 - STATUS OF REFORESTATION AFTER FINAL HARVEST
 REGION 05
 FISCAL YEAR 1994

COLUMN NUMBER	1		2		3		4		5		6	
	FINAL HARVEST		ADJUSTMENTS		REVISED		ADEQUATELY		NOT		NOT ADEQUATELY STOCKED	
	REPORTED IN 1989		TO DATE		FINAL HARVEST		STOCKED		ADEQUATELY STOCKED		NO FURTHER TREATMENTS	
FOREST	ACRES		ACRES		ACRES		ACRES	%	ACRES	%	ACRES	%
01	0	0	0	0	0	0						
02	0	0	0	0	0	0						
03	1,044	+501	1,545	1,409	91	134	9	2	0			
04	1,808	-1254	554	471	85	83	15					
05	1,876	+1,862	3,738	3,415	91	323	9	0	0			
06	17,897	-12,974	4,923	4,762	97	161	3	0				
07	0	0	0									
08	36	+4,077	4,113	3,523	86	590	14					
09	0	867	867	846	98	21	2					
10	1,409	+1,578	2,987	2,790	93	197	7	0	0			
11	0	+4,437	4,437	3,742	84	647	15	48	1			
12	0	0	0									
13	302	+1,108	1,410	1,167	83	243	17	0	0			
14	1,680	+1,192	2,872	2,865	100	7	0	0	0			
15	1,499	+ 757	2,256	1,720	76	536	24	0	0			
16	114	5,589	5,703	2,604	46	3,099 *	54	0	0			
17	1,888	+404	2,292	2,113	92	179	8	0	0			
18	1,226	+5,815	7,041	6,561	93	249	4	231	3			
19	0	0	0									
TOTAL	30,779	13,959	44,738	37,988	85	6,469	14	281	1			

* These acres are delayed for reforestation until herbicides can be used. Environmental documents are currently being prepared for site preparation, planting, and release. Hamm-Hasloe EIS has been signed and is through the NEPA process.

558

APPENDIX C

Projected Volume

SNEP STUDY AREA - PLANTATIONS PLANTED BEFORE 1981 - 170,000 ACRES

AVERAGE SUMMARY STATISTICS BY CYCLE

04-04-95 13:46:39

YEAR	AGE	START OF SIMULATION PERIOD							REMOVALS					AFTER TREATMENT					GROWTH THIS PERIOD			MAI MERCH CU FT				
		NO OF TREES	BA	SDI	CCF	HT	QMD	TOTAL CU FT	MERCH CU FT	BD	FT	NO OF TREES	TOTAL CU FT	MERCH CU FT	BD	FT	BA	SDI	CCF	HT	QMD		PERIOD YEARS	ACCRE PER	MORT YEAR	
1991	23	278	48	106	37	34	5.4	625	471	1666												0	65	0	19	
1995	27	276	61	131	44	39	6.2	846	663	2343												4	73	0	24	
1996	28	276	64	137	46	41	6.5	918	727	2606												1	90	2	25	
2005	37	269	101	196	64	52	8.3	1719	1471	5956												9	121	5	39	
2015	47	257	141	256	79	64	10.1	2887	2598	11774	3,653 is linear interpolation												10	145	11	55
2025	57	240	179	306	92	75	12.8	4232	3917	19125	between these 2 numbers.												10	159	18	69
2035	67	222	212	346	102	84	13.4	5640	5315	27373												10	0	0	80	

THE FOLLOWING STRATA WERE SUMMARIZED USING THE SORNEC VARIANT-

09E1 09E2 09E3 09F1 09F2
 09R1 06M1 06M2 06M3 06E1
 06E2 06E3 06R1

-FVS has different geographic variants (each with different growth coefficients). In this analysis, strata on the Modoc and Lassen National Forests were projected using the SORNEC variant of FVS, all other strata were projected using the WESSIN variant.

THE FOLLOWING STRATA WERE SUMMARIZED USING THE WESSIN VARIANT-

11M1 11M2 11P1 11F1 11F2
 11F3 11R1 11R2 11J1 11J2
 11J3 17J1 17J2 17J3 17M1
 17M2 17M3 17R1 17R2 03F1
 03F2 03F3 03M1 03M2 03M3
 03P2 03P3 03R1 16M1 16M2
 16M3 16P1 16P2 16P3 16R1
 16R2 04J1 04J2 04J3 15M2
 15P1 15P2 15R1 13M1 13M2
 13M3 13R1

NOTE: Strata labels incorporate the national forest code, then the forest type code, then the age class code.

APPENDIX D

Land Area Table

LAND AREA TABLE

(NET FOREST SERVICE ACRES)

Forest Land (7.6 million acres)						
Forest	Natural Stocking	Plantations planted before 1981	Plantations planted from 1981-1991	Not stocked	Non-Forest Land	TOTALS
Modoc	1,095,000	35,000	22,200	17,900	624,200	1,794,300
Lassen	871,800	20,900	12,500	4,100	354,000	1,263,300
Plumas	952,400	18,600	25,300	35,800	220,400	1,252,500
Tahoe	604,300	30,900	28,200	500	153,300	817,200
Eldorado	475,400	12,900	10,900	1,100	103,900	604,200
Stanislaus	544,100	17,500	8,900	71,000	250,700	892,200
Inyo	948,300	1,600	1,000	200	980,000	1,931,100
Sierra	803,500	13,500	12,600	10,000	460,300	1,299,900
Sequoia	844,300	17,400	16,200	3,300	255,900	1,137,100
TOTALS	7,139,108	168,300	137,800	143,900	3,402,700	10,991,800
PERCENT OF FOREST- LAND	94%	2%	2%	2%		

APPENDIX E

Status of Plantation Inventories

Status of Plantation Inventories Inventory Sample Design

FOREST /YEAR*	LIVE TREES		DEAD STANDING TREES						DOWN
	< 1.0" DBH	1.0"-4.9" DBH	5.0" + DBH	1.0"-4.9" DBH	5.0" + DBH	5.0"-19.9" DBH	1.0"-19.9" DBH	20.0" + DBH	10.0" + **
MOD 1993	1/100 AC. FIXED	1/100 AC. FIXED	20 BAF PRISM				1/8 AC. FIXED	1/4 AC. FIXED	1/8 AC. FIXED
LAS 1993/94	"	"	"				1/8 AC. FIXED	1/4 AC. FIXED	1/8 AC. FIXED
PLU 1992	"	"	"	1/100 AC. FIXED	20 BAF PRISM				NO SAMPLE
TAH 1990	"	"	"	1/100 AC. FIXED	20 BAF PRISM				NO SAMPLE
ELD 1994	"	"	"				1/8 AC. FIXED	1/4 AC. FIXED	1/8 AC. FIXED
STA 1991	"	"	"	1/100 AC. FIXED	20 BAF PRISM				NO SAMPLE
INY 1994	"	"	"	1/100 AC. FIXED		1/8 AC. FIXED		1/4 AC. FIXED	1/8 AC. FIXED
SIE 1986	"	"	"		20 BAF PRISM				NO SAMPLE
SEQ 1990	"	"	"	1/100 AC. FIXED	20 BAF PRISM				NO SAMPLE

* Inventory Year ** at the large end

Status of Plantation Inventories

PLANTATION STRATA THAT HAVE BEEN INVENTORIED										
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin	Last Map Update *	Year Inventoried	# of Cluster Plots	# of Sample Points	
Pacific Ponderosa Pine	1	P1X	PLU	357	'72-'80	1992	1992	4	26	
			STA	901	'71-'80	1992	1991	6	49	
			SIE	1,116	'71-'80	1992	1986	2	10	
			Sub-totals	2,374				12	85	
	2	P2X	ELD	1,773	'61-'80	1992	1994	6	50	
			STA	1,117	'61-'70	1992	1991	4	49	
			SIE	3,654	'30-'70	1992	1986	2	10	
			Sub-total	6,544				12	109	
	3	P3X	ELD	906	'49-'59	1992	1994	2	20	
			STA	779	'46-'60	1992	1991	5	47	
			Sub-total	1,685				7	67	
	Forest Type Totals				10,603				31	261

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin	*LastMap Update	Year Inven-toried	# of Cluster Plots	# of Sample Points
Sierran Mixed Conifer	1	M1X	LAS	3,691	'71-'80	1993	1994	11	76
			PLU	1,722	'71-'82	1992	1992	3	17
			TAH	5,432	'71-'80	1992	1990	8	40
			ELD	2,473	'71-'80	1992	1994	3	27
			STA	6,108	'71-'80	1992	1991	7	61
			SEQ	9,965	'71-'80	1992	1990	10	49
			Sub-totals	29,391				42	270
	2	M2X	LAS	12,355	'61-'70	1993	1994	8	58
			PLU	1,876	'47-'72	1992	1992	6	56
			TAH	16,209	'61-'70	1992	1990	8	40
			ELD	2,734	'61-'70	1992	1994	5	45
			STA	4,393	'61-'70	1992	1991	9	78
			SIE	6,260	'10-'70	1992	1986	5	24
			SEQ	4,292	'61-'70	1992	1990	7	33
			Sub-totals	48,119				48	334
	3	M3X	LAS	1,604	'36-'60	1993	1994	13	120
			TAH	1,225	'48-'60	1992	1990	8	40
			ELD	900	'40-'59	1992	1994	3	30
			STA	2,453	'51-'60	1992	1991	6	60
			SEQ	1,740	'32-'60	1992		5	23
			Sub-totals	7,922				35	273
Forest Type Totals				85,432				125	877

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin	Last Map Update *	Year Inven-toried	# of Cluster Plots	# of Sample Points
Red Fir	1	R1X	MOD	64	'75-'76	1993	1993	3	29
			LAS	338	'62-'80	1993	1993	4	34
			PLU	218	'71-'80	1992	1992	8	76
			TAH	1,003	'71-'80	1992	1990	8	39
			ELD	429	'69-'80	1992	1994	8	69
			STA	783	'71-'80	1992	1991	6	55
			SIE	2,016	'50-'80	1992	1986	3	15
			SEQ	941	'62-'79	1992	1990	5	24
			Sub-totals	5,792				45	341
	2	R2X	PLU	333	'40-'70	1992	1992	7	47
			TAH	416	'62'-70	1992	1990	8	40
			STA	627	'50-'70	1992	1991	6	44
			Sub-total	1,376				21	131
	Forest Type Totals				7,168				66

PLANTATION STRATA THAT HAVE BEEN INVENTORIED										
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin	Last Map Update *	Year Inventoried	# of Cluster Plots	# of Sample Points	
White Fir (Eastside Mixed Conifer)	1	F1X	MOD	1,954	'71-'91	1993	1993	7	70	
			PLU	1,342	'71-'82	1992	1992	12	120	
			ELD	1,538	'71-'80	1992	1994	7	64	
			Sub-totals	4,834				26	254	
	2	F2X	MOD	641	'47-'70	1993	1993	11	101	
			PLU	5,418	'61-'70	1992	1992	9	87	
			ELD	862	'61-'69	1992	1994	3	27	
			Sub-total	6,921				23	215	
	3	F3X	PLU	791	'38-'60	1992	1992	8	78	
			ELD	987	'40-'60	1992	1994	2	20	
			Sub-total	1,778				10	98	
	Forest Type Totals				13,533				59	567

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin	Last Map Update *	Year Inventoried	# of Cluster Plots	# of Sample Points
Interior Ponderosa Pine	1	E1X	MOD	8,587	'70-'81	1993	1993	10	101
			LAS	821	'71-'80	1993	1994	3	30
			Sub-totals	9,408				13	131
	2	E2X	MOD	14,401	'61-'70	1993	1993	9	90
			LAS	4,128	'61-'70	1993	1994	12	104
			Sub-total	18,529				21	194
	3	E3X	MOD	9,396	'40-'60	1993	1993	10	100
			LAS	1,001	'36-'60	1993	1993	6	59
			Sub-total	10,397				16	159
Forest Type Totals				38,334				50	484

PLANTATION STRATA THAT HAVE BEEN INVENTORIED										
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin	Last Map Update *	Year Inventoried	# of Cluster Plots	# of Sample Points	
Jeffrey Pine	1	J1X	PLU	3,380	'71-'80	1992	1992	7	65	
			TAH	3,706	'71-'80	1993	1990	8	39	
			INY	1,223	'64-'74	1992	1994	9	45	
			Sub-totals	8,309				24	149	
	2	J2X	PLU	1,066	'61-'70	1992	1992	8	74	
			TAH	2,162	'61-'70	1993	1990	8	40	
			INY	141	'64-'69	1992	1994	8	40	
			Sub-total	3,369				24	154	
	3	J3X	PLU	1,451	'41-'60	1992	1992	7	70	
			TAH	231	'58-'60	1993	1990	8	39	
			INY	246	'52-'85	1992	1994	7	35	
			Sub-total	1,928				22	144	
	Forest Type Totals				13,606				70	447
	Inventoried Grand Total				168,676				401	3,108

PLANTATION STRATA THAT HAVE NOT BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin **	Last Map Update *	Year Inventoried	# of Cluster Plots	# of Sample Points
Pacific Ponderosa Pine	0	POX	ELD	2,316	'82-'92	1992	No Inventory		
			STA	2,317	'81-'91	1992			
			SIE	3,536	'81-'91	1991			
			Sub-totals	8,169				0	0
Forest Type Totals				8,169				0	0
Sierran Mixed Conifer	0	MOX	LAS	5,261	'81-'92	1993	No Inventory		
			PLU	7,633	'81-'91	1992			
			TAH	22,814	'81-'94	1994			
			ELD	6,500	'81-'92	1992			
			STA	5,523	'81-'92	1992			
			SIE	8,737	'71-'91	1991			
			SEQ	14,235	'81-'93	1993			
			Sub-totals	70,703				0	0
Forest Type Totals				70,703				0	0

PLANTATION STRATA THAT HAVE NOT BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin **	Last Map Update *	Year Inventoried	# of Cluster Plots	# of Sample Points
Red Fir	0	R0X	LAS	1,230	'82-'93	1993	No Inventory		
			PLU	108	'85-'90	1992			
			TAH	1,077	'81-'92	1994			
			ELD	1,524	'81-'91	1992			
			STA	717	'81-'91	1992			
			SIE	2,139	'81-'91	1991			
			SEQ	1,284	'81-'93	1993			
			Sub-totals	8,079			0	0	
Forest Type Totals				8,079			0	0	
White Fir (Eastside Mixed Conifer)	0	FOX	MOD	1,719	'82-'92	1994	No Inventory		
			PLU	9,714	'81-'92	1992			
			ELD	8,550	'81-'91	1992			
			Sub-totals	19,983			0	0	
Forest Type Totals				19,983			0	0	
Interior Ponderosa Pine	0	E0X	MOD	20,434	'81-'94	1994	No Inventory		
			LAS	5,861	'81-'93	1993			
			Sub-totals	26,295			0	0	
Forest Type Totals				26,295			0	0	

PLANTATION STRATA THAT HAVE NOT BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	Acres	Years of Origin **	Last Map Update *	Year Inventoried	# of Cluster Plots	# of Sample Points
Jeffrey Pine	0	J0X	PLU	6,038	'81-'91	1992	No Inventory		
			TAH	3,421	'81-'92	1994			
			INY	1,048	'83-'92	1992			
			Sub-totals	10,507				0	0
Forest Type Totals				10,507				0	0
Not Inventoried Grand Total				143,736				0	0

* Forests updated plantation maps in the year indicated. The source imagery upon which plantation boundaries were drawn dates to 1991 (either ortho photos, color infrared photos, or spot 10 meter imagery). Instructions were to draw boundaries only for plantations where openings are visible on the 1991 imagery. Openings created after 1991 are not included. Plantation map coverage is complete through 1991 and incomplete from 1992 on.

** All acreage with origin prior to 1992 is accounted for because the imagery upon which plantation boundaries were drawn dates to 1991. The acreage accounting for origin after 1991 is a partial accounting. Only plantations where openings were created prior to 1992 with subsequent planting occurred before year of update are included.

APPENDIX F

Wildlife Habitat Relationships Stages

Wildlife Habitat Relationship Stages ¹

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
				ACRES BY HABITAT STAGE **					
Forest Type	Age Class	Strata	Forest	1X	2X	3P	3M	4P	4M
Pacific Ponderosa Pine	1	P1X	PLU		357				
			STA		901				
			SIE		1,116				
			Sub-totals	0	2,374	0	0	0	0
	2	P2X	ELD			1,773			
			STA		1,117				
			SIE			3,654			
			Sub-total	0	1,117	5,427	0	0	0
	3	P3X	ELD					906	
			STA			779			
			Sub-total	0	0	779	0	906	0
	Forest Type Acre Totals by Stage				0	3,491	6,206	0	906

¹Reference both Mayer, 1988 and USDA-FS, 1995.

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	ACRES BY HABITAT STAGE					
				1X	2X	3P	3M	4P	4M
Sierran Mixed Conifer	1	M1X	LAS		3,691				
			PLU		1,722				
			TAH		5,432				
			ELD		2,473				
			STA			6,108			
			SEQ			9,965			
			Sub-totals	0	13,318	16,073	0	0	0
	2	M2X	LAS			12,355			
			PLU		1,876				
			TAH				16,209		
			ELD					2,734	
			STA			4,393			
			SIE			6,260			
			SEQ			4,292			
			Sub-total	0	1,876	27,300	16,209	2,734	0
	3	M3X	LAS					1,604	
			TAH				1,225		
			ELD						900
			STA					2,453	
			SEQ			1,740			
			Sub-total	0	0	1,740	1,225	4,057	900
Forest Type Acre Totals by Stage				0	15,194	45,113	17,434	6,791	900

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
				ACRES BY HABITAT STAGE					
Forest Type	Age Class	Strata	Forest	1X	2X	3P	3M	4P	4M
Red Fir	1	R1X	MOD		64				
			LAS		338				
			PLU		218				
			TAH		1,003				
			ELD		429				
			STA		783				
			SIE		2,016				
			SEQ		941				
			Sub-totals	0	5,792	0	0	0	0
	2	R2X	PLU		333				
			TAH		416				
			STA		627				
			Sub-total	0	1,376	0	0	0	0
Forest Type Acre Totals by Stage				0	7,168	0	0	0	0

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
				ACRES BY HABITAT STAGE					
Forest Type	Age Class	Strata	Forest	1X	2X	3P	3M	4P	4M
White Fir (East-side Mixed Conifer)	1	F1X	MOD		1,954				
			PLU		1,342				
			ELD					1,538	
			Sub-totals	0	3,296	0	0	1,538	0
	2	F2X	MOD		641				
			PLU			5,418			
			ELD					862	
			Sub-total	0	641	5,418	0	862	0
	3	F3X	PLU			791			
			ELD		987				
			Sub-total	0	987	791	0	0	0
	Forest Type Acre Totals by Stage				0	4,924	6,209	0	2,400

PLANTATION STRATA THAT HAVE BEEN INVENTORIED									
Forest Type	Age Class	Strata	Forest	ACRES BY HABITAT STAGE					
				1X	2X	3P	3M	4P	4M
Interior Ponderosa Pine	1	E1X	MOD		8,587				
			LAS			821			
			Sub-totals	0	8,587	821	0	0	0
	2	E2X	MOD		14,401				
			LAS			4,128			
			Sub-total	0	14,401	4,128	0	0	0
	3	E3X	MOD					9,396	
			LAS					1,001	
			Sub-total	0	0	0	0	10,397	0
Forest Type Acre Totals by Stage				0	22,988	4,949	0	10,397	0

PLANTATION STRATA THAT HAVE BEEN INVENTORIED										
Forest Type	Age Class	Strata	Forest	ACRES BY HABITAT STAGE						
				1X	2X	3P	3M	4P	4M	
Jeffrey Pine	1	J1X	PLU		3,380					
			TAH	3,706						
			INY					1,223		
			Sub-totals	3,706	3,380	0	0	1,223	0	
	2	J2X	PLU			1,066				
			TAH			2,162				
			INY			141				
			Sub-total	0	0	3,369	0	0	0	
	3	J3X	PLU			1,451				
			TAH			231				
			INY			246				
			Sub-total	0	0	1,928	0	0	0	
Forest Type Totals				3,706	3,380	5,297	0	1,223	0	
SNEP Study Area Totals				3,706	57,145	67,774	17,434	21,717	900	

** Codes for size and cover (from USDA-FS, 1995):

<u>Code</u>	<u>Size Class</u>	<u>DBH</u>	<u>Code</u>	<u>Closure Class</u>
1	Seedling	< 1"	X	assigned to seedling or sapling size class
2	Sapling	1"-6"	P	Open Cover (less than 40%)
3	Pole	6"-11"	M	Moderate Cover (40%-69%)
4	Small Tree	11"-24"		

APPENDIX G

Current Plantation Condition Graphics

SPECIES CODES FOR APPENDIX G

<u>CODE</u>	<u>SPECIES</u>
DF	Douglas-fir
LP	Lodgepole pine
SP	Sugar pine
BO	Black oak
RF	Red fir
IC	Incense cedar
WF	White fir
JP	Jeffrey pine
PP	Ponderosa pine
ARPA9	Greenleaf manzanita
CECO2	Whitethorn
UG	Unidentified grass
CEVE3	Snowbrush
CEPR	Squaw carpet
ART5	Sage (woody shrub form)
CHR9	Rabbitbrush
RIB	Ribes - perennial shrub
RINE	Sierra currant
PRU2	Cherry
ARC5	Manzanita
CEIN3	Deerbrush
CHFO2	Bearclover

PLANTATION INVENTORY AVERAGES (ACRE WEIGHTED)

PLANTATION STRATA AGE CLASSES 1,2, AND 3 (>10 YRS OLD)

FOREST TYPE: **ENTIRE SNEP STUDY AREA**

NATIONAL FOREST OCCURRENCE: **MODOC, LASSEN, PLUMAS, TAHOE, ELDORADO, STANISLAUS, INYO, SIERRA, SEQUOIA**

SIZE: **170,000 ACRES**

INVENTORY YEAR: **1991**

AGE: **23**

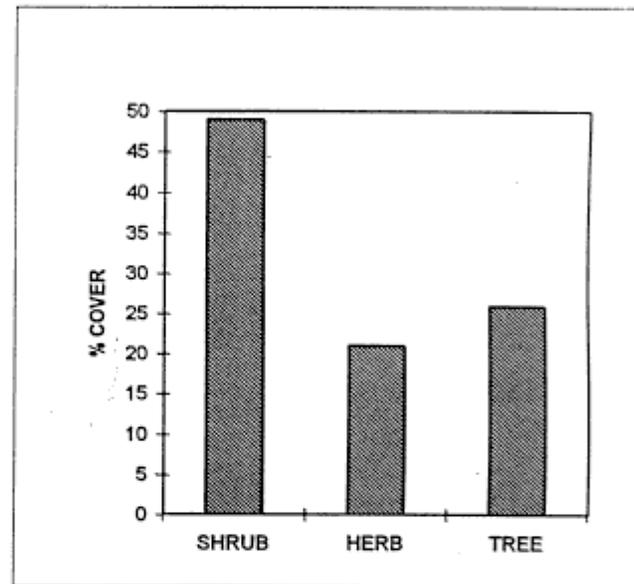
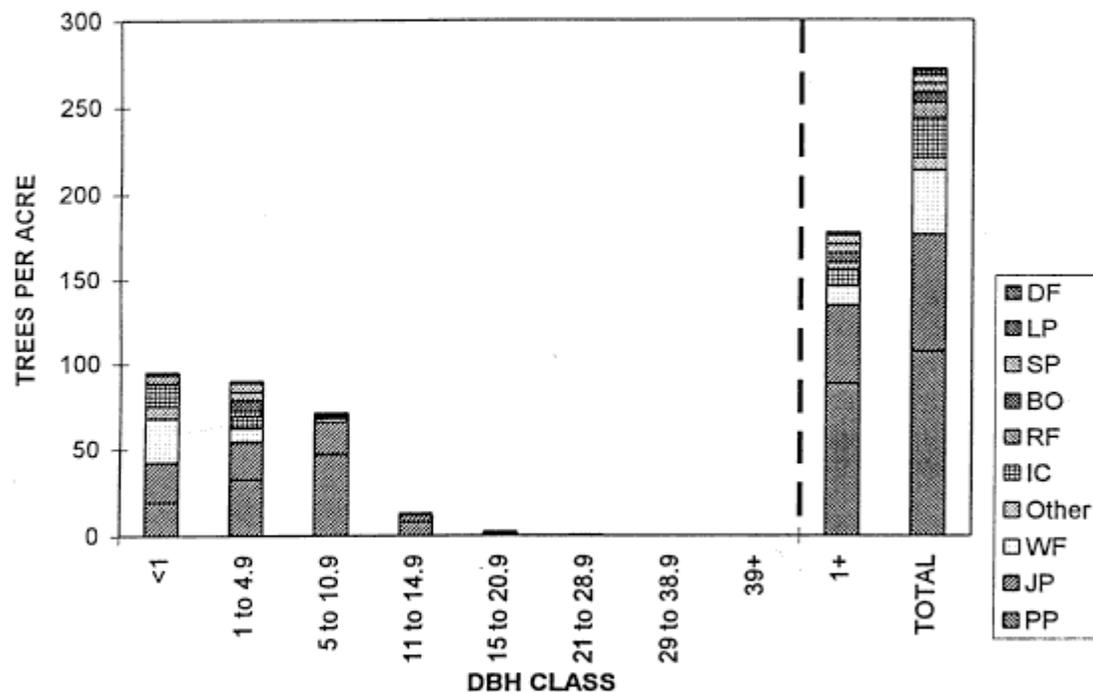
OF SAMPLE POINT CLUSTERS: **401**

SITE CLASS: **3**

YEAR OF ORIGIN: **1968**

HABITAT STAGE: **3X, 2X**

OF SAMPLE POINTS: **3091**



	SHRUB	HERB	TREE
% COVER	49	21	26
HEIGHT	3		20
# OF SPECIES	12	5	6
DOMINANT SPECIES			
	ARPA9	UG	PP
	CECO2		

STATISTICS*										
	<1	1 to 4.9	5 to 10.9	11 to 14.9	15 to 20.9	21 to 28.9	29 to 38.9	39+	1+	TOTAL
TPA	95	90	75	14	2.9	0.5	0.1	0	182	277
QMD	0.1	3	7.5	12.5					6.6	5.4
HEIGHT	3	11	23	39	57	73			20	15
AGE		22	28	47	64				36	
BA	0	4	24	12	5	2	0.4	0	47	47
BAG ₅	0	1.5	8.9	3.3	0.9	0.1			14.8	14.8
TCUV	0	25	254	184	95	42	15	9	623	623
TBFV ₁₀₋₆	0	0	198	682	422	223	80	61	1636	1636

*** ABBREVIATIONS**

- TPA - Trees per Acre
- QMD - Quadratic Mean Diameter (in.)
- BA - Basal Area (ft²/acre)
- BAG₅ - Basal Area Growth in Last 5 Years
- TCUV - Total Volume, Cubic Feet
- TBFV₁₀₋₆ - Total Volume, Board Feet, 10" dbh to 6" top

PLANTATION INVENTORY AVERAGES (ACRE WEIGHTED)

PLANTATION STRATA AGE CLASSES 1,2, AND 3 (>10 YRS OLD)

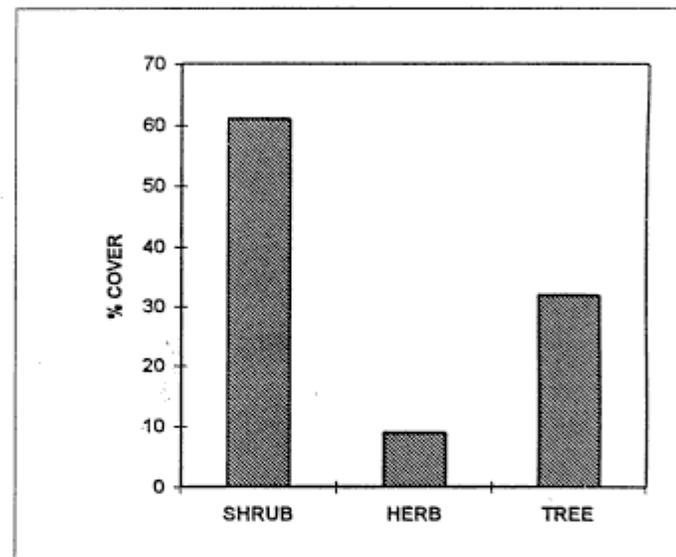
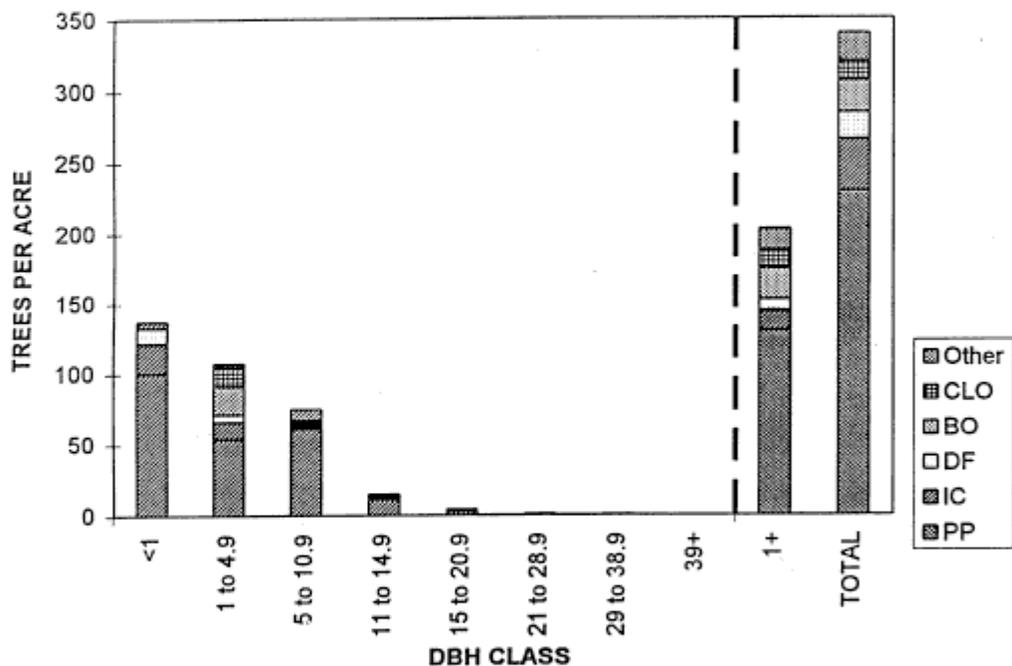
FOREST TYPE: PACIFIC PONDEROSA PINE NATIONAL FOREST OCCURRENCE: PLUMAS, ELDORADO, STANISLAUS, SIERRA

SIZE: 11,000 ACRES
SITE CLASS: 3

INVENTORY YEAR: 1989
YEAR OF ORIGIN: 1965

AGE: 24
HABITAT STAGE: 3P, 2X

OF SAMPLE POINT CLUSTERS: 31
OF SAMPLE POINTS: 244



	SHRUB	HERB	TREE
% COVER	61	9	32
HEIGHT	3		23
# OF SPECIES	8	4	5
DOMINANT SPECIES			
	CHFO2	UF	PP
	CEIN3		

STATISTICS*										
	<1	1 to 4.9	5 to 10.9	11 to 14.9	15 to 20.9	21 to 28.9	29 to 38.9	39+	1+	TOTAL
TPA	137	107	75	15	4	1	0.3	0.01	202	339
QMD	0.1	3.1	7.4	12.4					7.1	5.4
HEIGHT	3	13	27	44	60	81			23	15
AGE		24	30	48	62				40	
BA	0	5	26	14	7	3	1	0	56	56
BAG ₅	0	1.5	9.2	1.7	0.7	0.3			13.4	13.4
TCUV	0	29	272	229	145	104	59	12	851	851
TBFV ₁₀₋₆	0	0	121	665	571	424	181	85	2048	2048

*** ABBREVIATIONS**

- TPA - Trees per Acre
- QMD - Quadratic Mean Diameter (in.)
- BA - Basal Area (ft²/acre)
- BAG₅ - Basal Area Growth in Last 5 Years
- TCUV - Total Volume, Cubic Feet
- TBFV₁₀₋₆ - Total Volume, Board Feet, 10" dbh to 6" top

PLANTATION INVENTORY AVERAGES (ACRE WEIGHTED)

PLANTATION STRATA AGE CLASSES 1,2, AND 3 (>10 YRS OLD)

FOREST TYPE: **MIXED CONIFER**

NATIONAL FOREST OCCURRENCE: **LASSEN, PLUMAS, TAHOE, ELDORADO, STANISLAUS, SIERRA, SEQUOIA**

SIZE: **85,000 ACRES**

INVENTORY YEAR: **1991**

AGE: **23**

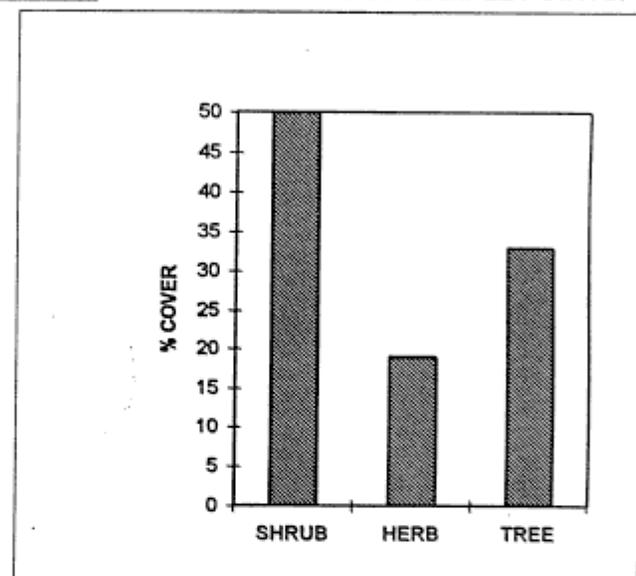
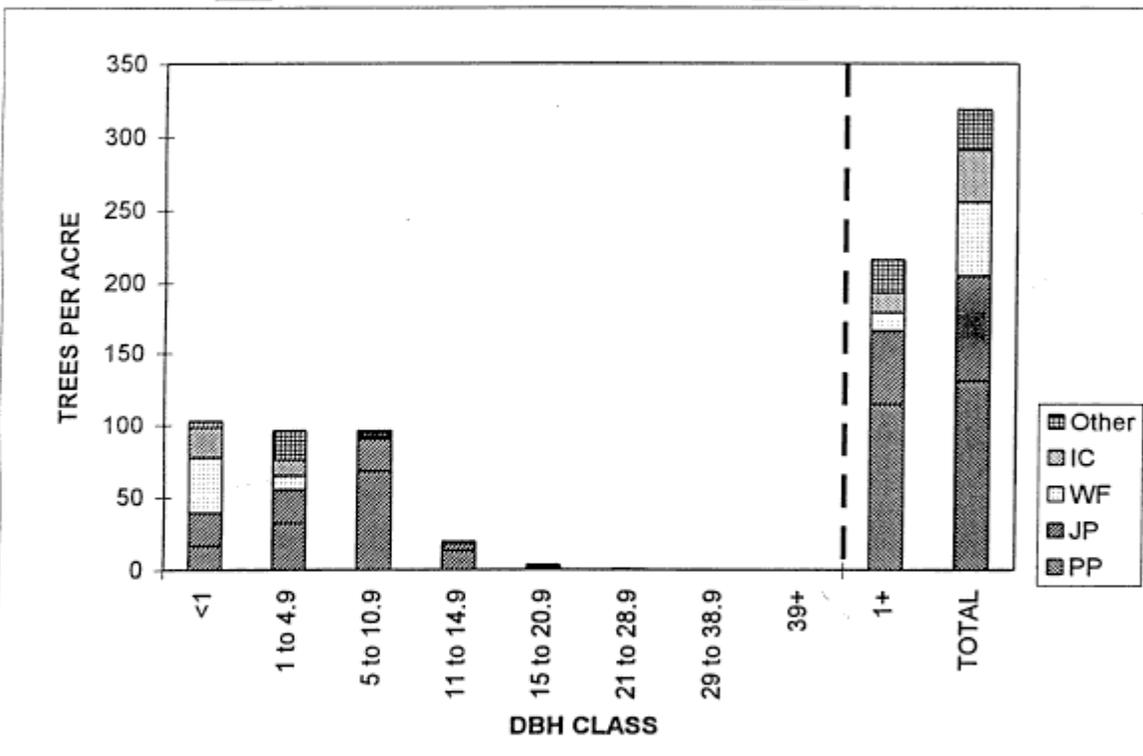
OF SAMPLE POINT CLUSTERS: **125**

SITE CLASS: **3, 2**

YEAR OF ORIGIN: **1968**

HABITAT STAGE: **3P, 3M, 2X**

OF SAMPLE POINTS: **877**



% COVER	50	19	33
HEIGHT	4		21
# OF SPECIES	11	5	7

DOMINANT SPECIES

ARPA9	UG	PP
CECO2		
ARC5		

STATISTICS*										
TPA	103	96	92	19	3.1	0.4	0	0	211	314
QMD	0.1	2.9	7.7	12.5					6.8	5.5
HEIGHT	3	12	26	38	59	74			21	15
AGE		21	27	36	54				32	
BA	0	5	31	16	5	1	0	0	58	58
BAG ₅	0	1.8	12.1	5.1	1.1	0.1	0	0	20.3	20.3
TCUV	0	25	314	247	89	36	9	8	738	738
TBFV ₁₀₋₆	0	0	274	916	424	193	47	56	1854	1854

*** ABBREVIATIONS**

- TPA - Trees per Acre
- QMD - Quadratic Mean Diameter (in.)
- BA - Basal Area (ft²/acre)
- BAG₅ - Basal Area Growth in Last 5 Years
- TCUV - Total Volume, Cubic Feet
- TBFV₁₀₋₆ - Total Volume, Board Feet, 10" dbh to 6" top

PLANTATION INVENTORY AVERAGES (ACRE WEIGHTED)

PLANTATION STRATA AGE CLASSES 1,2, AND 3 (>10 YRS OLD)

FOREST TYPE: WHITE FIR

NATIONAL FOREST OCCURRENCE: MODOC, PLUMAS, ELDORADO

SIZE: 14,000 ACRES

INVENTORY YEAR: 1993

AGE: 26

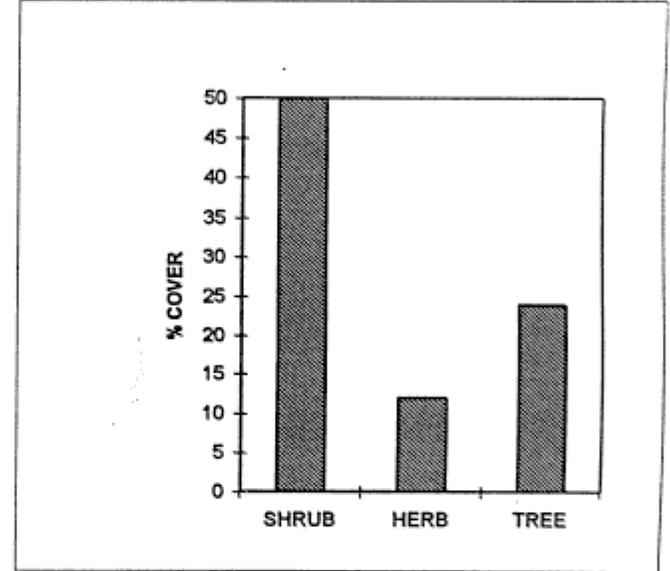
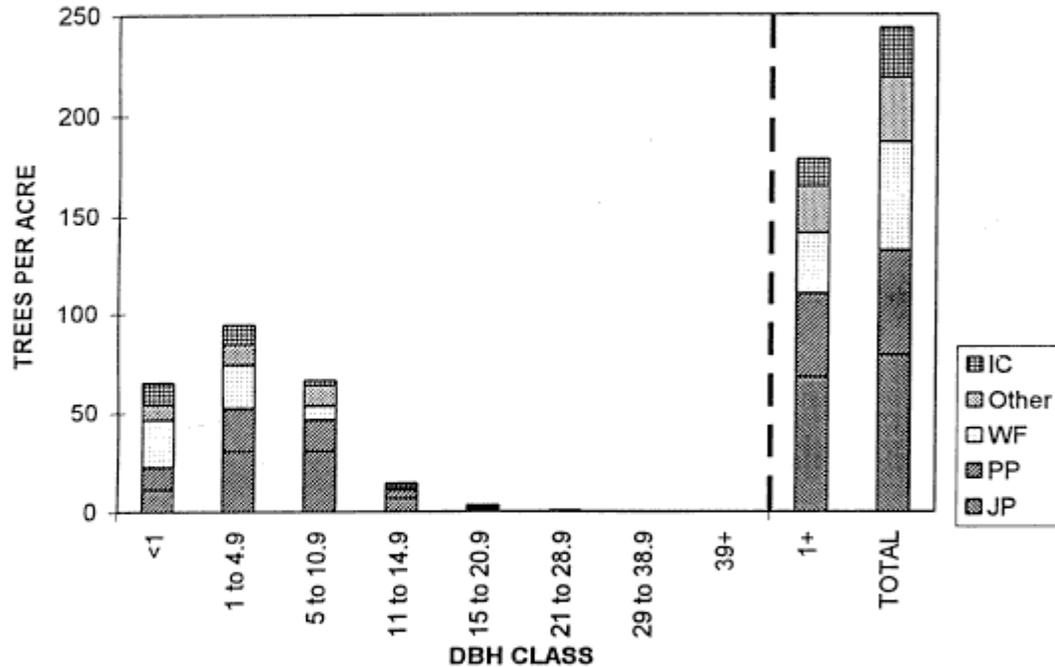
OF SAMPLE POINT CLUSTERS: 59

SITE CLASS: 3

YEAR OF ORIGIN: 1967

HABITAT STAGE: 2X, 3P

OF SAMPLE POINTS: 567



% COVER	50	12	24
HEIGHT	4		21
# OF SPECIES	15	4	7

DOMINANT SPECIES

ARPA9	UG	JP
CECO2		
PRU2		

STATISTICS*										
	65	94	66	14	3.1	0.7	0.1	0.1	178	243
TPA	65	94	66	14	3.1	0.7	0.1	0.1	178	243
QMD	0.1	3.1	7.7	12.6					6.8	5.7
HEIGHT	3	12	26	41	56	73			21	16
AGE		25	34	65	78				43	
BA	0	5	22	12	5	2	1	1	47	47
BAG ₅	0	1.4	6.5	3.4	1	0.1	0.1		12.6	12.6
TCUV	0	24	218	171	95	53	23	25	608	608
TBFV ₁₀₋₆	0	0	153	547	415	304	149	163	1731	1731

* ABBREVIATIONS

- TPA - Trees per Acre
- QMD - Quadratic Mean Diameter (in.)
- BA - Basal Area (ft²/acre)
- BAG₅ - Basal Area Growth in Last 5 Years
- TCUV - Total Volume, Cubic Feet
- TBFV₁₀₋₆ - Total Volume, Board Feet, 10" dbh to 6" top

PLANTATION INVENTORY AVERAGES (ACRE WEIGHTED)

PLANTATION STRATA AGE CLASSES 1,2, AND 3 (>10 YRS OLD)

FOREST TYPE: **RED FIR**

NATIONAL FOREST OCCURRENCE: **MODOC, LASSEN, PLUMAS, TAHOE, ELDORADO, STANISLAUS, SIERRA, SEQUOIA**

SIZE: **7,000 ACRES**

INVENTORY YEAR: **1990**

AGE: **18**

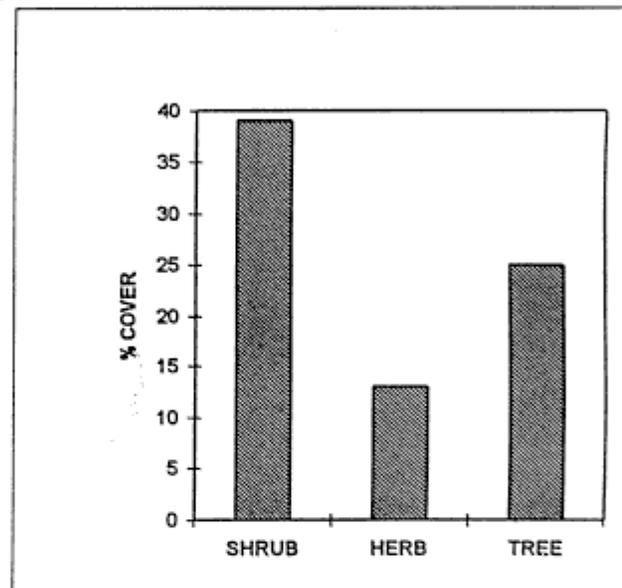
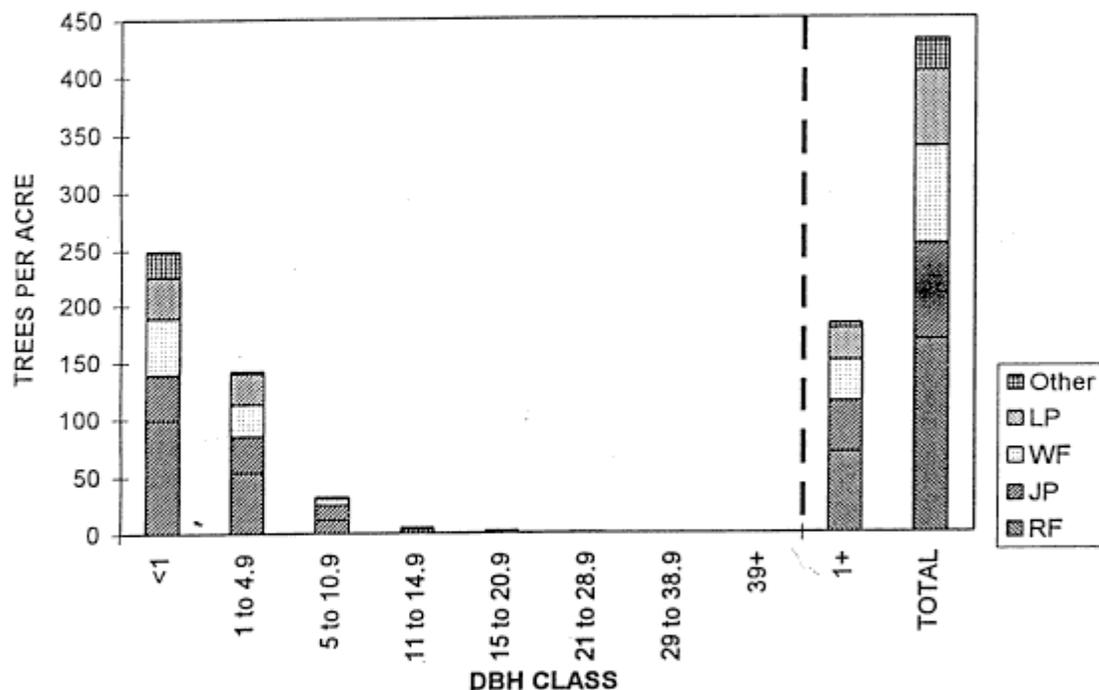
OF SAMPLE POINT CLUSTERS: **66**

SITE CLASS: **3**

YEAR OF ORIGIN: **1972**

HABITAT STAGE: **2X**

OF SAMPLE POINTS: **472**



	SHRUB	HERB	TREE
% COVER	39	13	25
HEIGHT	2		14
# OF SPECIES	7	4	5
DOMINANT SPECIES			
	CECO2	UG	RF
	RIB		
	RINE		

STATISTICS*										
TPA	249	142	32	5	1.9	0.7	0.2	0.1	182	431
QMD	0.1	2.8	7	12.1					5	3.1
HEIGHT	3	10	23	40	59	83			14	8
AGE		22	33	54	94				50	
BA	0	6	9	4	3	2	1	1	26	26
BAG ₅	0	1.6	3	1.4	1	0.3	0.1		7.3	7.3
TCUV	0	26	73	56	61	62	37	36	351	351
TBFV ₁₀₋₆	0	0	35	199	299	373	250	279	1436	1436

*** ABBREVIATIONS**

- TPA - Trees per Acre
- QMD - Quadratic Mean Diameter (in.)
- BA - Basal Area (ft²/acre)
- BAG₅ - Basal Area Growth in Last 5 Years
- TCUV - Total Volume, Cubic Feet
- TBFV₁₀₋₆ - Total Volume, Board Feet, 10" dbh to 6" top

PLANTATION INVENTORY AVERAGES (ACRE WEIGHTED)

PLANTATION STRATA AGE CLASSES 1,2, AND 3 (>10 YRS OLD)

FOREST TYPE: **INTERIOR PONDEROSA PINE**

NATIONAL FOREST OCCURRENCE: **MODOC, LASSEN**

SIZE: **38,000 ACRES**

INVENTORY YEAR: **1993**

AGE: **23**

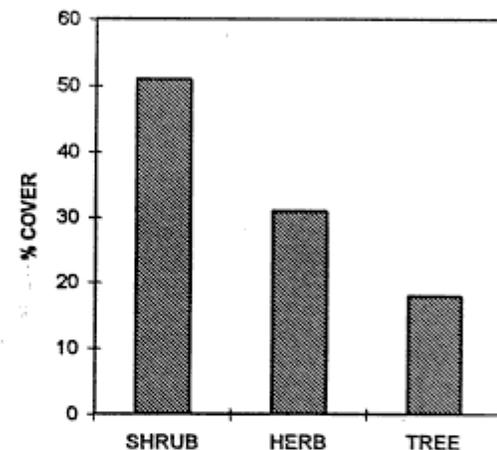
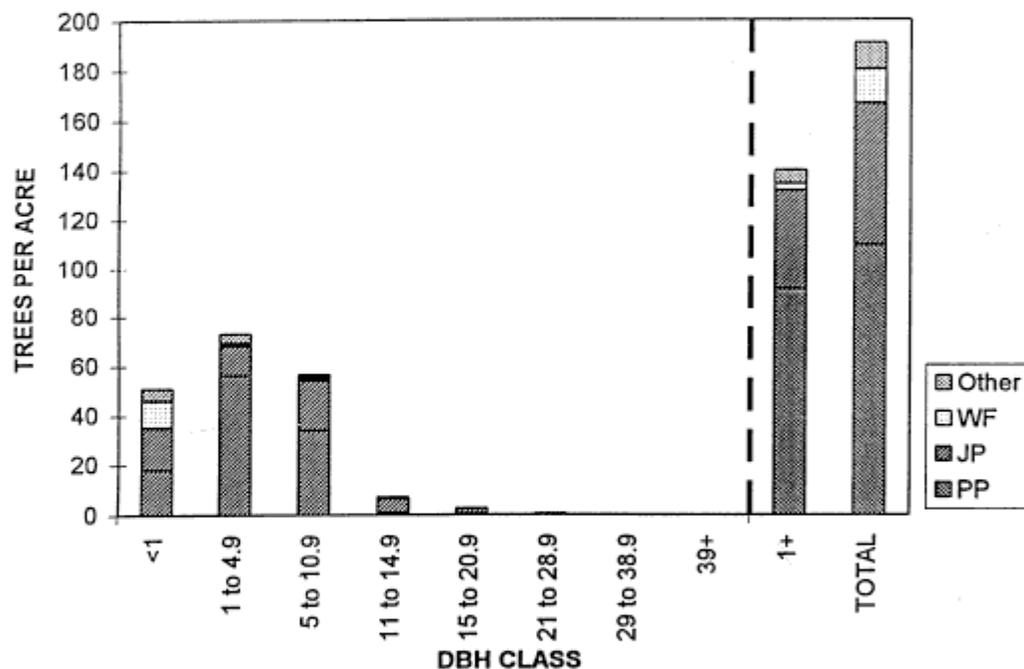
OF SAMPLE POINT CLUSTERS: **50**

SITE CLASS: **4**

YEAR OF ORIGIN: **1970**

HABITAT STAGE: **2X, 4P**

OF SAMPLE POINTS: **484**



	SHRUB	HERB	TREE
% COVER	51	31	18
HEIGHT	3	19	19
# OF SPECIES	14	4	4

DOMINANT SPECIES

	ARPA9	UG	PP
CHR9			

STATISTICS*	<1	1 to 4.9	5 to 10.9	11 to 14.9	15 to 20.9	21 to 28.9	29 to 38.9	39+	1+	TOTAL
TPA	51	73	57	7	2.7	0.5	0.1	0	139	190
QMD	0.1	3.1	7.2	12.6					6.3	5.5
HEIGHT	3	11	23	41	56	70			19	15
AGE		22	28	66	80				37	
BA	0	4	17	6	4	1	0.3	0	32	32
BAG ₅	0	1.1	5.2	0.9	0.4	0.1			7.6	7.6
TCUV	0	28	218	105	94	39	10	1	494	494
TBFV ₁₀₋₆	0	0	149	489	462	223	63	5	1391	1391

*** ABBREVIATIONS**

- TPA - Trees per Acre
- QMD - Quadratic Mean Diameter (in.)
- BA - Basal Area (ft²/acre)
- BAG₅ - Basal Area Growth in Last 5 Years
- TCUV - Total Volume, Cubic Feet
- TBFV₁₀₋₆ - Total Volume, Board Feet, 10" dbh to 6" top

PLANTATION INVENTORY AVERAGES (ACRE WEIGHTED)

PLANTATION STRATA AGE CLASSES 1,2, AND 3 (>10 YRS OLD)

FOREST TYPE: JEFFREY PINE

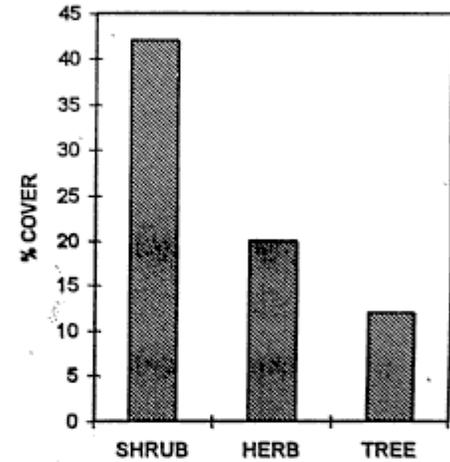
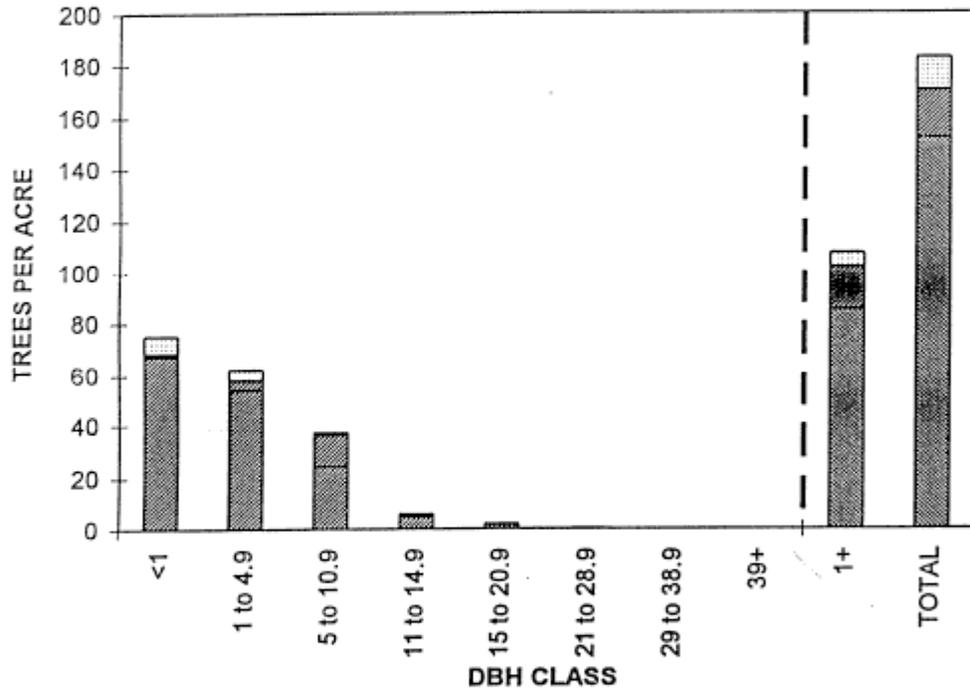
NATIONAL FOREST OCCURRENCE: PLUMAS, TAHOE, INYO

SIZE: 14,000 ACRES
SITE CLASS: 4

INVENTORY YEAR: 1991
YEAR OF ORIGIN: 1970

AGE: 21
HABITAT STAGE: 3P, 1X

OF SAMPLE POINT CLUSTERS: 70
OF SAMPLE POINTS: 447



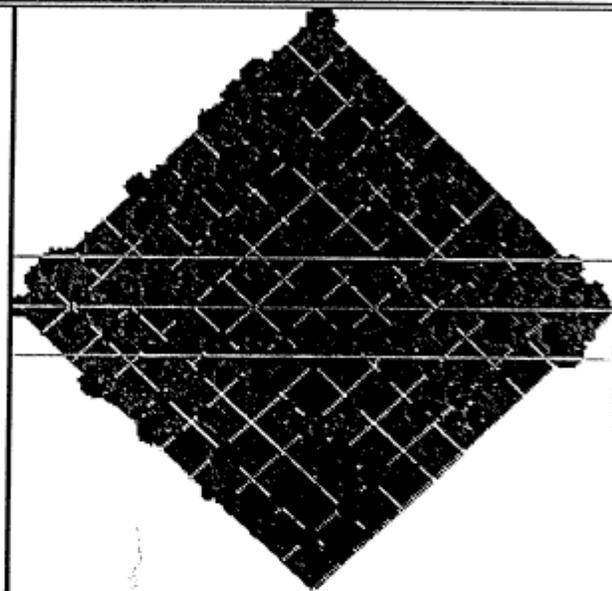
% COVER	42	20	12
HEIGHT	2		17
# OF SPECIES	11	4	4
<u>DOMINANT SPECIES</u>			
CEVE3		UG	JP
CEPR			
ART5			

STATISTICS*										
TPA	75	62	37	6	2	0.3	0.1	0.01	107	182
QMD	0.1	2.8	7.3	12.4					6.1	4.9
HEIGHT	4	10	22	33	50	63			17	13
AGE		19	25	42	63				46	
BA	0	2	12	5	3	1	1	0	24	24
BAG ₅	0	0.8	4.6	0.8	0.3	0.1			6.9	6.9
TCUV	0	8	94	55	55	21	14	2	250	250
TBFV ₁₀₋₆	0	0	45	159	242	97	93	14	650	650

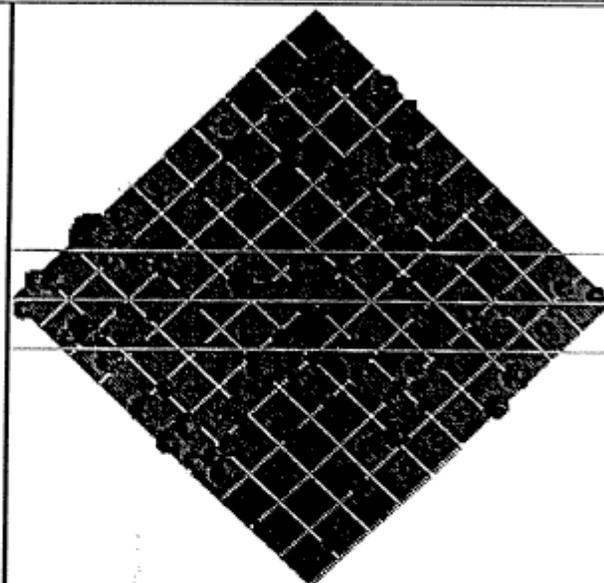
*** ABBREVIATIONS**

- TPA - Trees per Acre
- QMD - Quadratic Mean Diameter (in.)
- BA - Basal Area (ft²/acre)
- BAG₅ - Basal Area Growth in Last 5 Years
- TCUV - Total Volume, Cubic Feet
- TBFV₁₀₋₆ - Total Volume, Board Feet, 10" dbh to 6" top

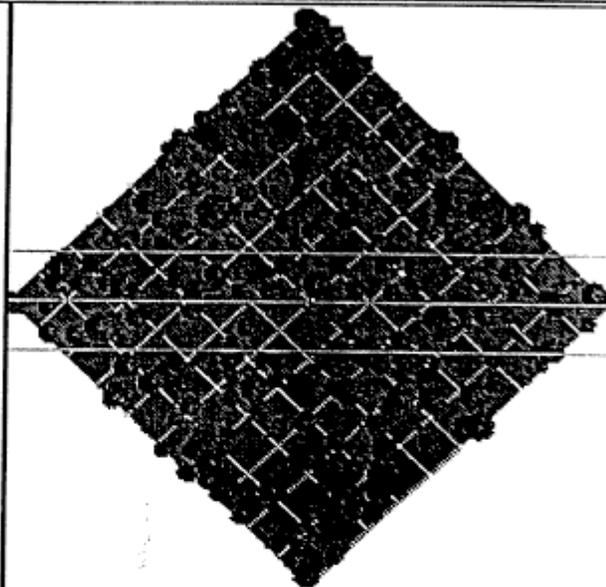
Tahoe NF
M2X Stratum Average
Random Distribution



Tahoe NF
M2X Strata
Cluster Plot 509
Random Distribution



Tahoe NF
Strata M2
Cluster Plot 524
Random Distribution



APPENDIX H

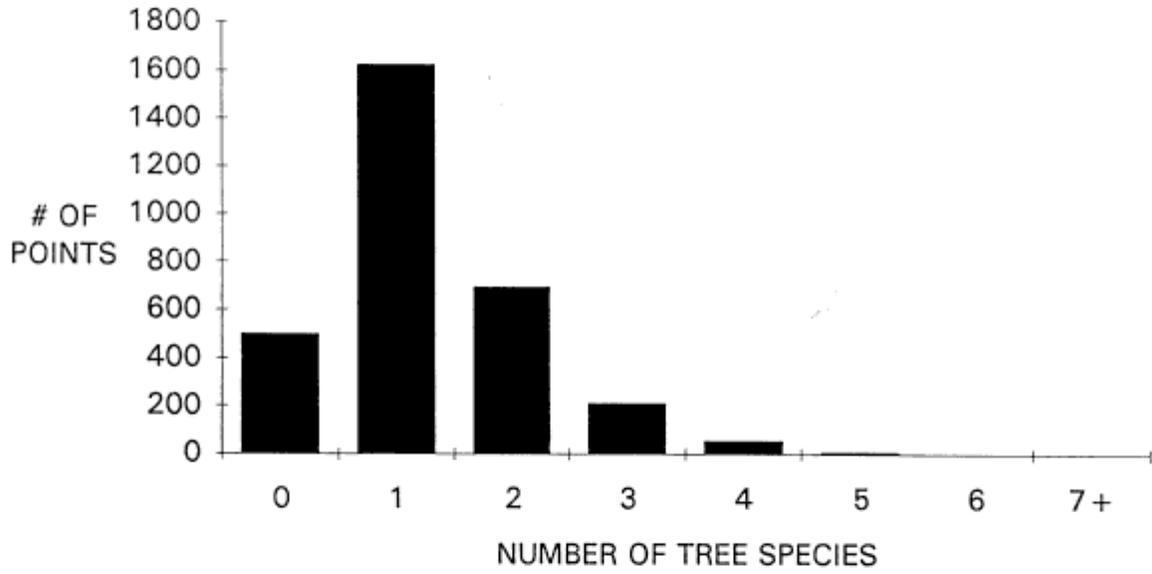
Variation Among Inventory Sample Points

About 3,000 individual sample points of data have been collected on plantations planted prior to 1981. The graphs on the following pages are frequency diagrams for selected attributes. They are intended to convey how many of the 3,000 points contain particular values for particular attributes.

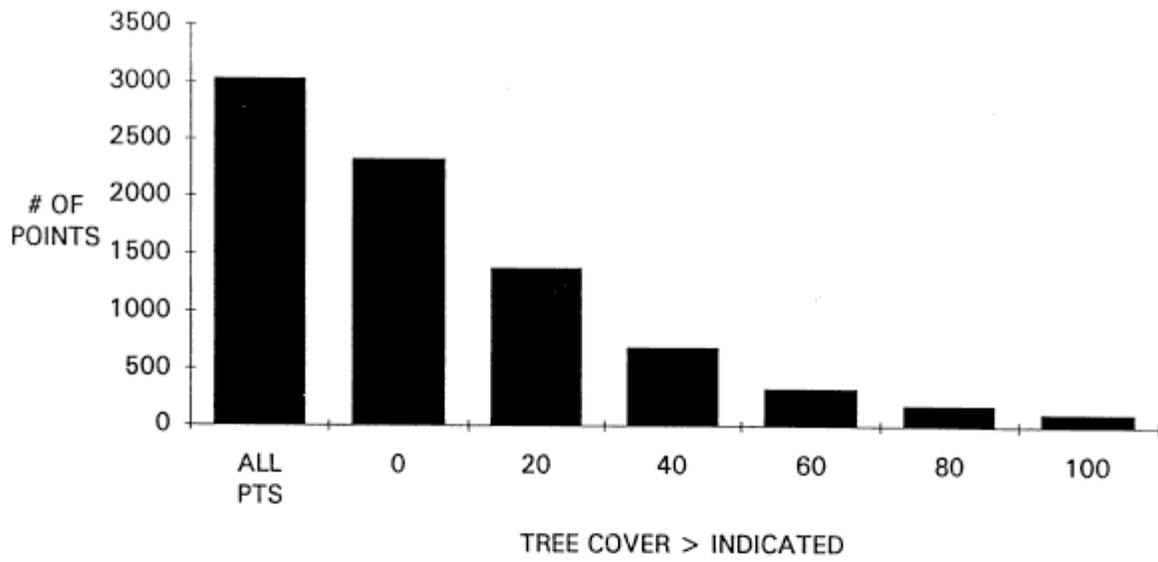
SNEP STUDY AREA



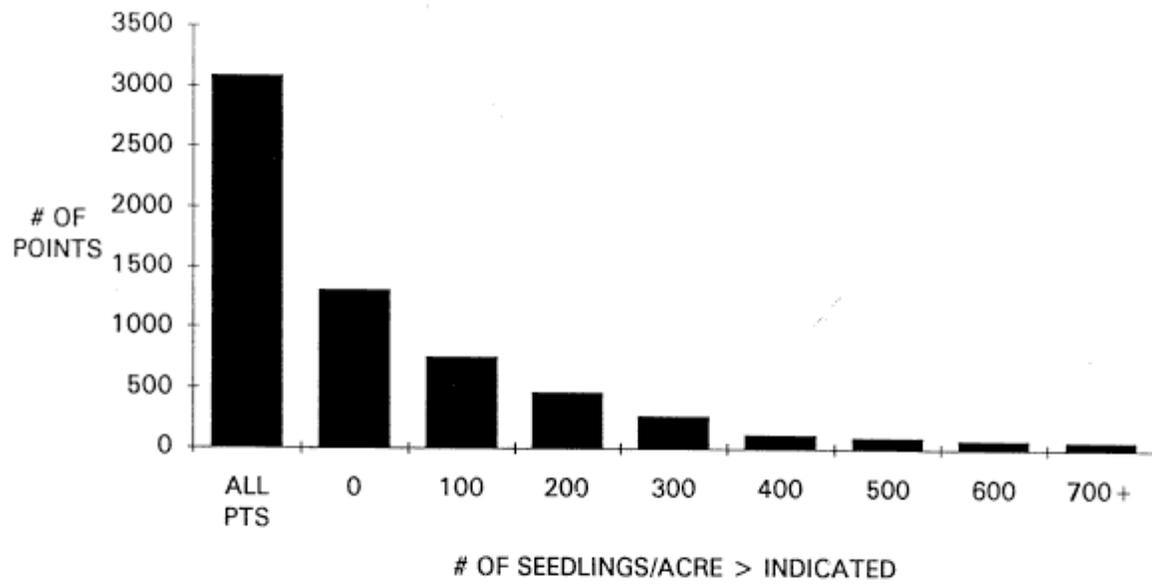
SNEP STUDY AREA



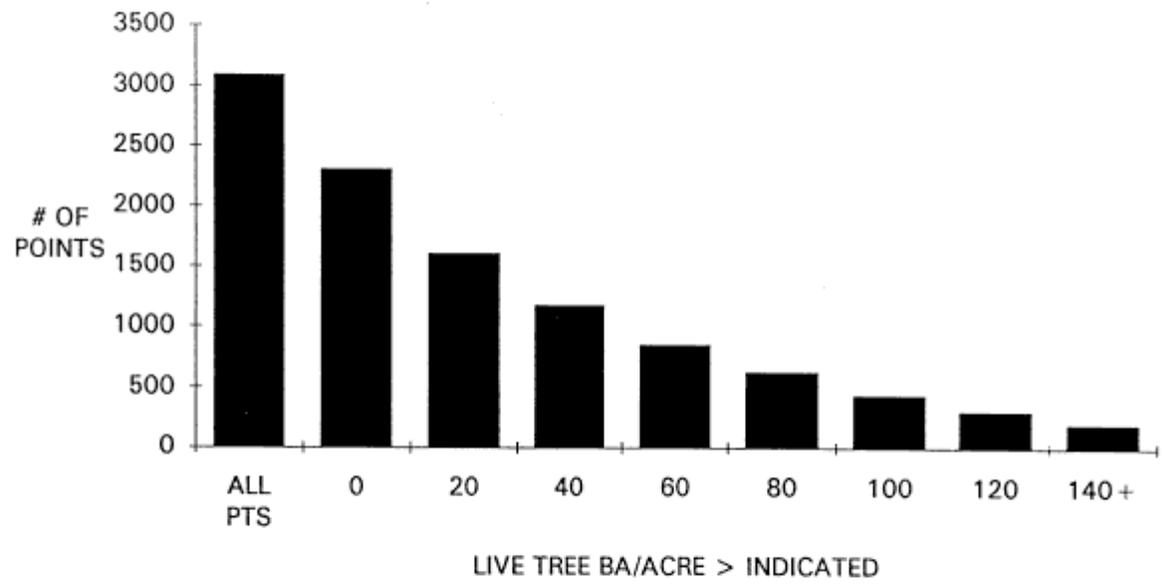
SNEP STUDY AREA
(EXCEPT SIERRA NF)



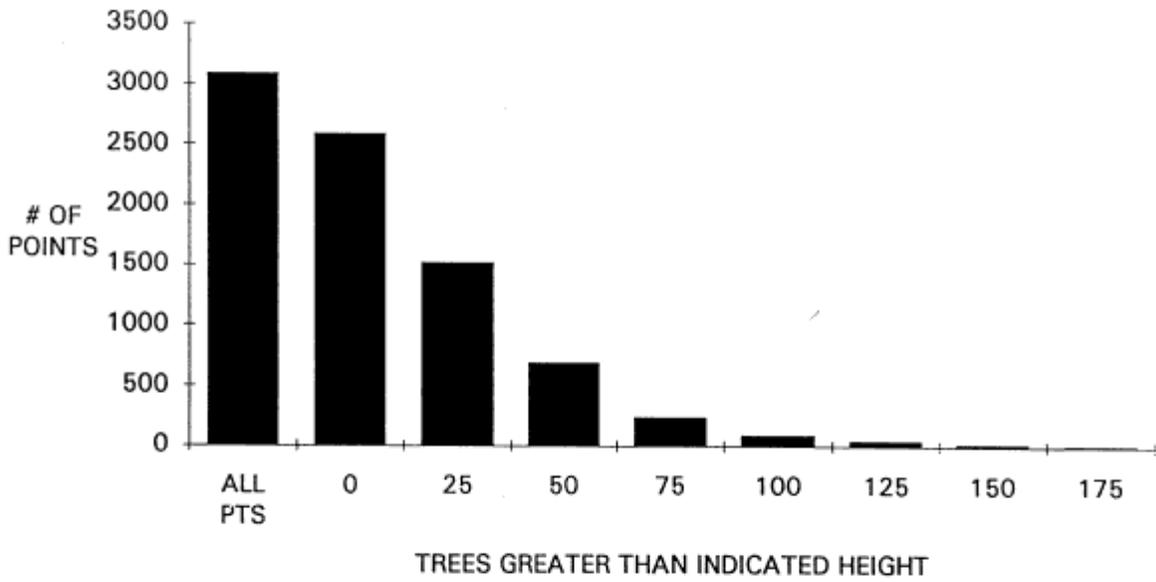
SNEP STUDY AREA



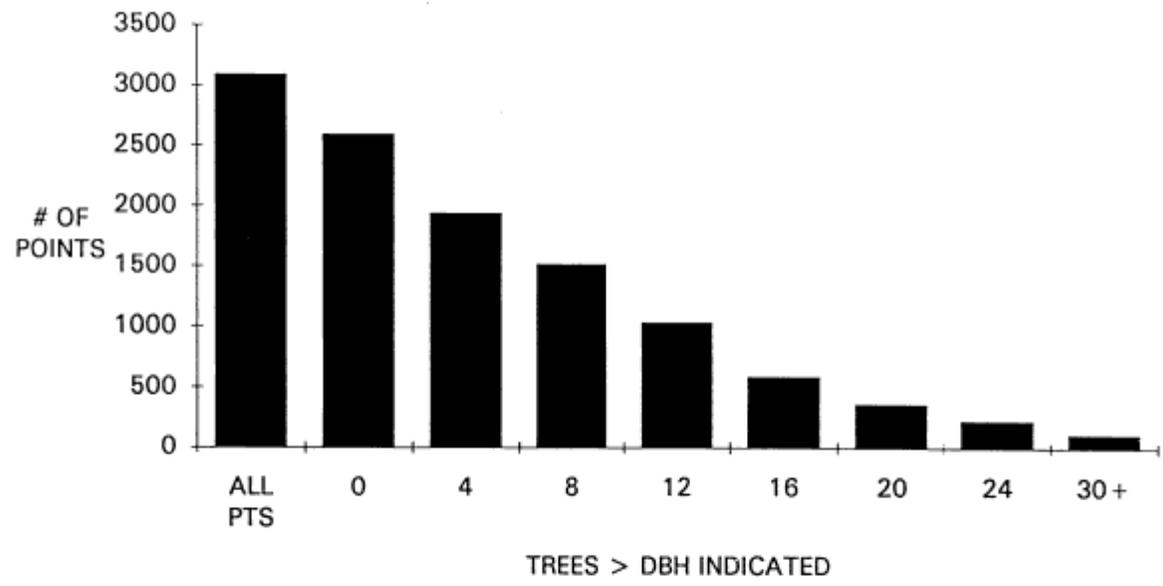
SNEP STUDY AREA



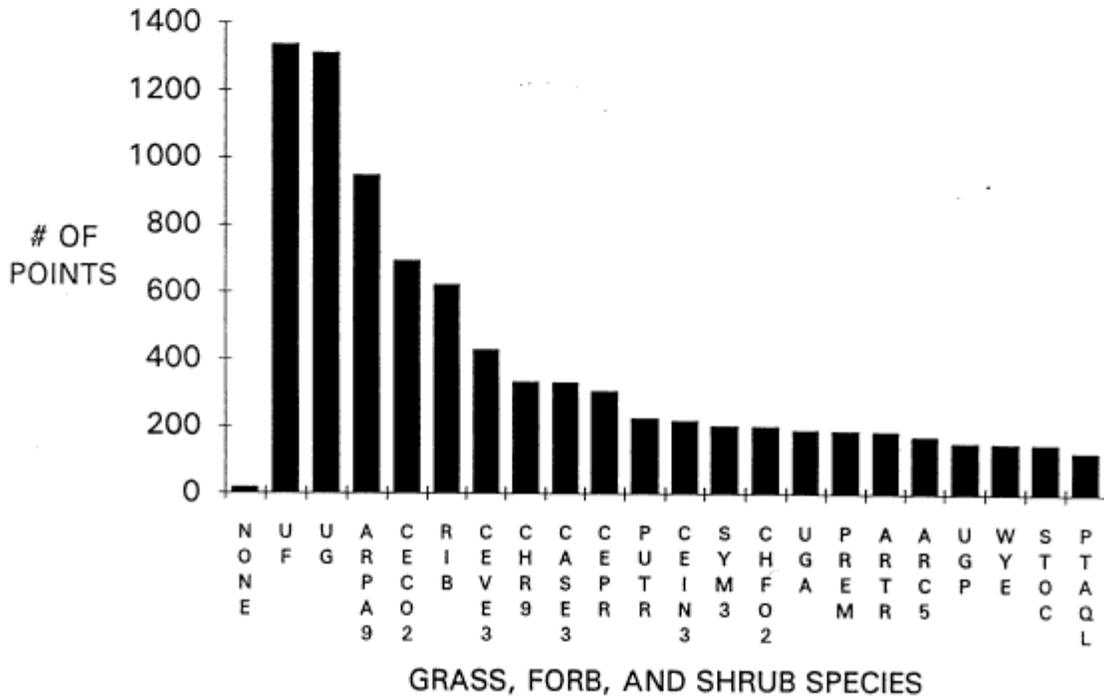
SNEP STUDY AREA



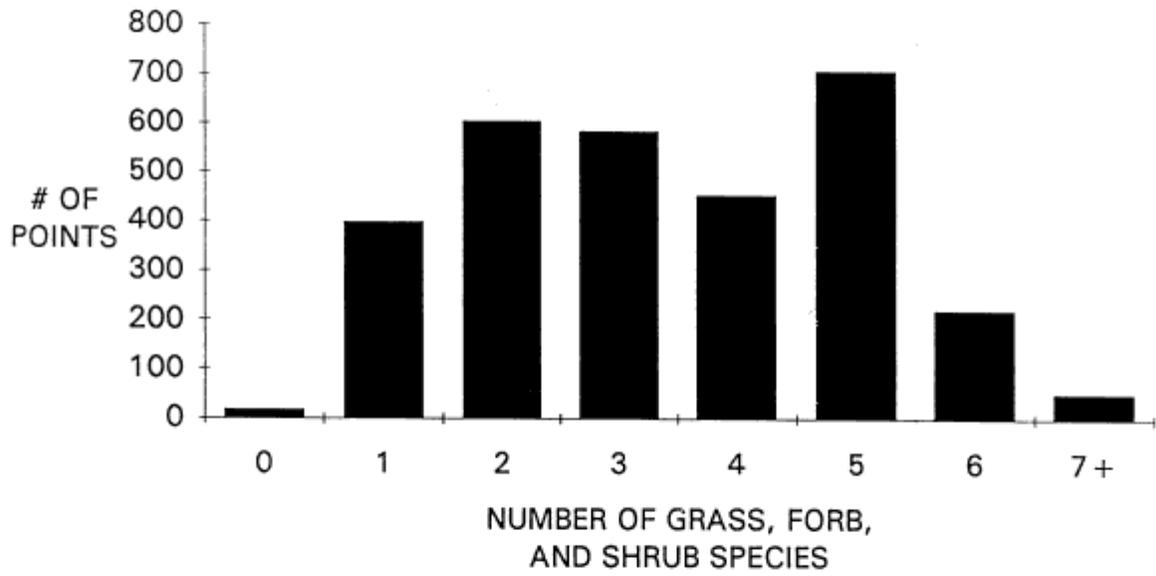
SNEP STUDY AREA



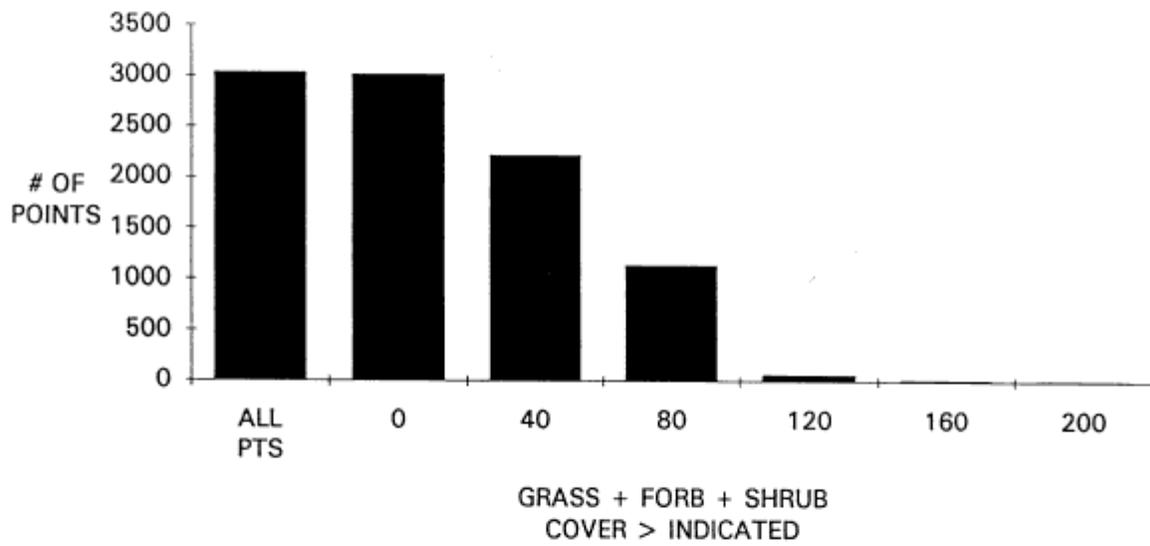
SNEP STUDY AREA



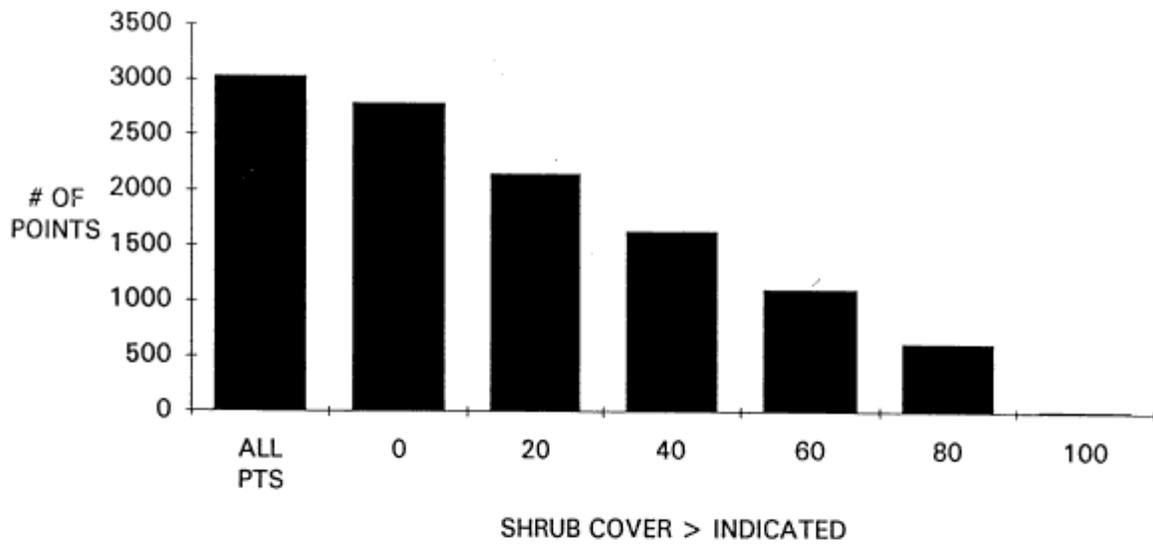
SNEP STUDY AREA



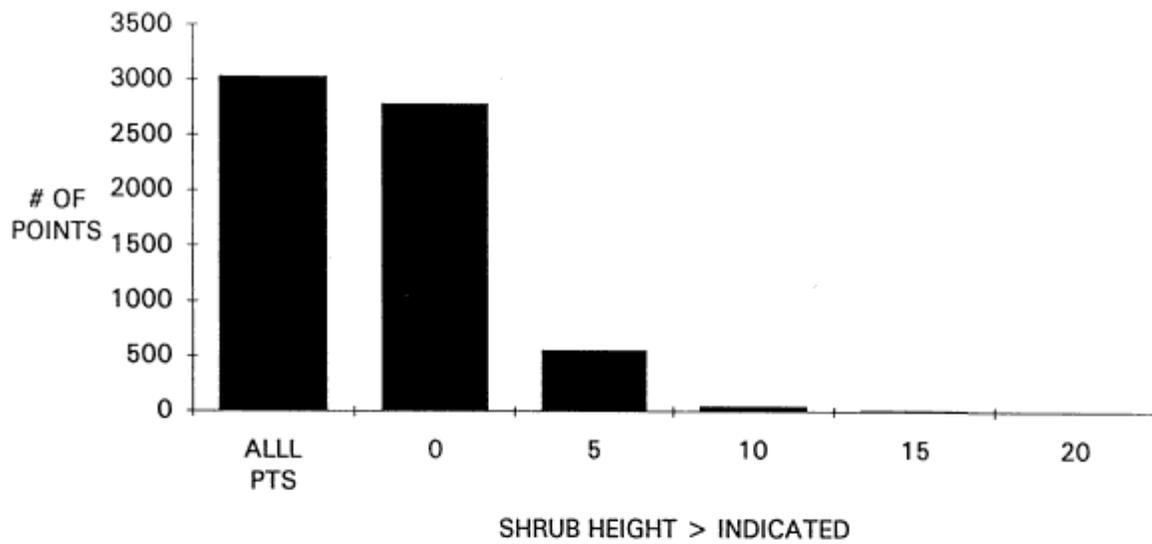
SNEP STUDY AREA
(EXCEPT SIERRA NF)



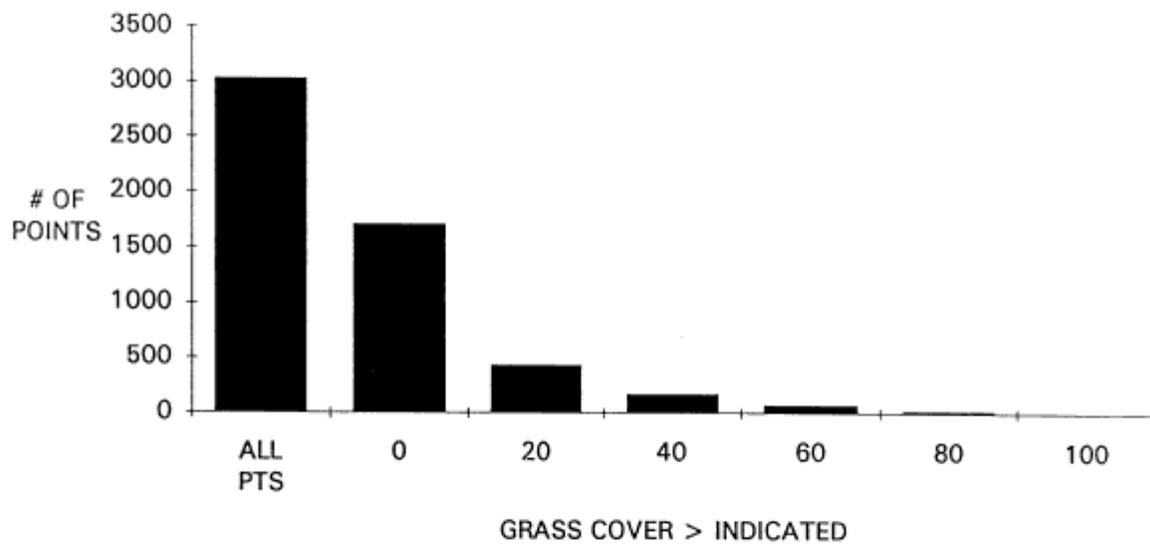
SNEP STUDY AREA
(EXCEPT SIERRA NF)



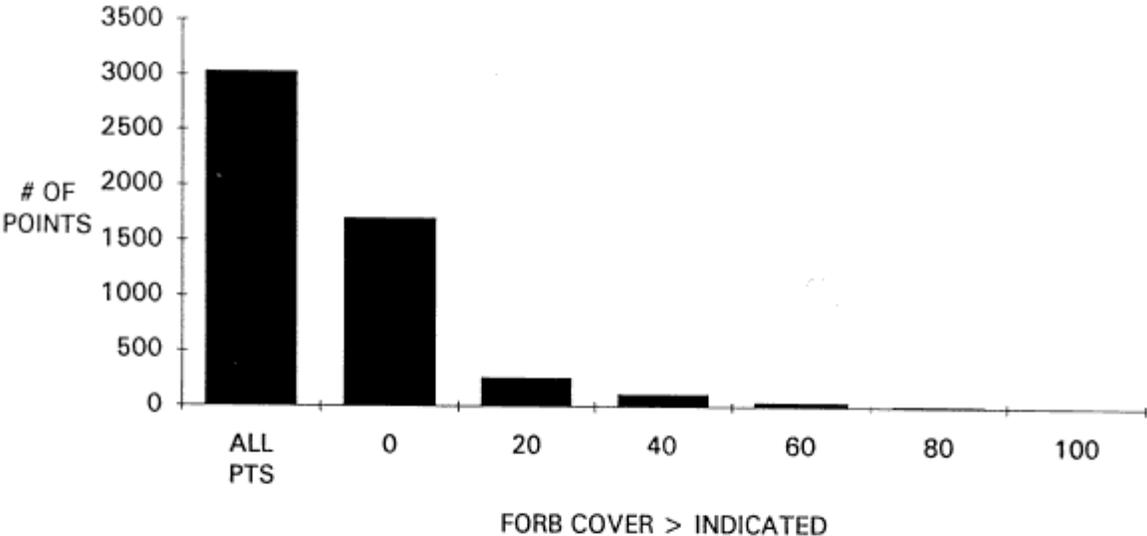
SNEP STUDY AREA
(EXCEPT SIERRA NF)



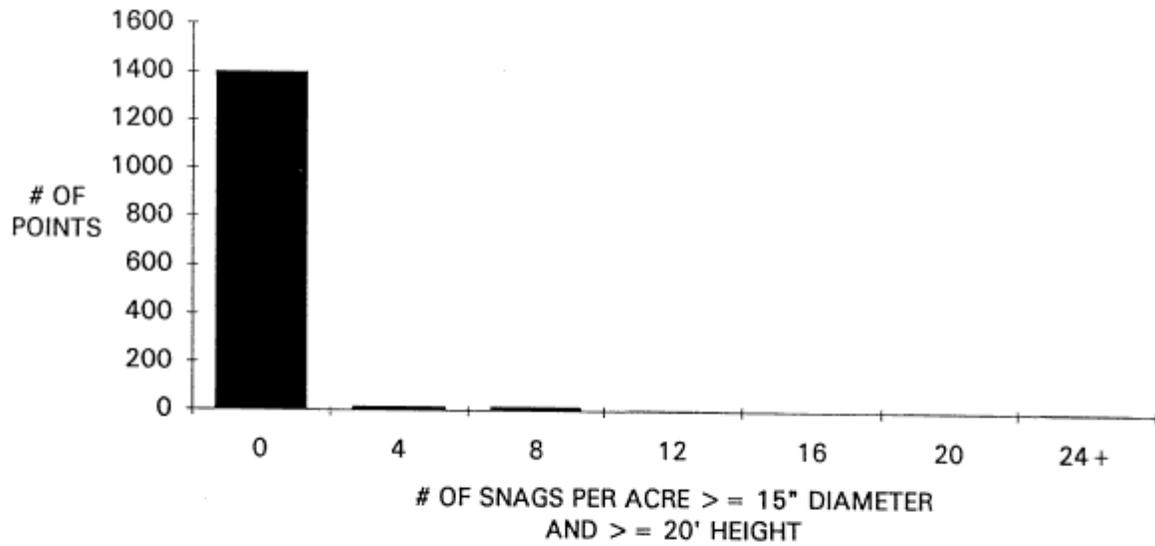
SNEP STUDY AREA
(EXCEPT SIERRA NF)



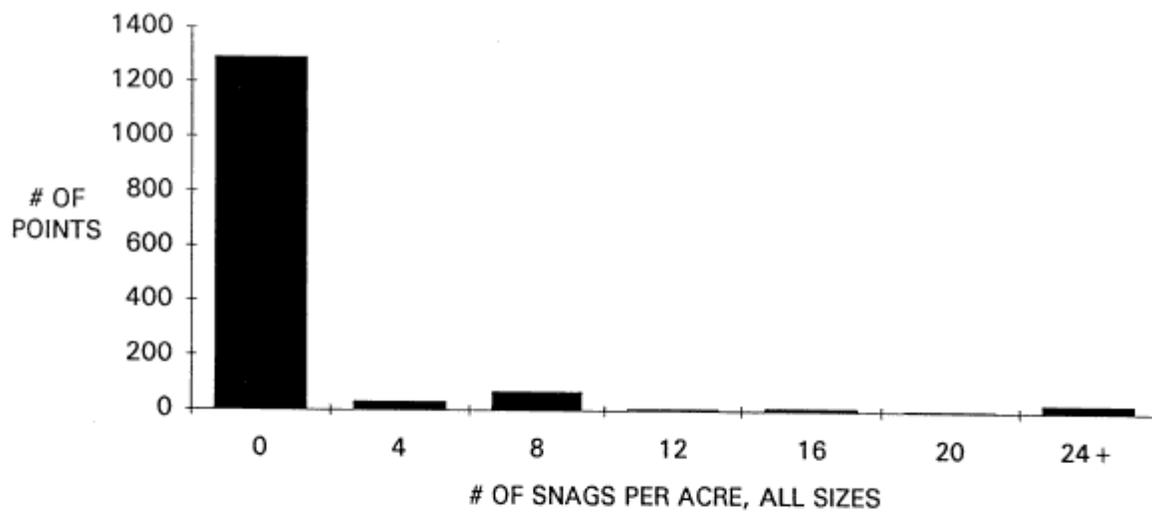
SNEP STUDY AREA
(EXCEPT SIERRA NF)



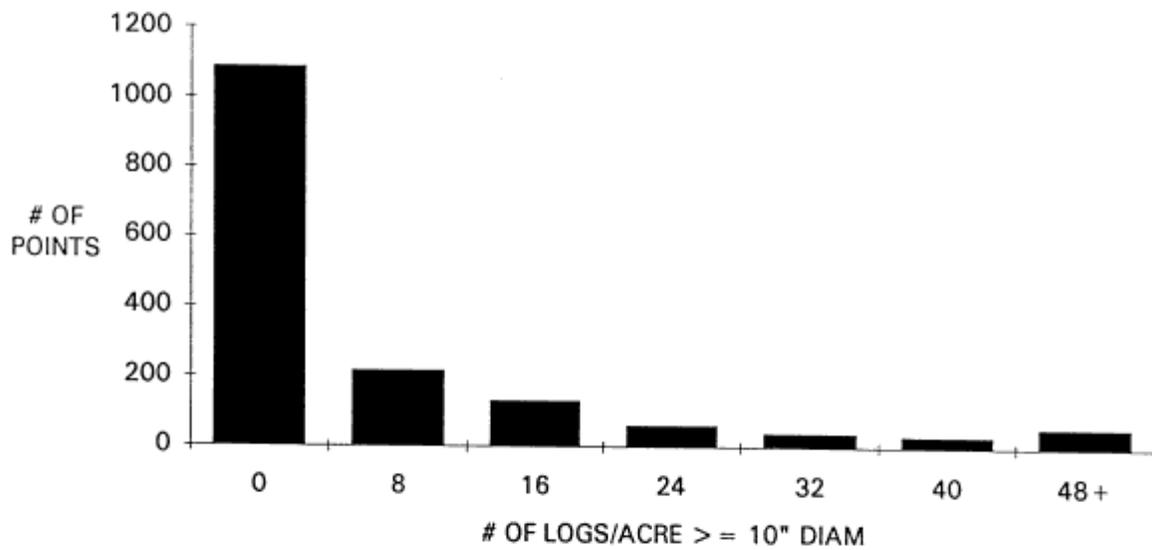
SNEP STUDY AREA
MODOC, LASSEN, ELDORADO, INYO NATIONAL FORESTS ONLY



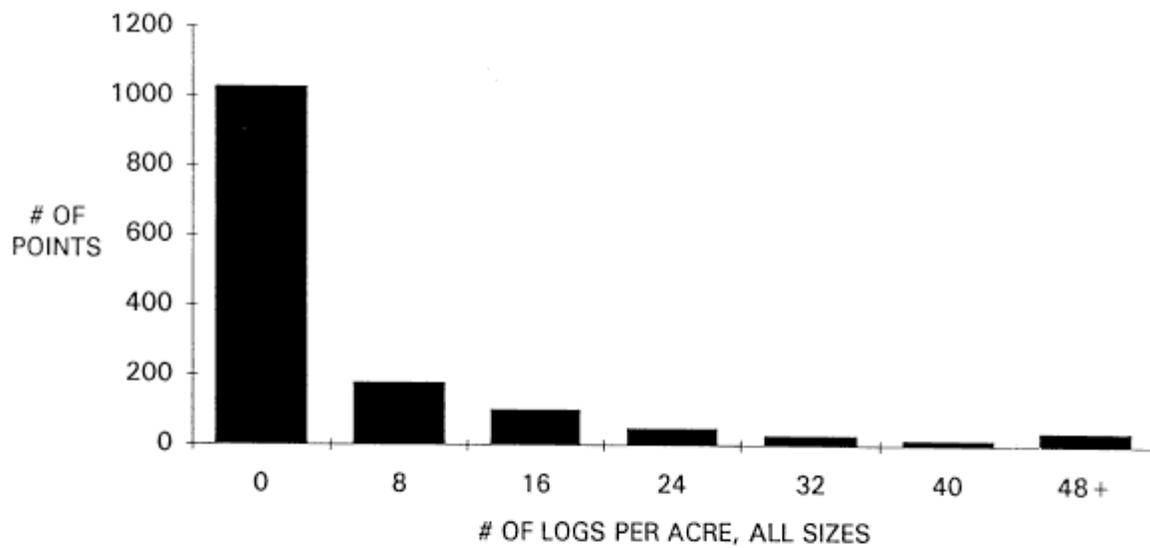
SNEP STUDY AREA
MODOC, LASSEN, ELDORADO, INYO NATIONAL FORESTS ONLY



SNEP STUDY AREA
MODOC, LASSEN, ELDORADO, INYO NATIONAL FORESTS ONLY



SNEP STUDY AREA
MODOC, LASSEN, ELDORADO, INYO NATIONAL FORESTS ONLY



APPENDIX I

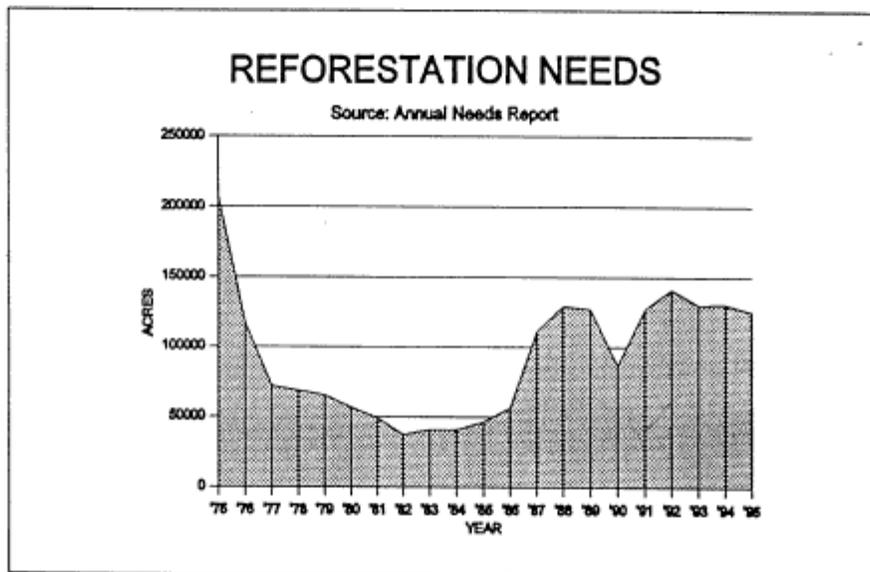
Traditional Program Indicators

TRADITIONAL PROGRAM INDICATORS

Reforestation Needs Report

Reforestation needs have been assessed annually in a relatively consistent fashion since 1973. Records are on file at USDA Forest Service, San Francisco, California. The Needs Report estimates how much total acreage is in need of reforestation under the current national forest land and resource management plans and is used to monitor trends, and as a starting place for program planning and budget negotiations with Congress. Figure 1 displays the history of total reforestation needs for the SNEP Study Area.

Figure 1



Needs estimates reflect a combination of management intent, levels of knowledge about the stocking conditions on the land base, planting rates, and trends in fire and harvest. Early 1970's estimates, reflective of management plans with most land considered suitable for timber production and many shrub covered areas lacking ground inventories, proved to be high. Subsequent improved inventories throughout the 1970's led to decisions to withdraw some areas from need, because either the lands were adequately stocked with trees or the lands did not qualify as suitable for timber production. In this same time period, planting rates exceeded the rate at which new areas were being created by fire or harvest. This combination led to the decline in need. Management plans in the early 1980's began to reflect a desire for increased harvest levels. Those increases happened in the late 1980's and, in combination with several large fires, caused needs to rise. Planting rates rose in respond to that need. 1990 is the year when the Needs Report was automated from stand records. The dip in that year is a reporting anomaly associated with that change.

Accomplishment Reports

Annual acreage treated has been reported and is on file (USDA-FS, 1956-1965; USDA-FS, 1966-1994) for the following reforestation activities for all or part of the period:

Pre-treatment Examinations

Site Preparation for Planting or Seeding

Planting

Seeding

Site Preparation for Natural Regeneration

Stocking/Survival Examinations

Animal Damage Control

Certification of Planting (seedling establishment)

Certification of Seeding (seedling establishment)

Certification of Natural Regeneration With Site Prep (seedling establishment)

Certification of Natural Regeneration Without Site Prep (seedling establishment)

Using these reports, the intended indicator of success is a comparison between acres planted and certification of planting (establishment). The measure has never been reliable for these reasons:

It compares different land areas. The areas planted in a given year are different than the ones being certified. The comparison would be valid if the annual planting amount was constant, as it was in the 1970's, but not since.

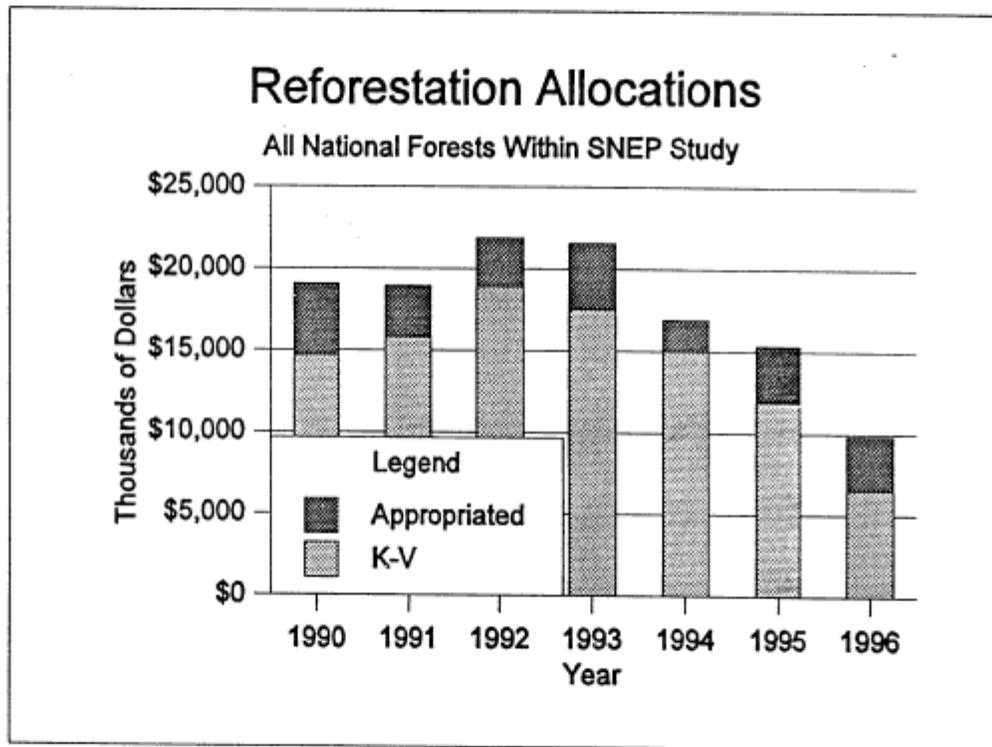
Incentives to conduct and report planting operations are built in to the budget and management performance evaluation system. No such incentives exist for conducting certifications.

Those that make the decisions to certify have a conservative bias. There is a tendency to withhold certification until the likelihood of tree persistence is virtually certain. Even low risks of fire, insect damage, animal damage, or dessication from moisture competition with competing vegetation are often viewed as cause to withhold certification.

Funding Levels

The primary source for reforestation funding is timber sale receipts retained for reforestation under the authority of the Knutson-Vandenberg Act of June 9, 1930 (46 Stat. 527; 16 U.S.C. 576-576b). A secondary source of funding for reforestation is annual appropriations from Congress. Total funding is declining because declining harvest levels have reduced available K-V funds; appropriations remain relatively constant, as displayed in Figure 2.

Figure 2



Unit Costs

The cost per unit of accomplishment is the primary management indicator of economic efficiency. Unit cost is calculated by dividing the funding level by the number of acres of *qualifying* accomplished activities. The activities that qualify are:

Planting

Seeding

Site Preparation for Natural Regeneration

Certification of Natural Regeneration Without Site Prep

The following activities are paid for with reforestation funds but accomplished acreage for these activities is not included in unit cost calculations:

Pre-treatment Examinations

Site Preparation for Planting or Seeding

Stocking/Survival Examinations

Animal Damage Control

Certification of Planting

Certification of Seeding

Certification of Natural Regeneration With Site Prep

Figures 3-6 display current trends. Allocations are on a downward trend. Qualifying activity accomplishments are stable (Figure 4). Unit costs, therefore, are on a downward trend (Figure 5). However, this has been achieved primarily by reducing the amount of site preparation (Figure 6), a non-qualifying activity. Decreasing the amount of site preparation will adversely affect the quantity of reforestation accomplished because some areas cannot be planted successfully without site preparation. For those areas that can be planted, reduced tree survival rates and increased release costs are expected.

Trends

Figure 3

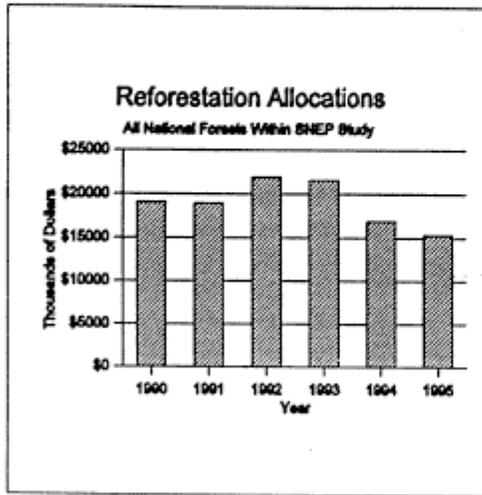


Figure 4

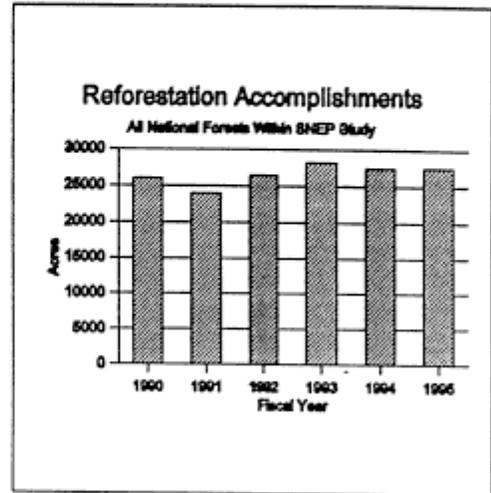


Figure 5

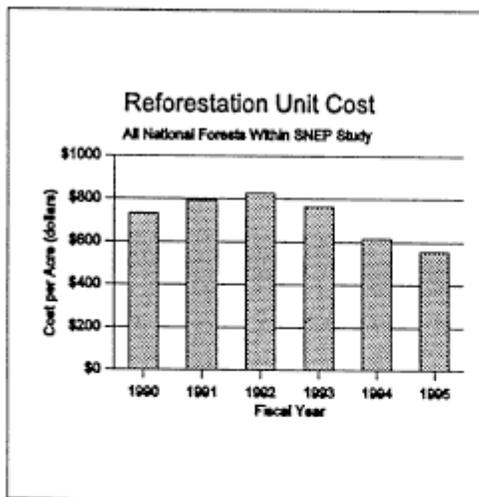
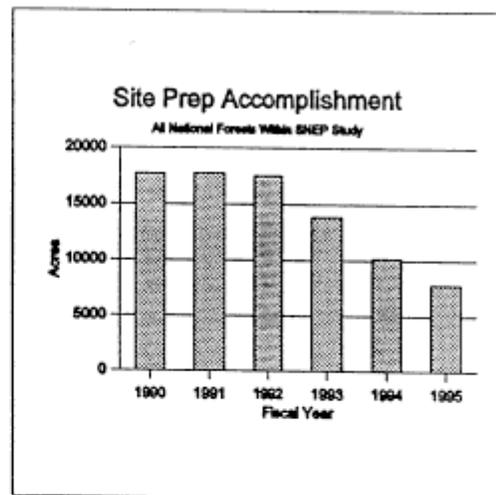


Figure 6



Tree Survival Report

Tree survival rates have been assessed at the end of the 1st and 3rd growing seasons for each land area planted since the Forest Service began operational planting (Fowells and Dunning, 1948). Records from 1980 forward are on file at USDA Forest Service, San Francisco, CA. Figures 7 and 8 summarize this information. Survival rates are used as a measure of efficiency. They convey little information about stocking success in plantations. Note that more shade tolerant species (firs) have lower survival rates than less tolerant species (pines), which is a result of their more restrictive physiologic requirements. Tradeoffs between survival rates and number of trees planted can be made to achieve the same stocking.. Cost is a driving factor in the decision regarding how many trees to plant.

Figure 7

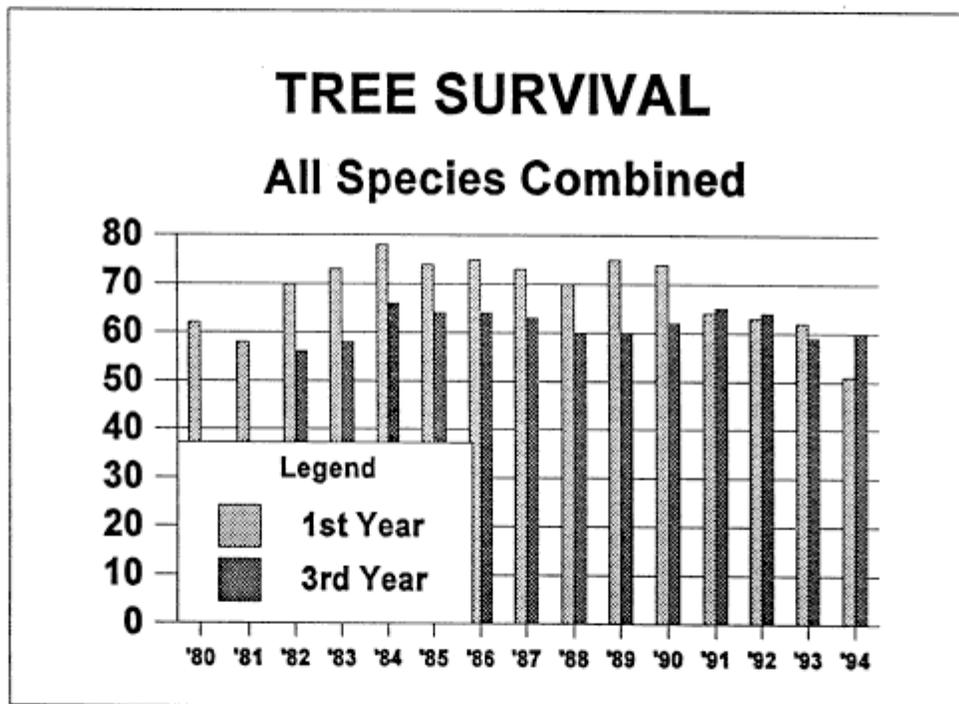


Figure 8

