Forest Health Pilot Monitoring Report

Vegetation, Fuels, Wildlife Habitat

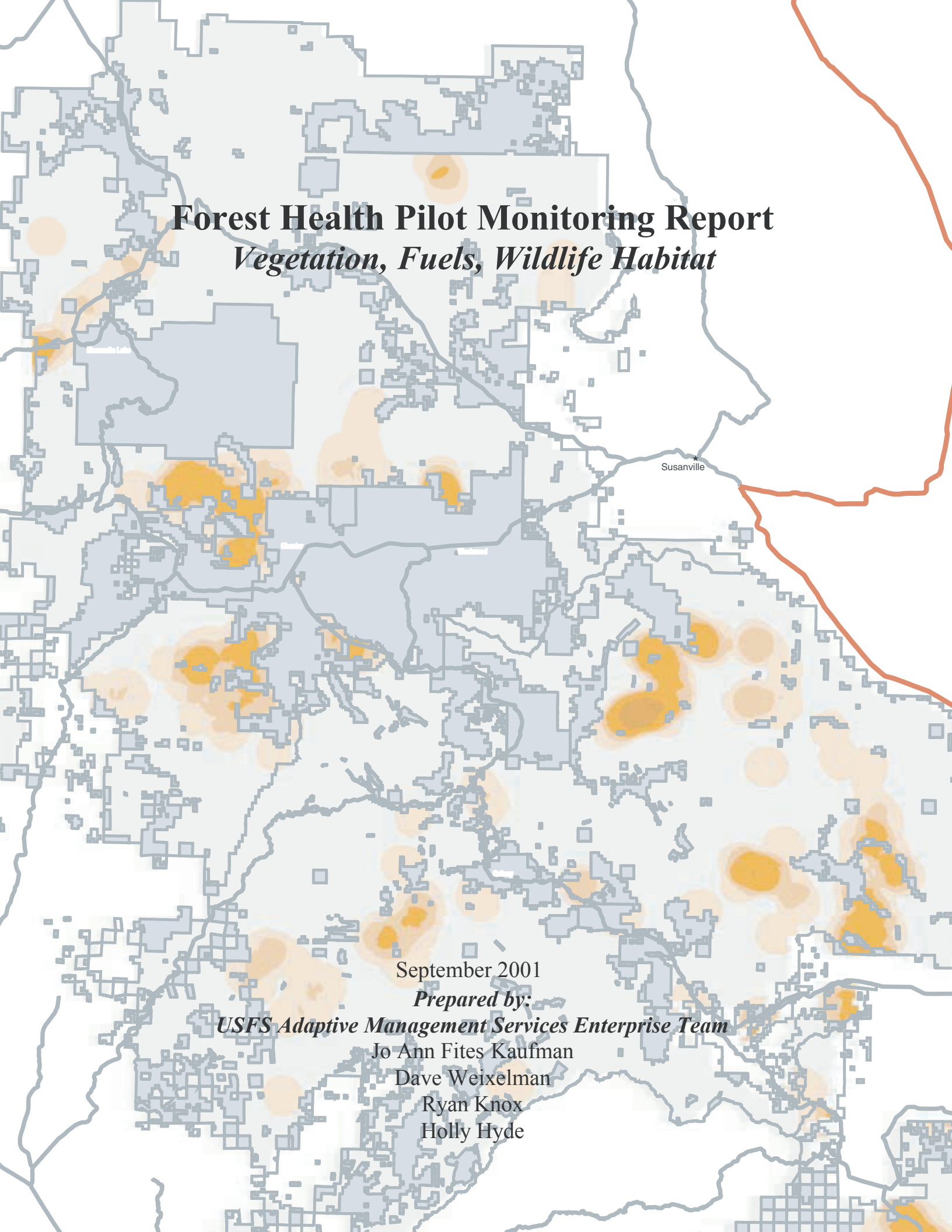

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Table of Contents

	Page Number
I. Introduction	1
II. Methods Summary	2
Statistical Design and Sampling	2
Ecological Stratification	2
Treatment Assignment and Stratification	3
Selection of Monitoring Indicators and Measures	4
Selection of Random Units and Reference Sites	5
Statistical Analysis	6
Field Sampling Methods and Protocols	8
Data Processing for Wildlife Habitat and Fuels Response Variables at Site and Landscape Scales	8
III. Results	9
A. Project Treatments and Current Status	9
B. Vegetation Structure and Composition	12
Site Scale	12
Cautions in Interpreting Results	12
Overstory Tree Canopy Cover	12
Eastside Pine	12
Mixed Conifer	13
Quadratic Mean Diameter	15
Eastside Pine	16
Mixed Conifer	17
Shrubs and Understory Cover	17
Eastside Pine	18
Mixed Conifer	20
Tree Densities by DBH Classes	23
Eastside Pine	23
Mixed Conifer	27
Landscape Scale	32
California Spotted Owl Habitat/Locations	32
Defining Owl Locations and Modeling Homeranges	32
Estimates of Overlap Between FHP Units, Owl Locations and Owl Habitats	34
C. Fuels and Predicted Fire Behavior	36
Site Scale	36
Crown Bulk Density	36
Eastside Pine	36
Mixed Conifer	37

Height to Live Crown 39
Eastside Pine 40
Mixed Conifer 41
Surface and Ground Fuels 44
1 Hour Fuels (0-1/4" diameter) 44
Eastside Pine 44
Mixed Conifer 45
10 Hour Fuels 47
Eastside Pine 47
Mixed Conifer 49
100 Hour Fuels 50
Eastside Pine 50
Mixed Conifer 51
Litter and Duff 52
Eastside Pine 52
Mixed Conifer 53
Total Surface Fuels-<3" diam 54
Eastside Pine 54
Mixed Conifer 55
Fuel Depth 57
Eastside Pine 58
Mixed Conifer 59
Fuel Models 60
Eastside Pine 61
Mixed Conifer 62
Predicted Fire Behavior 62
Flamelength 63
Eastside Pine 63
Mixed Conifer 64
Predicted Fire Type Under High Weather Conditions 66
Eastside Pine 66
Mixed Conifer 67
Landscape Scale 68

IV. Adaptive Management 70
Effectiveness of Treatments in Reaching Fire/Fuel Goals 70
Site Scale 71
Changes over time 73
Landscape Scale 73
Environmental Effects 74
Wildlife Habitat & California Spotted Owl 74
What Habitat Was Affected & How? 75

How Much Habitat Was Affected Within Homeranges & How Many Were Affected? 75
Monitoring Operations: Design, Indicators, Field Methods, Data Analysis, Costs and Time 76
Design: Pre-Existing Conditions& Retrospective Design 76
Effectiveness of Monitoring Indicators 77
Field Methods 78
Differences Between Ecological Groups 79
Tracking Projects 79
Analysis 80
Costs & Time Involved and Value Derived 81

V. Summary and Key Findings 83

Appendix A. 86
Detailed Description of Field Sampling Protocols and Data Processing Methods and Models

Appendix B. 96
Project and Unit Treatment and Status Database

Literature Cited 129

Appendix C. Maps 131

I. INTRODUCTION

This report summarizes the vegetation, wildlife habitat and fuels portion of the Forest Health Pilot (FHP). FHP projects have been designed to reduce risk of stand replacing fires, improve stand health, and improve riparian and aquatic condition on the Lassen and Plumas National Forests and the Sierraville Ranger District of the Tahoe National Forest. The projects involve a wide variety of treatments including: thinning, prescribed burning, biomass, thinning and burning, and sanitation or salvage. Some of the treatment units were specifically designed and implemented as part of a network of strategically placed defensible fuel profile zones (DFPZ's) (Olson et al. 1995). An important part of the overall project is monitoring the effectiveness and environmental effects of treatments.

The FHP monitoring design was developed based upon two different conceptual models of ecosystem function. The most important model is a series of questions related to the environmental effectiveness and environmental effects of treatments and is described in the Tri-Forest Assessment (Fites et al. 1996, Appendix 5). This assessment focuses on the characterization of historic and existing conditions of vegetation, fire, and insects and pathogens in the FHP area. The second model was developed by the Sierra Nevada Province Assessment and Monitoring (SPAM) Team (Manley et al. 2000) and conceptualizes how ecosystems function and likely respond to treatments. The Tri-Forest Assessment provided background information on important measures to track and key conditions upon which to stratify sampling and analysis. The SPAM model provided additional background information on which measures allowed us to best answer the monitoring questions identified below. The questions were developed based upon objectives of the pilot and input from the Forest Supervisors and the public, including the Quincy Library Group.

The overall FHP monitoring program was designed to answer three questions:

1) determine if projects were implemented as planned;
2) assess project effects on resources; and
3) assess project effectiveness.

The specific questions that relate to vegetation and fuels are:

1) what are the effect of treatments in modifying fire behavior?; and
2) what are the short-term differences between treated and untreated stands in terms of wildlife habitat, fuels, fire resiliency, and forest composition and structure?

This report contains the initial results of monitoring pre- and post-treatment vegetation conditions across the FHP area. The projects have only been implemented in the last several years. Therefore, most of the post-treatment results were obtained 1 to 2 years following treatment. Vegetation is continually changing, and therefore, these results may not reflect the full scope of effects that may occur in a longer time frame. The monitoring plan included plans for repeat measurements at the same site at 5-year intervals.

The vegetation portion of the monitoring pilot focused on a statistical sample design to evaluate differences between various treatments and between treated and untreated sites. Ideally, the design would focus on measurements before and after treatment over time in the same location to reduce variation in responses due to differences between individual sites. However, some of the sites had already been treated

prior to instigation of the monitoring pilot (referred to as treated).Therefore, in addition to measuring some sites before treatment (referred to as untreated) with plans to follow-up after treatment, we also designed the sample scheme to allow comparisons between both the treated and untreated sites with randomly selected stands from the landscape. We refer to these latter sites as reference sites.

The sampling design was also geared to provide information on changes at both the site and landscape scales. Reference sites were randomly selected, and treatment sites were digitized into a GIS layer enabling portrayal of significant changes detected at the landscape scale. All of the results presented here are between treated and untreated sites or between either of these and reference sites. There is no data available yet on before and after treatment differences at the same site. Because we were unable to do a direct comparison of effects of treatments on an individual site, we also tested the assumption that sites selected for different treatments (e.g., thinning vs. burning) may have been different before treatment. This assumption was tested by statistical comparison of untreated sites of different planned treatments.

II. METHODS SUMMARY

A detailed description of field sampling protocols are included at the end in appendix A. The methods summary focuses on the overall monitoring design and analysis.

Statistical Design and Sampling

Key components of the monitoring design include stratification of the data for sampling, categorization of treatments and assignment of treatment categories, sample selection, selection of monitoring response indicators and variables and statistical analysis approaches.

Ecological Stratification

A stratified random approach for sampling was used, based on ecological zones and forest types. This stratification procedure is detailed in the Tri-Forest Assessment (Fites et al. 1996). In summary, the FHP area was divided into three major ecological zones based upon differences in precipitation and vegetation communities: eastside, transition, and westside (Table 1). These ecological zones were further stratified into ecological groups based on forest type (dominant tree species) and topographic conditions reflecting different microclimates (aspect and elevation) (Table 2). The purpose was to develop strata where vegetative response to treatments (i.e. thinning or burning) and historic conditions would be similar.

Table 1. Characteristics of ecological zones used to stratify sampling.

	Ecological Zone			
	Eastside	**Transition**	**Westside**	
			central	*wet*
Precipitation (average annual)	<30”	30”-45”	45”-60”	>60”
Forest Types	Yellow Pine	Mixed Conifer	Mixed Conifer	Mixed Conifer

Table 2. Ecological groups used to stratify within ecological zones.

Ecological Group	Ecological Zone	Dominant Species	Elevation	Aspect
Yellow pine - dry	eastside	Ponderosa and Jeffrey pine	5,000'-6,000'	S,W
Yellow pine - moist	eastside	Ponderosa and Jeffrey pine, white fir	5,000'-6,000'	N,E
White fir	eastside, transition	White fir	>6,000'	
Mixed conifer - dry	transition	Ponderosa pine, white fir, incense cedar, sugar pine	<6,000'	S,W
Mixed conifer- moist	transition	Ponderosa pine, white fir, incense cedar, sugar pine, Douglas-fir	<6,000'	N,E
Mixed conifer, low elevation - dry	westside	Ponderosa pine, incense cedar, black oak, Douglas-fir	<5,000'	S,W
Mixed conifer, low elevation - moist	westside	Douglas-fir, incense cedar, white fir	<5,000'	N,E
Mixed conifer, high elevation - dry	westside	Ponderosa and Jeffrey pine, sugar pine, incense cedar, white fir	5,000'-6,000'	S,W
Mixed conifer, high elevation - moist	westside	White fir, sugar pine, incense cedar	5,000'-6,000'	N,E
Lodgepole pine	eastside, transition, westside	Lodgepole pine	6,000'-8,000'	All
Red fir	transition, westside	Red fir, white fir	6,000'-8,000'	All

Treatment Assignment and Stratification

The projects were planned and designed by personnel from individual Ranger Districts. We queried District personnel for the projects they had planned and implemented or planned to implement with FHP funds or with other funds for projects consistent with FHP goals. Silviculturists, sale planners, and fuels officers on each District were asked to provide information on the location, treatment plans and implementation status. Random selections were made based upon the initial treatment information given to us. However, during the course of the monitoring pilot, some of the projects changed. Units were dropped, added, or modified and prescriptions were changed. This is common between the planning and implementation phases of a project, with changes needed identified in the NEPA process to mitigate environmental effects. As a result of the changes, some of the treatment assignments varied. We also found that some of the planned treatments had only been partially implemented. This was frequently the case for planned thin and burn treatments. Most of the time, only the thin treatment had occurred at the time the

units were sampled. We also found that there was inconsistency or lack of specificity in assigned treatments, especially for thin and biomass treatments. To provide more consistency, we developed mutually exclusive categories for thinning based upon the size of trees removed. In order to obtain sufficient sample sizes for statistical analyses, it was necessary to lump treatments. The individual treatment categories and lumped treatment categories are shown in Table 3.

Table 3. Individual and lumped treatment categories.

Treatment	**Description**	**Lumped treatment category**
Prescribed Burn	Prescribed burn	Burn
Biomass	Removal of trees <3" dbh	Biomass
Pre-commercial thin	Removal of trees <10" dbh	Biomass
Biomass -clearcut or overstory removal	Biomass following clearcut or overstory removal	Biomass/Clearcut-Overstory Removal
Thin: >0"	Removal of trees >0" dbh	Thin
Thin: >3"	Removal of trees >3"	Thin
Thin: >6"	Removal of trees >6"	Thin
Sanitation/Salvage		Salvage
Thin and Burn	Thin followed by prescribed fire	Thin and Burn

Selection of Monitoring Indicators and Measures

Indicators to monitor were selected based upon the key questions described in the Introduction and the conceptual models from the Tri-Forest Assessment (Fites et al. 1996) and SPAM (Manley et al. 2000). There is overlap in the measures used for indicators to address fire, wildlife habitat, and forest health questions. Table 4 displays the specific measures and indicators that relate to these questions.

Table 4. Specific measures and indicators.

		Process or Type of Question Addressed	
Indicator	Measure	Fuels/Fire Behavior	Wildlife Habitat
Fuels	Ground fuel loading	x	
	Surface fuel loading	x	
	Fuelbed depth (feet)	x	
Forest Structure	% Cover	x	x
	Crown bulk density	x	
	Crown base height (ft)	x	
	Quadratic mean diameter		x
	Tree density by dbh class		x
	Snag density	x	x
	Understory cover	x	x
	Shrub cover	x	x
Forest Composition	Tree density by species & dbh class	x	

Selection of Random Units and Reference Sites

Two separate processes were used to select treatment units and reference sites. For treated units, a database was created with a record for each individual unit within a project. There were 993 individual units from 85 projects entered into the database. The implemented or planned treatment and ecological group assignments were assigned to each individual treatment unit and added to the database. A stratified, random design was employed. Random selections were made using SPSS (1999) for each treatment-ecological group combination.

For the reference sites, a GIS layer was developed from the timber strata layers of each National Forest. Stands were queried for those most likely to receive forest health treatments. These stands included: 1) forested stands (vs. non-forested); 2) tree cover >40%; and 3) average stand diameter >12" dbh (strata size classes 3 or 4). The queried layer was then stratified into ecological groups based upon Digital Elevation and Terrain Model (DEM) data and forest types from the timber strata using the criteria shown in Table 2 above for assignment of individual units. From this filtered layer of stands, polygons were randomly selected in ARC-INFO for sampling as reference stands. Ten stands in each ecological group were selected. A total of 55 different reference sites were sampled.

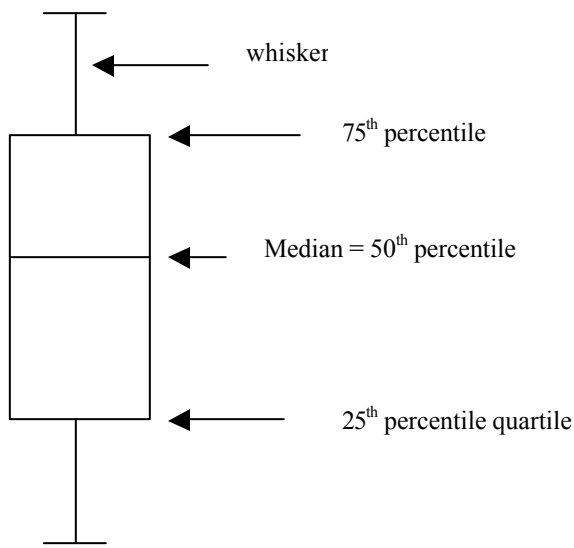
Statistical Analysis

Several approaches were used to analyze the data. First, simple descriptive statistics were applied, especially in the form of graphs to portray overall patterns in the data. Second, more formal, inferential statistical tests were evaluated and some applied.

Descriptive Statistics

Box plots, that include the median, 25th and 75th percentiles and high and low ranges were created using SPSS (1999). Figure 1 shows the box and whisker plot and the 25th, 50th, and 75th percentiles. The median line represents the middle value after the data have been sorted from lowest to highest. The median therefore represents the 50th percentile, where 50% of the values fall below the median value and 50% fall above the median. The upper boundary of the box represents the 75th percentile and therefore 75% of the values fall below this value. The bottom boundary of the box represents the 25th percentile and therefore 25% of the values fall below this value. The whiskers are lines that extend from the box to the highest and lowest values excluding outliers. Outliers are values that are greater than 1.5 times the box length away from the median and less than 3 times the box length away from the median.

Figure 1. Boxplots diagram showing the 25th, 50th, and 75th percentiles.



The SPSS software uses the Tukey method for calculating the percentiles (called "hinges" in the Tukey method) in the box plot. This method uses the following steps:

1) Find the median of the data.
2) Divide the data into two groups using the median, half above and half below.
3) Count the median in both groups when there are an odd number of values.
4) The 75th percentile is the median of the upper half.

5) The 25th percentile is the median of the lower half.

The data were lumped into major ecological zones and forest types based upon similarity in range of values. One group comprised all of the forest types in the eastside ecological zone. The second group comprised all of the mixed conifer and white fir types in the transition and westside ecological zones. The third group included red fir forests throughout the westside and transition zones. The fourth group included lodgepole pine throughout all of the ecological zones.

For each of these groups, treatments were lumped based on similarity in range of values and to increase the sample size for under-represented categories. The groupings were the same as those used in the formal, inferential statistical analysis described below, and displayed in Table 3 previously.

In the preliminary report we displayed means and standard errors. We have omitted these because many of the variables have skewed distributions rather than normal, bell-shaped distributions that underlie reliable estimates of means and standard errors from data.

Inferential Statistics

An important part of this monitoring pilot was development of scientifically credible and statistically rigorous and defensible analyses approaches. Given the limitations in the type of data that we were able to collect, this was not a trivial task and traditional approaches were not available for the task. We evaluated three different inferential statistical approaches. The first was a more traditional analysis of variance and associated post-hoc tests. The second was a new approach designed specifically to apply to monitoring data but for chronic, local environmental impacts, the Impact vs. Reference Sites (IVRS) analysis (Stewart-Oaten and Bence 2001). The third approach included randomization tests (D. Lee, USFS-PSW pers. comm., Manly 1991).

In the preliminary monitoring report, we included results from analysis of variance and related post-hoc tests to test the difference between varied treatments, between pre- and post-treatment conditions and between ecological or forest types. This statistical approach was designed for experimental approaches where the treatments (such as thinning or burning) are randomly applied. We know from discussions with the districts and the descriptive statistics that this is not the case. Different areas are often selected for prescribed burning or thinning based upon differences in initial conditions, different management objectives or other varied and unknown reasons. Despite intensive efforts to conduct and complete this analysis, we have omitted the results from the final report because, in the end, in a final review with statisticians at the USFS Pacific Southwest (PSW) Research Station, we felt the results would not be defensible.

The second approach that we applied was a new one, published in May of this year (2001), designed for monitoring data that is similar in overall nature to ours. This is that there is not pre- and post-treatment data at the same site and that the treatments are not randomly applied. Stewart-Oaten and Bence (2001) proposed 3 different tests. The Impact vs. Reference site (IVRS) best fit our data. In this analysis, reference sites or untreated sites are used to develop predictive models of what conditions would be like before treatment. These predictions are then compared site by site with the post-treatment conditions and the results are displayed by individual treatment site. While we have used this analysis approach for some of the response variables, we found it to be "weak" in that it only highlighted the most obvious differences and that it did not directly answer key monitoring questions. Stewart-Oaten and Bence (2001) designed this for chronic, environmental impacts. Fuel treatments may not match the criteria of chronic. However, the IVRS test best fits our data and therefore we have presented the results here.

The third approach, randomization tests, was suggested to us by a PSW research scientist (D.C. Lee pers. comm.) at the presentation on the final report in August in Quincy. With this approach there are no assumptions about what represents a statistical population or the assumptions about normality or homoscedasticity (equal variances) that are required for the analysis of variance. The fact that the treatments were not randomly applied to sites still poses limitations on this analysis approach, as it did for the analysis of variance. We therefore, are limited to statistical comparisons of individual treatments with the randomly selected reference sites.

We chose to analyze the data using randomization tests instead of parametric tests in order to test the null hypothesis of no difference because randomization tests make no assumptions about the shape of the distributions being compared. Parametric tests require normal distributions that are symmetrical about the mean while randomization tests make no assumptions about the distribution of the data or about symmetry. In addition, the small sample sizes for certain treatments results in low power to detect differences using standard parametric methods.

The randomization statistical test uses a bootstrap approach to test the differences between reference plots and plots identified for treatments, and between reference plots and plots having received treatments. The resampling routine pools reference plots with either pre- or post-treated plots, depending on the comparison to be made, and then resamples from the combined pool according to the original sample sizes. Resampling is done with replacement. By comparing the original observed differences to the distribution of differences generated by resampling, we can estimate an approximate p value for determining the likelihood that the two distributions are the same.

Both one-tailed and two-tailed test results are presented for the randomization tests. One-tailed tests allow us to test for differences between treatment and reference sites when the direction of change or possibility of a change is known in advance. Two-tailed tests are more stringent and allow us to determine if a significant difference exists when the direction of change or possibility of a change is not known in advance. We conducted both one and two-tailed tests.

Because the final decisions on the most appropriate statistical analysis were arrived at near or when the final report was due, we were selective and only applied the tests to a few key variables. Our focus was on fuels first, since the primary intent of the pilot was in fuels treatments to improve forest health and secondarily on wildlife habitat variables.

Field Sampling Methods and Protocols

In general, quantitative measurement techniques were applied to obtain data on fuels, vegetation structure, composition and wildlife habitat. A series of nested, fixed-area plots were used for most of the data. Three plots were randomly placed within each treatment unit or stand sampled. For shrub, understory cover and surface fuel loadings, line intercept transects were applied. Overstory tree canopy cover was measured at 5 separate points within each plot. A detailed description of the data collection methods and protocols are included in an appendix.

Data Processing for Wildlife Habitat and Fuels Response Variables at Site and Landscape Scales

In general, procedures and programs used for the SNCF and HFQLG EIS's were used to process data for this pilot. Specifically, FlamMap, a landscape fire behavior program, and GAMMA,

a stand structure program were used for key data processing. These are described in more detail in Appendix A and in the modeling sections of these documents. In addition, a number of custom programs were written in SPSS for computation and processing of response variables.

III. RESULTS

As described in the methods, several different statistical approaches were evaluated and tested. The final decision on the most appropriate method was not made until August of this year. Therefore, we were unable to rerun the statistical analysis on all of the variables and selectively emphasized a few of the key fuels variables. The results reflect this process. Some of the response variables have all of the analyses results shown and others have only part. Those with missing IVRS or Randomization Test results are those where we were unable to complete the full spectra of planned statistical analysis.

PROJECTS, TREATMENTS AND CURRENT STATUS

The FHP projects include 45,791 acres of treatment, of which 93% have been completely or partially treated (Table 5). Most of the units have been mechanically treated to date. Although most of the treatments are mechanical thinning or biomass (93% of project acres), follow-up surface fuel treatments such as burning or mechanical piling are planned in many of these, but most have not been completed at the date of this report (6% of mechanically treated acres to date). Therefore, many of the thinned units could be considered partially treated thin and burn units but could not readily be analyzed as a third level of treatment status.

A complete listing of the individual Forest health projects and treatment units are displayed at the end of this report in Appendix B. To the best of our ability, this project database is accurate and complete.

An important caution in interpretation of the FHP treatment unit summary is that these are only the FHP treatments. Other projects, planned prior to the Forest Health Pilot and using other funds were and are ongoing. These include timber sales and especially prescribed burns. Two examples on Districts on two different National Forests illustrate the need for this caution. We were provided the entire prescribed burn history and planning layer for the Beckworth Ranger District on the Plumas National Forest. The District submitted a fraction of the past and planned prescribed burns to us when we requested a list of FHP projects because the FHP program did not fund these. Prescribed burn targets and accomplishments vary widely between districts and forests, so generalizing to all portions of the FHP based upon this one example is not appropriate. However, on at least some Districts, the acres of prescribed burning reported here are an underestimate of the area that has and is planned for prescribed burn treatments. Secondly, a thorough 10-year timber harvest and fuel treatment history was compiled across most of the Almanor Ranger District on the Lassen National Forest that overlaps with 1.5 mile radius circles around owl locations in the California spotted owl demographic study area. In this example, the FHP units represented 60% of the 8,881 acres in the 10-year treatment history.

Table 5. Summary of forest health pilot projects as of May 2001.

primary treatment	status	all acres	%	2nd treatment (in Acres) unknown	burn	pile & burn	machine pile & burn	roadside pile & burn	wildfire	all second treatments	% 2nd treatment
burn	planned	44	1%	44							
	treated	3068	99%	3068							
	partially treated	0	0%	0							
	total	3112		3112							
biomass	planned	14	0.2%	14							
	treated	7034	93%	4615	230	127	958	1104		2419	34%
	partially treated	516	7%	516							
	total	7564		5145							
cc or overstory removal then biomass	planned	0	0%	0							
	treated	623	100%	317	179	127				306	49%
	partially treated	0	0%	0							
	total	623		317							
thin	planned	813	3%	813							
	treated	27499	84%	18714	2519	938	170	5115	43	8785	32%
	partially treated	4108	13%	4108							
	total	32420		23635							
sanitation/ salvage	planned	250	19%	250							
	treated	1037	81%	392				645		645	62%
	partially treated	0	0%	0							
	total	1287		642							
shelterwood/ sanitation	planned	18	3%	18							
	treated	670	97%	491				179		179	27%
	partially treated	0	0%	0							
	total	688		509							
all mechanical treatments	planned	1095	3%	1095							
	treated	36863	86%	24529	2928	1192	1128	7043	43	12334	33%
	partially treated	4624	11%	4624							
	total	42582		30248							

VEGETATION STRUCTURE AND COMPOSITION

Site Scale

Cautions in Interpreting Results

Some of the sample sizes, or number of sites sampled, in different treatment categories are small. Interpretation of results when sample sizes are small should be conducted with caution because there is a greater possibility that the results may not be representative of the broader number of sites in that category, despite the carefully applied random selection of sample sites. A major reason for in-depth evaluation of different statistical analysis methods was trying to use the method that would most reliably describe patterns in the data and detect real differences. The randomization test was chosen in part because it allows reliable estimates with small sample sizes using re-sampling techniques. Despite the limitations with some of the sample sizes this data is amongst the most comprehensive of its kind in describing conditions before and after forest health and fuel treatments. Therefore, we felt it was important to report but with appropriate cautions applied.

Overstory Tree Canopy Cover

Eastside Pine

Overall Patterns

Overstory tree canopy cover mostly ranged from 20 to 60% across all treatments and treatment status, except for reference sites (Figure 2). Reference sites had higher canopy cover, ranging up to 90% cover. Reference sites were selected from those sites with >40% cover, which likely contributed to the higher levels sampled.

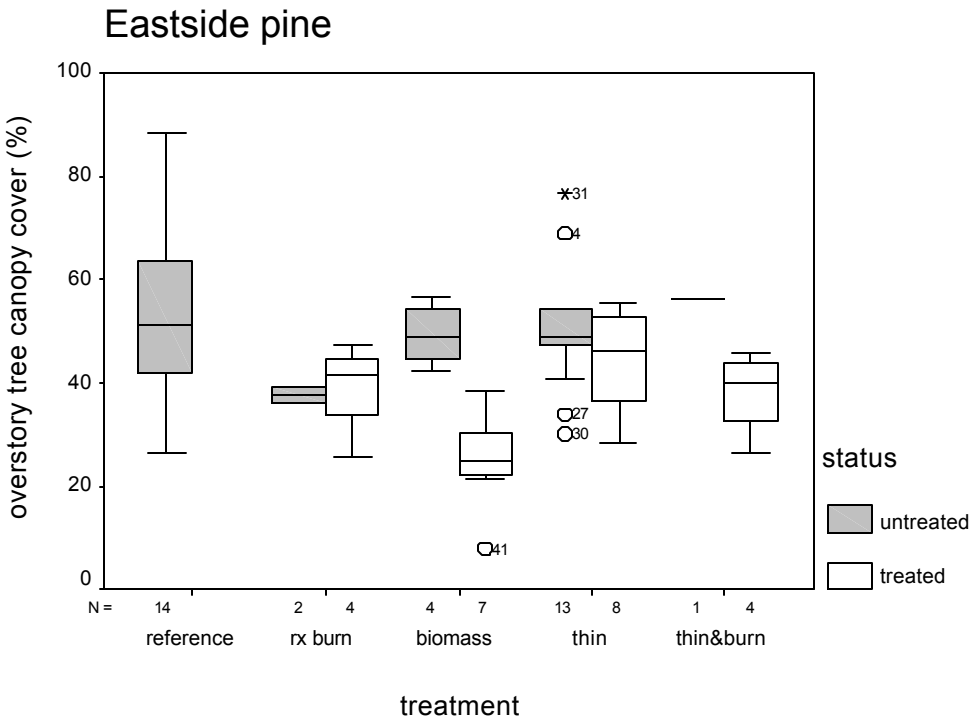


Figure 2. Box plot of overstory tree canopy cover in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Out of treatment units sampled before treatment, only those planned for burning had significantly different and lower canopy covers than the reference sites (Table 6). After treatment, those treated with biomass and thinning combined with burning had significantly lower canopy covers than reference sites.

Table 6. Results of randomization test for determining differences between reference sites and pre- or post-treatment overstory tree canopy cover in eastside pine.

Eastside Pine									
Variable: overstory tree canopy cover (%)									
Treatment	n	Median	Median Difference (treatment – reference)	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.10
Pre-Treatment									
Biomass	4	49	-2	0.37	N	N	0.79	N	N
Burn	2	38	-13	0.09	**Y**	N	0.32	N	N
Thin & burn	1	56	5	0.39	N	N	0.78	N	N
Thin	13	49	-2	0.28	N	N	0.57	N	N
Reference	14	51							
Post-Treatment									
Biomass	7	25	-26	0.01	**Y**	**Y**	0.03	**Y**	**Y**
Burn	4	42	-10	0.12	N	N	0.32	N	N
Thin & burn	4	40	-11	0.09	**Y**	Y	0.25	N	N
Thin	8	46	-5	0.24	N	N	0.46	N	N

Post-treatment levels compared with predicted pre-treatment levels-IVRS Results

Biomassed sites showed the greatest difference with predicted pre-treatment levels, with 71% of the sites significantly (p 0.10) lower than predicted (Table 7). Half of the thin and thin & burn sites had lower canopy cover than predicted but at a low significance (p 0.20) level. One of the burned sites had lower canopy cover than predicted levels before treatment (p 0.20). Close to one-third of the reference sites had higher canopy covers than predicted at untreated sites.

Table 7. Results of IVRS statistical tests for overstory tree canopy cover in eastside pine.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	8	0	0	0	0	0	50
Thin&burn	4	0	0	0	0	0	50
Burn	4	0	0	0	0	0	26
Reference	14	29	7	29	7	29	7
Biomass	7	0	29	0	71	0	86

Mixed Conifer

Overall Patterns

Canopy cover was generally higher in mixed conifer sites (Table 8) than eastside pine (Table 6), exceeding 40% on most sampled sites (Figure 3). Reference sites were mostly greater than 60% canopy cover. Burned sites, sampled either before or after treatment mostly had canopy cover lower than 40%, indicating that sites may be partly selected for burning based upon lower canopy cover.

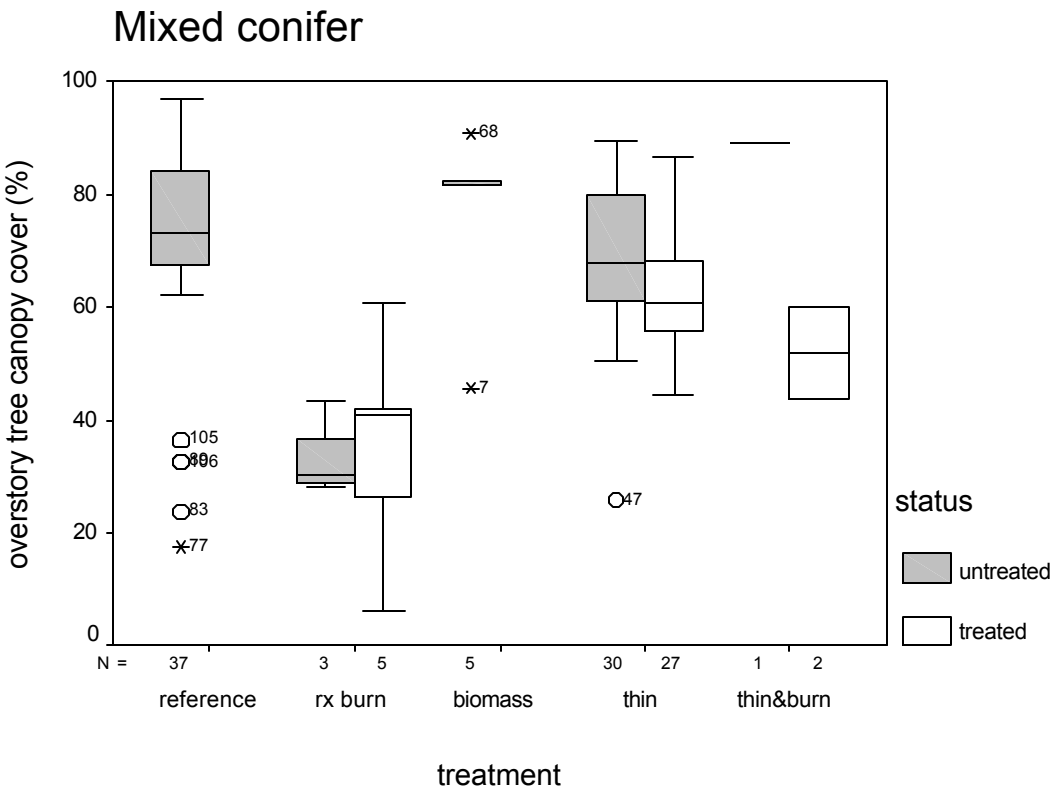


Figure 3. Box plot of overstory tree canopy cover in FHP sample sites by treatment type and treatment status in mixed conifer and white fir forests in the westside and transition zones. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Sites planned for burning and thinning both had significantly lower canopy covers than reference sites, although the difference was much greater for the burn sites (43% lower) (Table 8). Sites planned for combined thin and burn treatments had significantly greater canopy cover than reference sites. After treatment, the same treatments had significantly lower canopy covers than reference, burning and thinning.

Table 8. Results of randomization test for determining differences between reference sites and pre- or post-treatment overstory tree canopy cover in mixed-conifer.

Mixed Conifer									
Variable: overstory tree canopy cover (%)									
Treatment	n	Median	Median Difference (treatment – reference)	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
Biomass	5	81	8	0.15	N	N	0.27	N	N
Burn	3	30	-43	0.03	**Y**	**Y**	0.03	**Y**	**Y**
Thin & burn	1	89	16	0.09	**Y**	**Y**	0.23	N	N
Thin	30	68	-5.4	0.09	**Y**	**Y**	0.20	N	N
Reference	37	73							
Post-Treatment									
Burn	5	41	-32	0.04	**Y**	**Y**	0.04	**Y**	**Y**
Thin & burn	2	52	-21	0.13	N	N	0.13	N	N
Thin	27	61	-13	<0.01	**Y**	**Y**	0.01	**Y**	**Y**

Post-Treatment Levels Compared with Predicted Pre-Treatment Levels

One of the thinned sites had lower canopy cover than predicted pre-treatment levels. All of the burned sites had significantly (p 0.20) lower canopy cover than predicted pre-treatment levels (Table 9). The lower canopy cover in treated burned sites compared to treated is likely due to the fact that sites selected for burning tend to have lower canopy cover before treatment (Figure 3).

Table 9. Results of IVRS statistical tests for overstory tree canopy cover in mixed conifer.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	27	0	0	0	0	7	7
Thin&burn	2	0	0	0	0	0	0
Burn	5	0	80	0	80	0	80
Reference	37	16	11	16	11	22	11
San/Salv	4	0	0	0	25	25	25

Quadratic Mean Diameter

Eastside Pine

Overall Patterns

Mean stand diameter generally ranged from 12 to 20 inches, falling in the California Wildlife Habitat Relations (CWHR) (Mayer and Laudenslayer 1988) type size class of 4 (medium trees) (Figure 4).

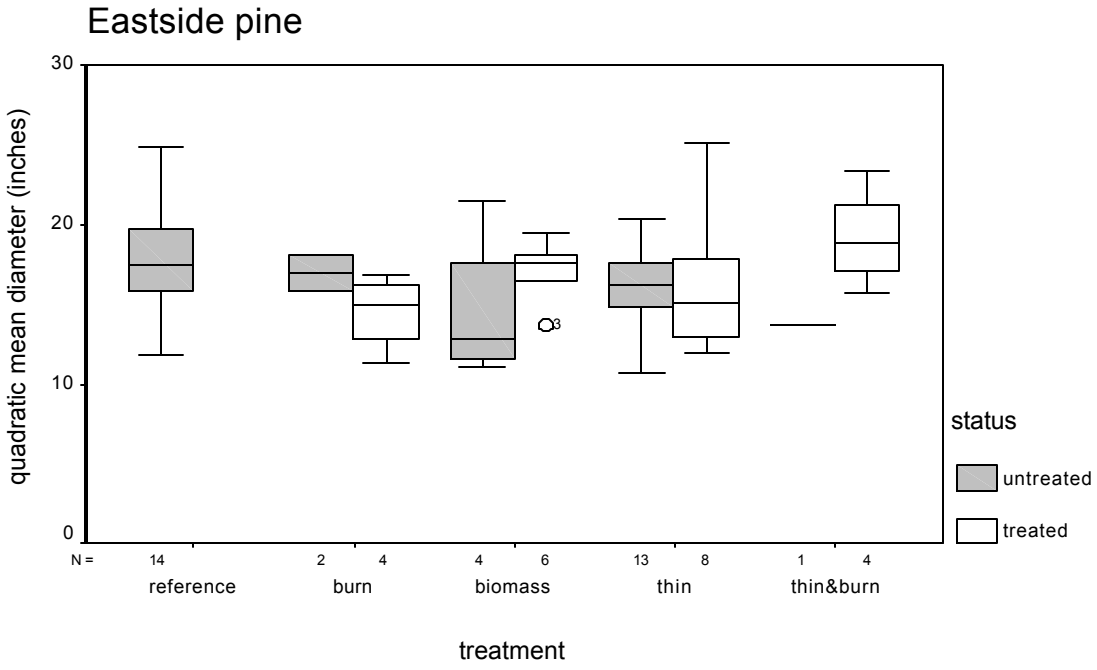


Figure 4. Box plot of quadratic mean diameter in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Mixed Conifer

Overall Patterns

Mean stand diameters were generally greater in mixed conifer than in eastside pine, ranging mostly from 12 to 22 inches, but with a number of sampled sites greater than 24". Most of these diameters fall into the CWHR size class 4, medium trees. Treated sites tend to have higher mean diameters (Figure 5).

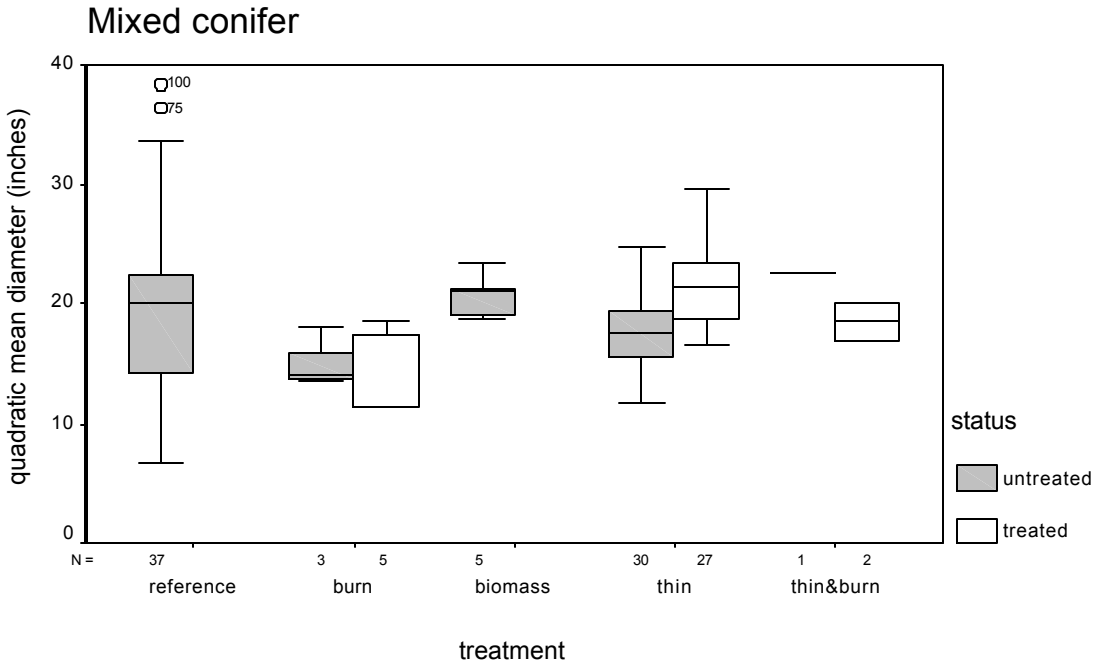


Figure 5. Box plot of quadratic mean diameter in FHP sample sites by treatment type and treatment status in mixed conifer and white fir forests in the westside and transition zones. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Shrub and Understory Cover

The timing of post-treatment sampling for this pilot was usually the same year, one-year or two- years following treatment. Shrub response to treatments may take more than one or two years to be fully expressed. Shrub sprouting or germination may occur immediately but it can take longer for shrubs to grow to a size to measurably change in cover. Therefore, the timing of the monitoring plots post-treatment should be considered when interpreting these results.

Eastside Pine

Overall Patterns

Shrub cover was variable across sites with different treatments and different treatment status. Reference plots had some of the highest deciduous shrub cover (Figure 7), while treatment sites had a higher prevalence of evergreen shrubs. Median evergreen shrub covers were generally less than 10% but a quarter of the thinned sites had more than 10% cover and up to 40% cover (Figure 6). Both reference and sites selected for prescribed burning had higher median total shrub cover (Figure 8). Low vegetation cover, which can include low growing shrubs, ranged primarily between 10 and 20% (Figure 9). Stands treated with thinning had the most sites with low vegetation greater than 20% cover.

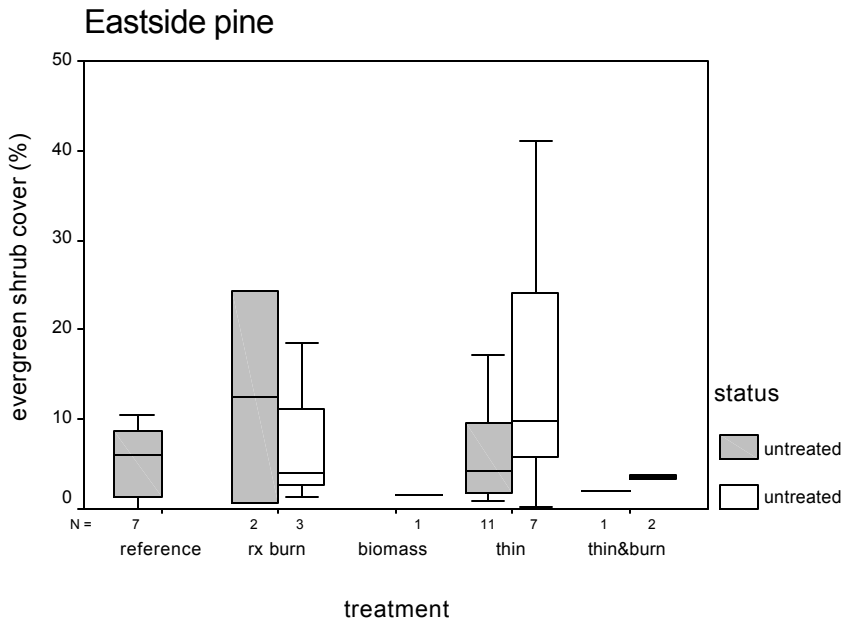


Figure 6. Box plot of evergreen shrub cover in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

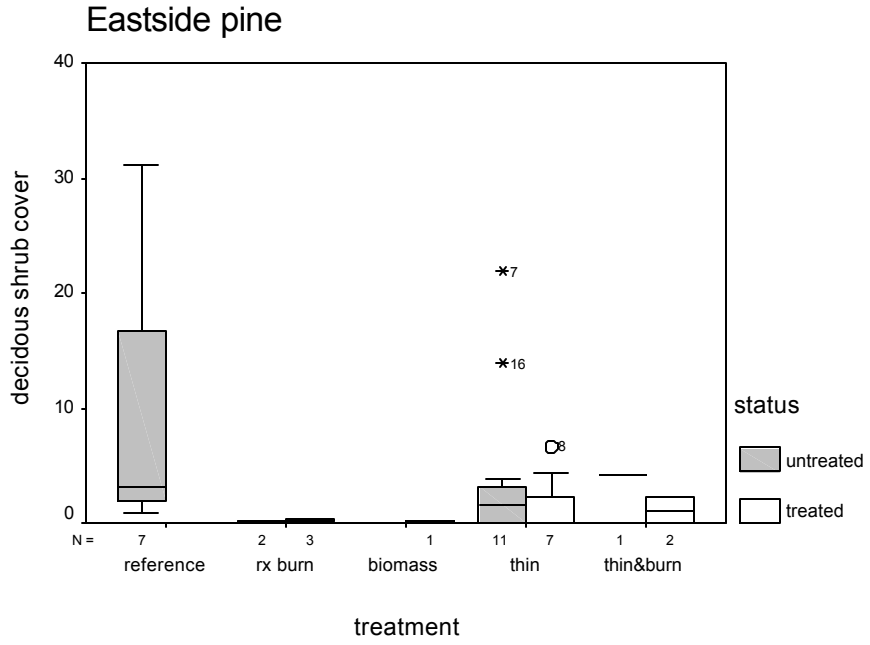


Figure 7. Box plot of deciduous shrub cover in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

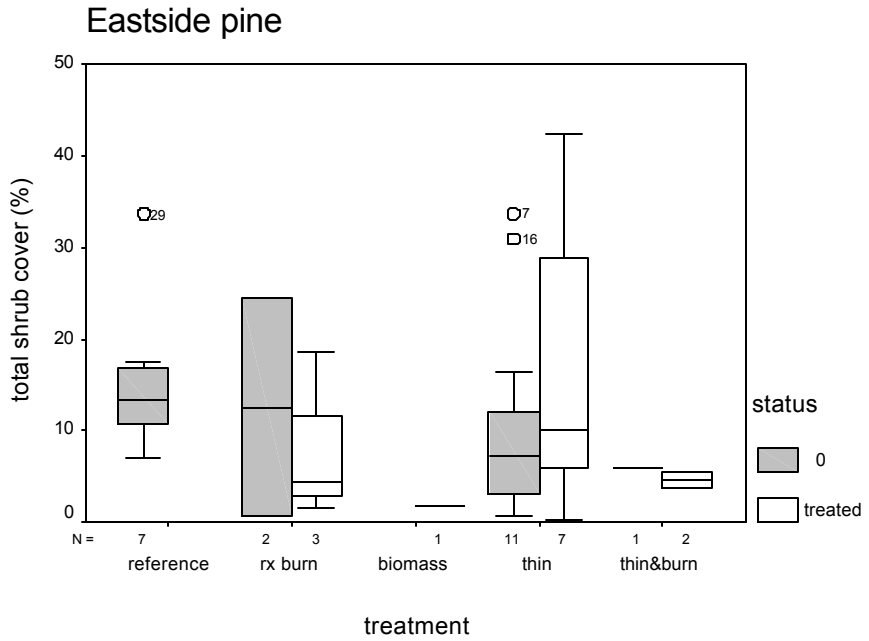


Figure 8. Box plot of total shrub cover in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

There were no significant differences between sites before treatment and reference stands (Table 10). Sites sampled post treatment had significantly lower shrub cover than reference sites for biomass, prescribed burning and thin and burn treatments. Thin treatments were not significantly different than reference.

Table 10. Results of randomization test for determining differences between reference sites and pre- or post-treatment shrub cover in eastside pine.

Eastside Pine-Variable: total shrub cover (%)									
Treatment	n	Median	Median Difference (treatment-reference)	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.10
Pre-Treatment									
Burn	2	12.5	-0.9	0.413	N	N	0.887	N	N
Thin & burn	1	5.9	-7.5	0.128	N	N	0.294	N	N
Thin	11	5.9	-6.2	0.148	N	N	0.259	N	N
Post-Treatment									
Biomass	2	3.9	-9.5	0.038	**Y**	**Y**	0.173	N	N
Burn	3	4.3	-9.1	0.090	**Y**	N	0.169	N	N
Thin & burn	2	4.6	-8.8	0.047	**Y**	**Y**	0.210	N	N
Thin	7	10.0	-3.4	0.224	N	N	0.441	N	N

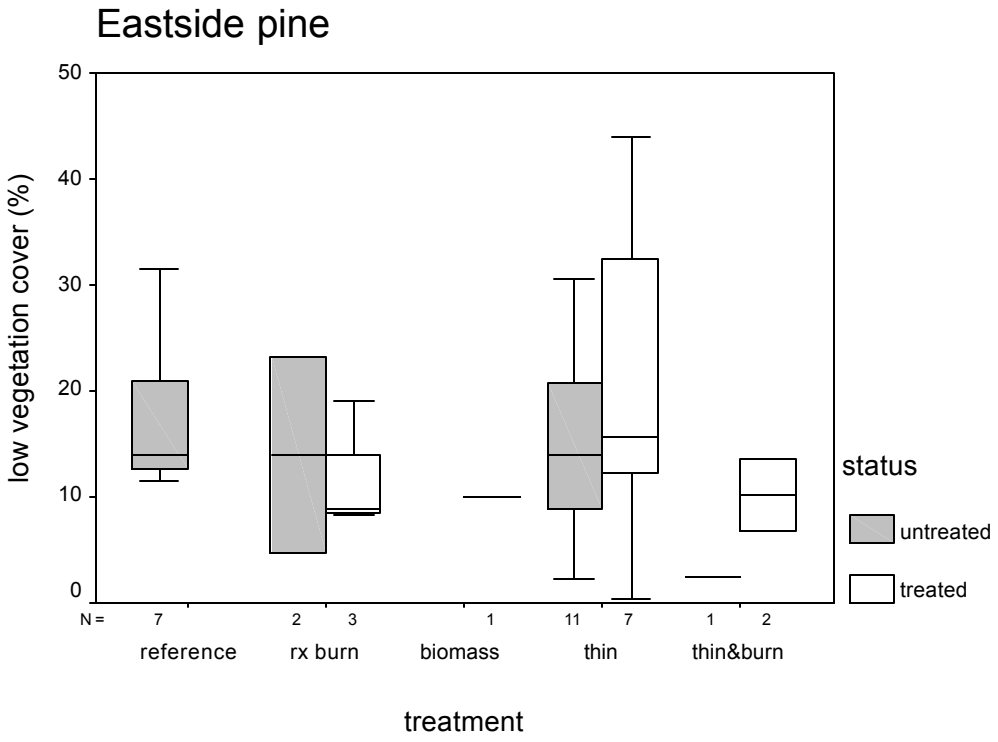


Figure 9. Box plot of low vegetation cover (<1.6' tall) in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Mixed Conifer

Overall Patterns

Shrub covers are similar in the mixed conifer sites to the eastside pine sites, except that there are a couple of mixed conifer sites that have shrub cover exceeding 50%. Sites planned for thinning and reference sites had the highest shrub cover, but generally levels were less than 20% (Figures 10, 11, 12).

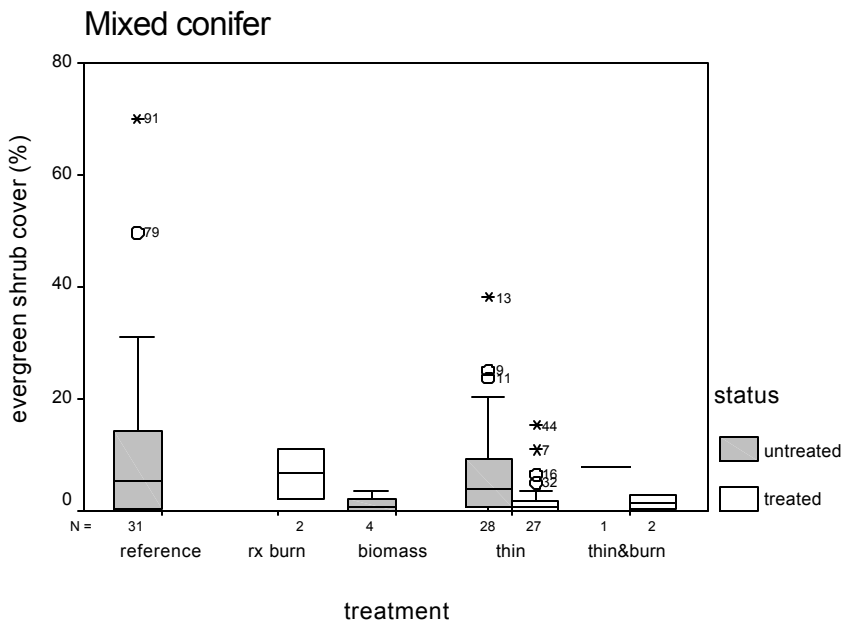


Figure 10. Box plot of evergreen shrub cover in FHP sample sites by treatment type and treatment status in mixed conifer and white fir forests in the westside and transition zones. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

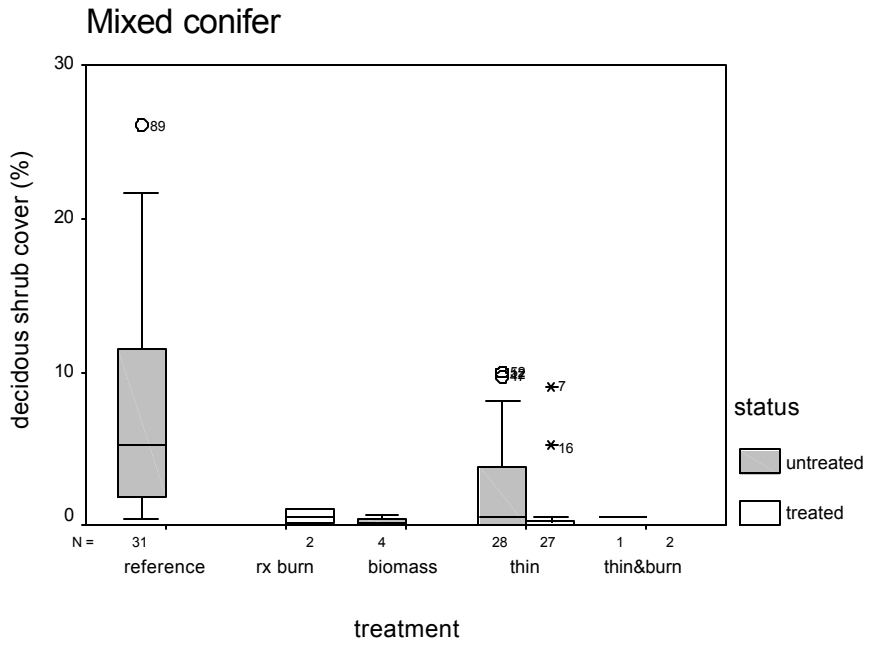


Figure 11. Box plot of deciduous shrub cover in FHP sample sites by treatment type and treatment status in mixed conifer and white fir forests in the westside and transition zones. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

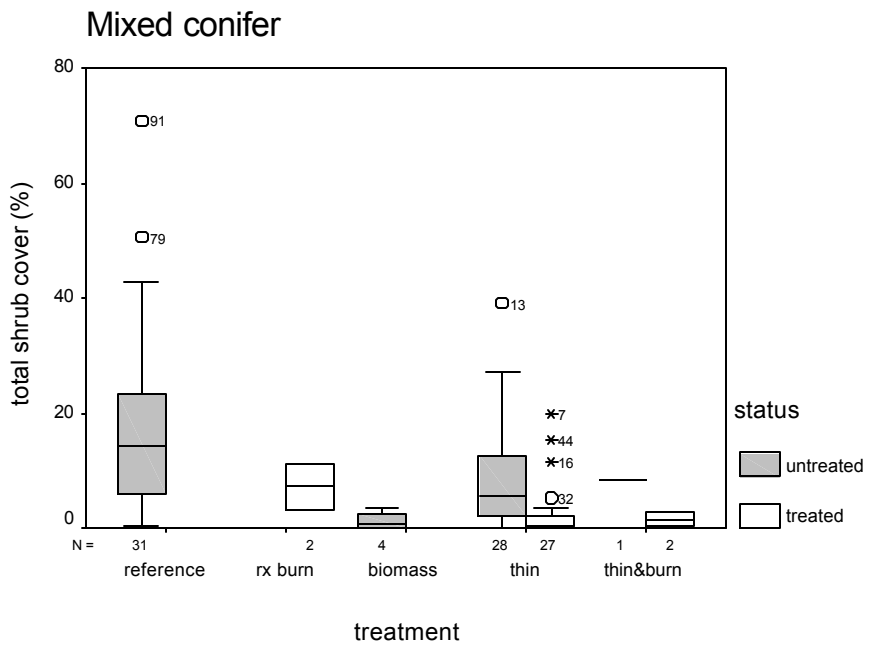


Figure 12. Box plot of total shrub cover in FHP sample sites by treatment type and treatment status in mixed conifer and white fir forests in the westside and transition zones. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Sites selected for biomass or thin treatments had significantly lower shrub cover than reference sites (Table 11). After treatment, sites treated with both thinning and combined thinning and burning had significantly lower shrub cover than reference sites.

Table 11. Results of randomization test for determining differences between reference sites and pre- or post-treatment shrub cover in mixed-conifer.

Mixed Conifer Variable: total shrub cover (%)									
Treatment	n	Median	Median Difference (treatment – reference)	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
biomass	4	0.765	-13.565	0.024	**Y**	**Y**	0.121	N	N
Thin & burn	1	8.470	-5.860	0.332	N	N	0.687	N	N
Thin	28	5.40	-8.93	0.0194	**Y**	**Y**	0.033	**Y**	**Y**
Post-Treatment									
Burn	2	7.100	-7.230	0.152	N	N	0.482	N	N
Thin & burn	2	1.365	-12.96	0.0522	**Y**	N	0.228	N	N
Thin	27	0.600	-13.73	0.004	**Y**	**Y**	0.004	**Y**	**Y**

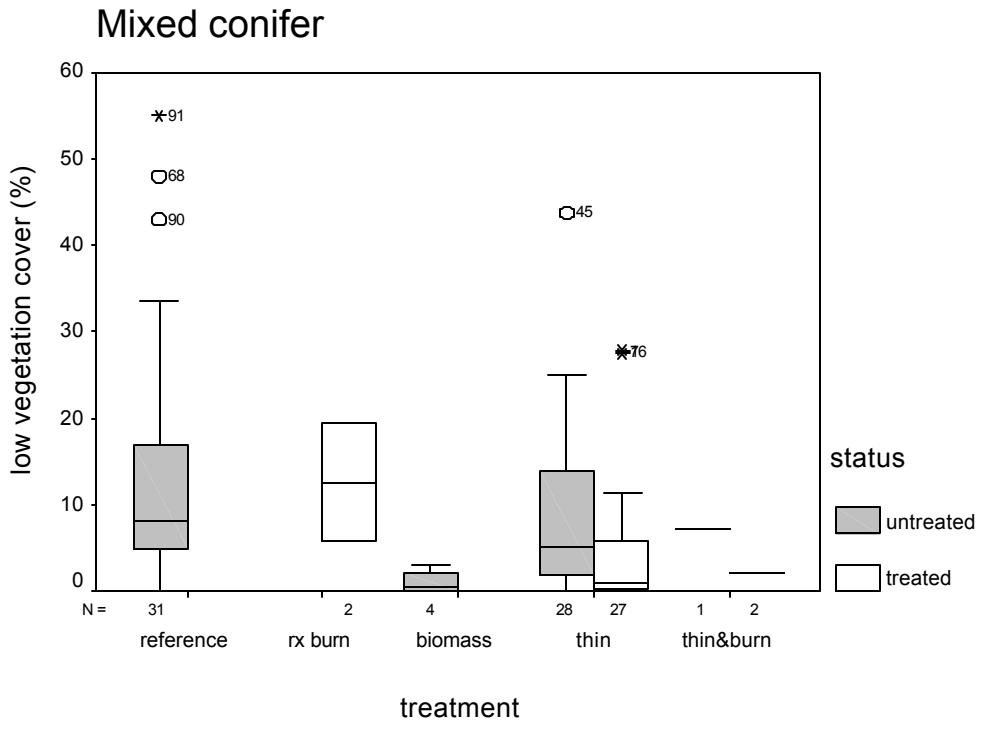


Figure 13. Box plot of low vegetation cover (<1.6' tall) in FHP sample sites by treatment type and treatment status in mixed conifer and white fir forests in the westside and transition zones. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Tree Density by Diameter Class

Only descriptive statistics were completed for tree density response variables due to lack of time after selection of final appropriate statistical analysis approaches.

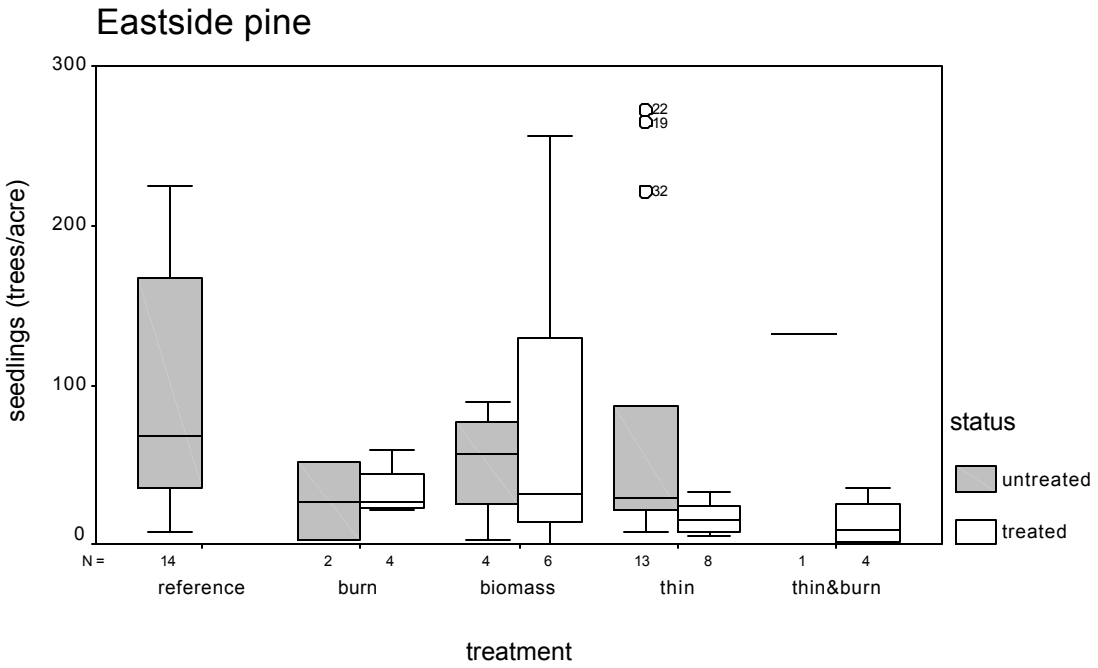
Eastside Pine

Overall Patterns

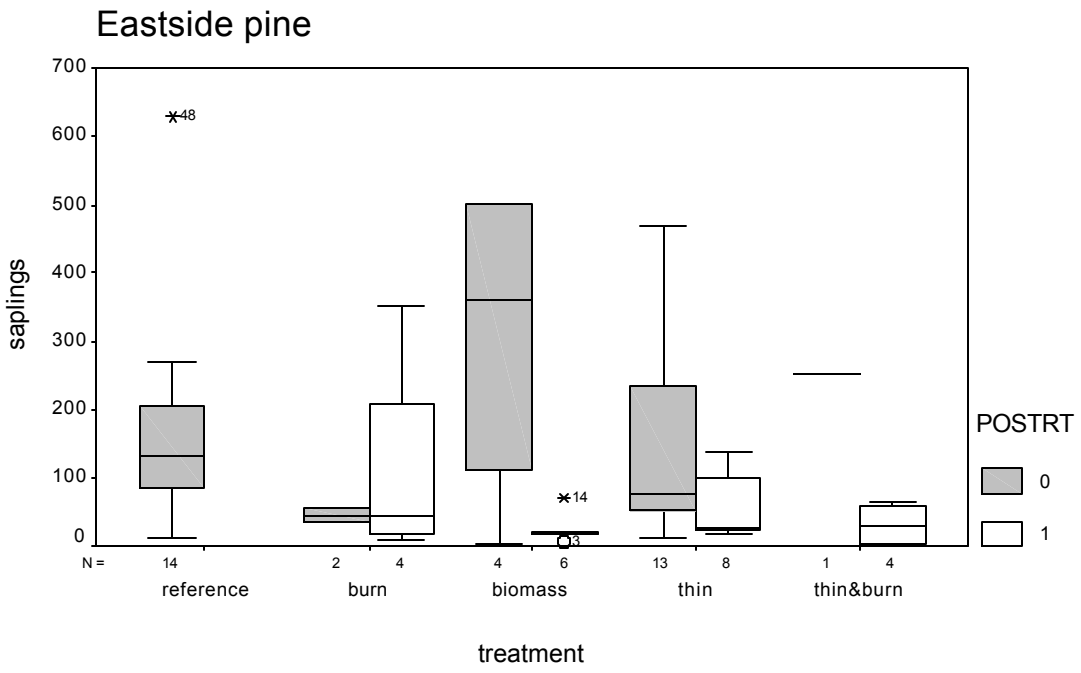
Seedling densities ranged from 30 to over 200 per acre (Figure 14) and sapling densities from less than 10 to 500 per acre (Figure 15). Densities of pole size trees (6-12" dbh) generally ranged between 20 and 100 trees/acre but some sites exceeded 150 trees/acre (Figure 16). Small tree (12-24" dbh) densities varied from 20 to 60 trees/acre (Figure 17). Medium trees (24-30" dbh) densities were almost always less than 10 trees/acre with median values generally falling between 2 and 5 trees/acre (Figure 18). Large trees (>30" dbh) had the lowest densities, as would be expected with the productivity and extensive land use history of the eastside, with median densities rarely exceeding 1 tree/acre and with many sites with no large trees.

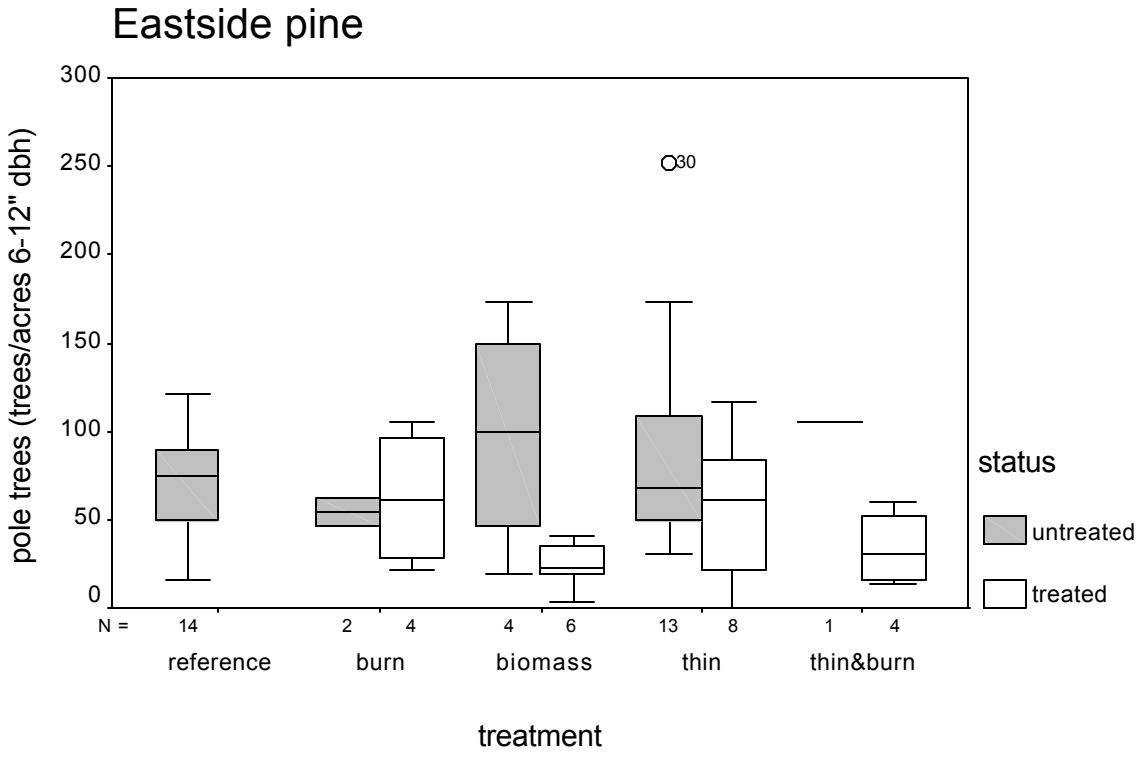
There were many similarities in densities of trees in reference and untreated stands planned for thinning or biomass treatments. Seedling or sapling densities were higher than post-treatment conditions in general than at sites planned for burning. Sites planned for biomass treatment had the highest median and range of both sapling and pole size tree densities. After treatment, the levels of seedlings and saplings varied amongst treatments. Some of the sites treated with biomass had high densities of seedlings and some of the burned sites had high densities of saplings. Sites treated with thinning and burning had the lowest post-treatment levels of seedlings, saplings and pole size trees.

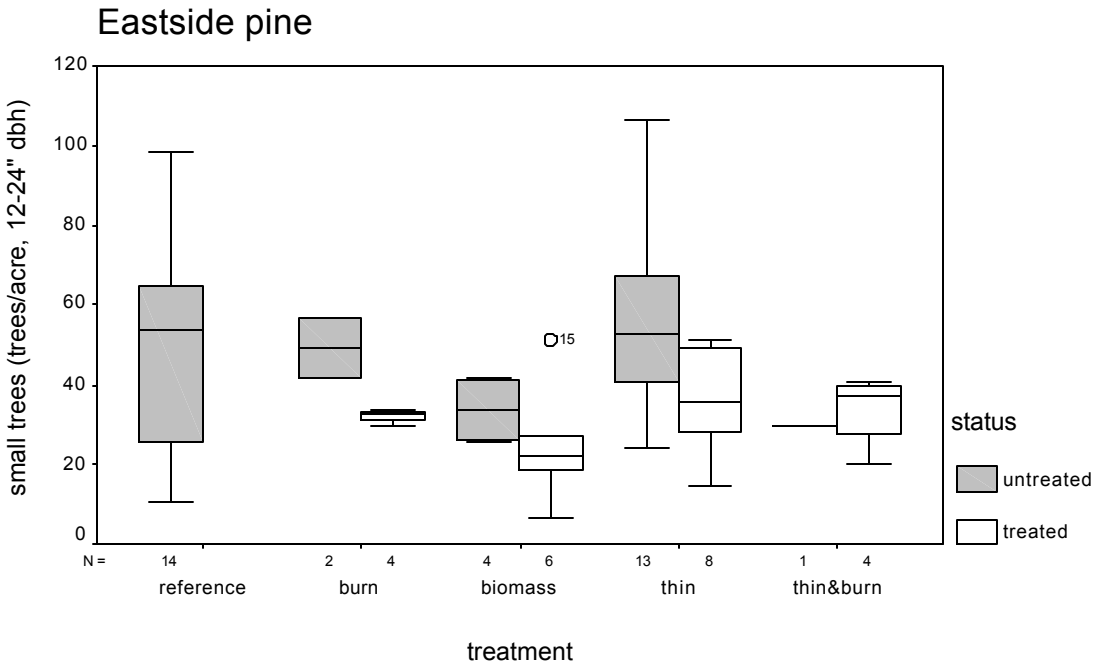
Small (12-24" dbh), medium (24-30" dbh) and large trees (>30" dbh) were similar and had the highest levels in the reference and sites sampled before treatment. At sites sampled after treatment, densities of the medium and large trees were similar or slightly lower, but the small trees were noticeably lower. Because we did not sample the same sites before and after treatment, we cannot say whether any differences between pre and post-treatment are do to the treatments or due to differences in the stands. However, the objective of the mechanical treatments is to remove trees, so this definitely affected stem density to some degree.

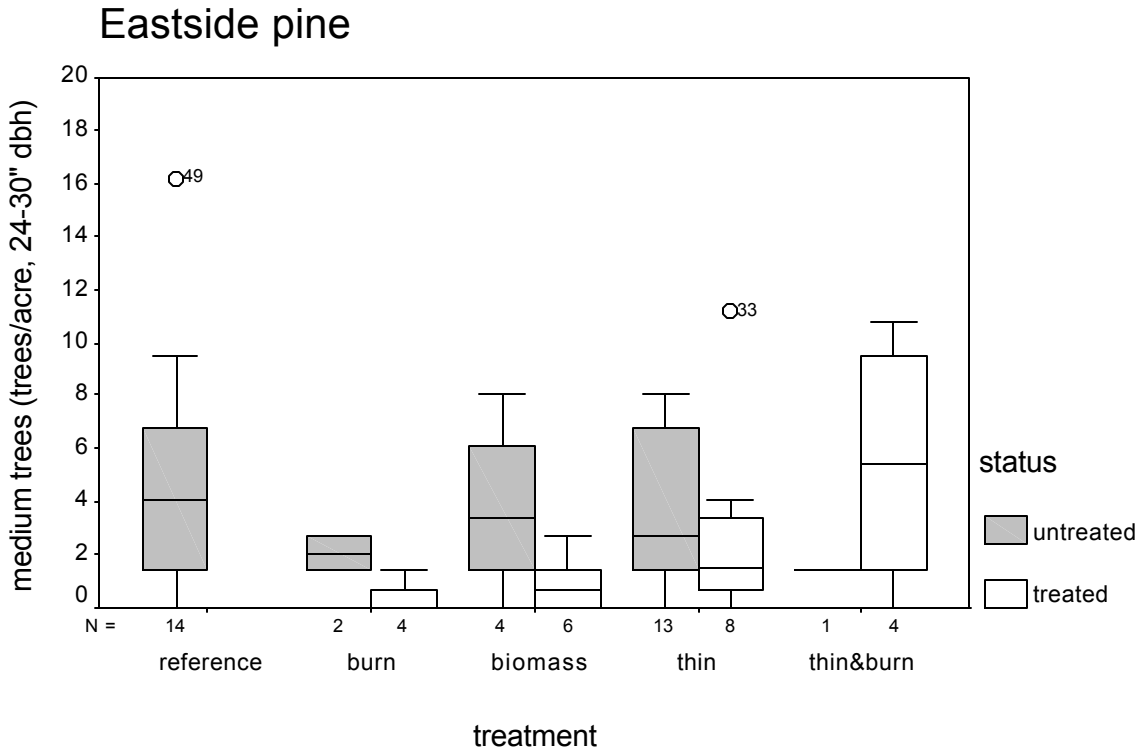


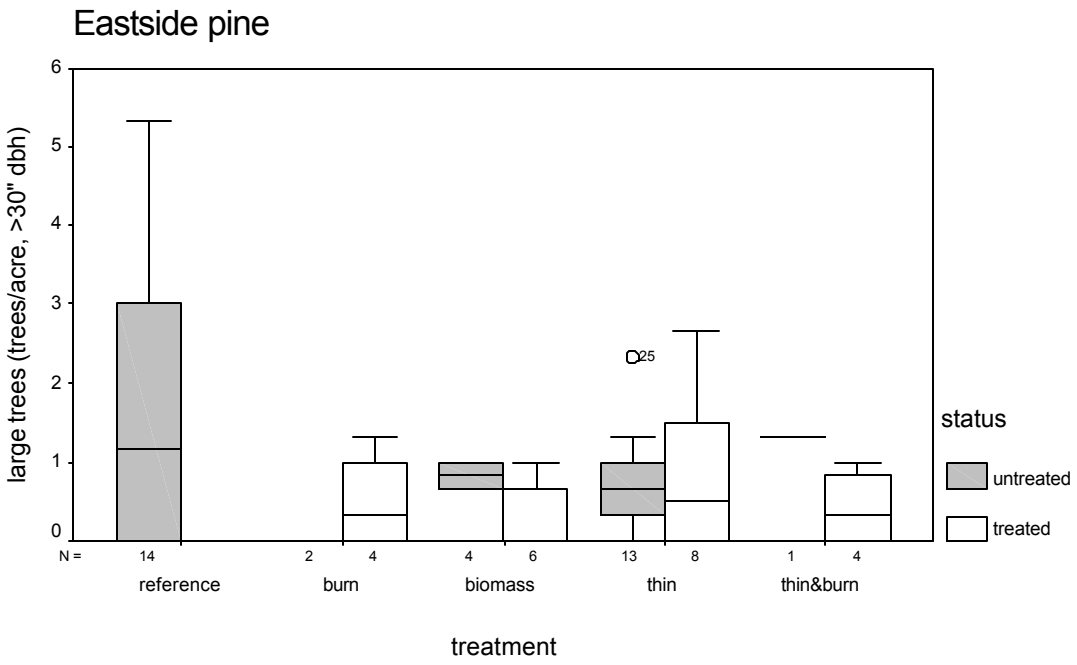
Figures 14-19. Box plot of tree density in FHP sample sites by dbh class, treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.


Eastside pine
saplings
700
600
500
400
300
200
100
0
48
14
3
N =
14
2
4
4
6
13
8
1
4
reference
burn
biomass
thin
thin&burn
treatment
POSTRT
0
1


Eastside pine
pole trees (trees/acres 6-12" dbh)
300
250
200
150
100
50
0
30
N =
14
2
4
4
6
13
8
1
4
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated


Eastside pine
small trees (trees/acre, 12-24" dbh)
120
100
80
60
40
20
0
15
N =
14
2
4
4
6
13
8
1
4
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated


Eastside pine
medium trees (trees/acre, 24-30" dbh)
20
18
16
14
12
10
8
6
4
2
0
49
33
N =
14
2
4
4
6
13
8
1
4
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated



Mixed Conifer

Overall Patterns

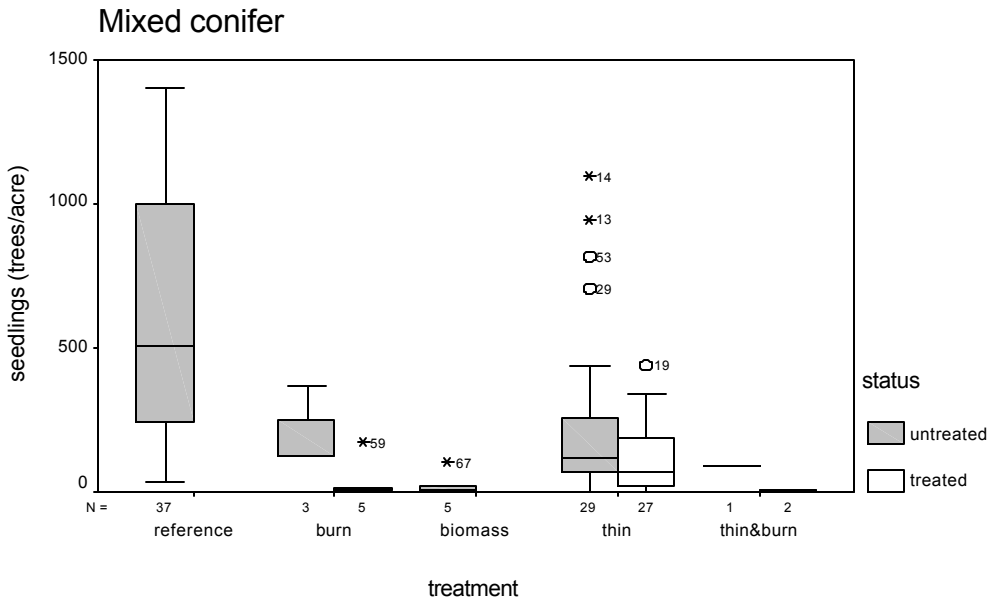
Seedling densities reached higher levels in the mixed-conifer sites than in the eastside pine, particularly at the reference sample locations. Densities generally ranged from less than 10 to 200 trees/acre but on the reference sites the median value was near 500 and 25% of the sites were between 500 and 1000 seedlings/acre (Figure 20). Sapling densities were more similar to eastside pine, with densities generally ranging from 20 to 300 per acre. As with the seedlings though, the maximum measured densities exceeded any of those sampled in eastside pine, reaching over 700 saplings per acre at some of the reference sites (Figure 21). Given the patchy nature of regeneration in many forest stands, caution must be placed on interpreting average densities because it requires more extensive sampling than is usually practical to obtain estimates without a lot of variance.

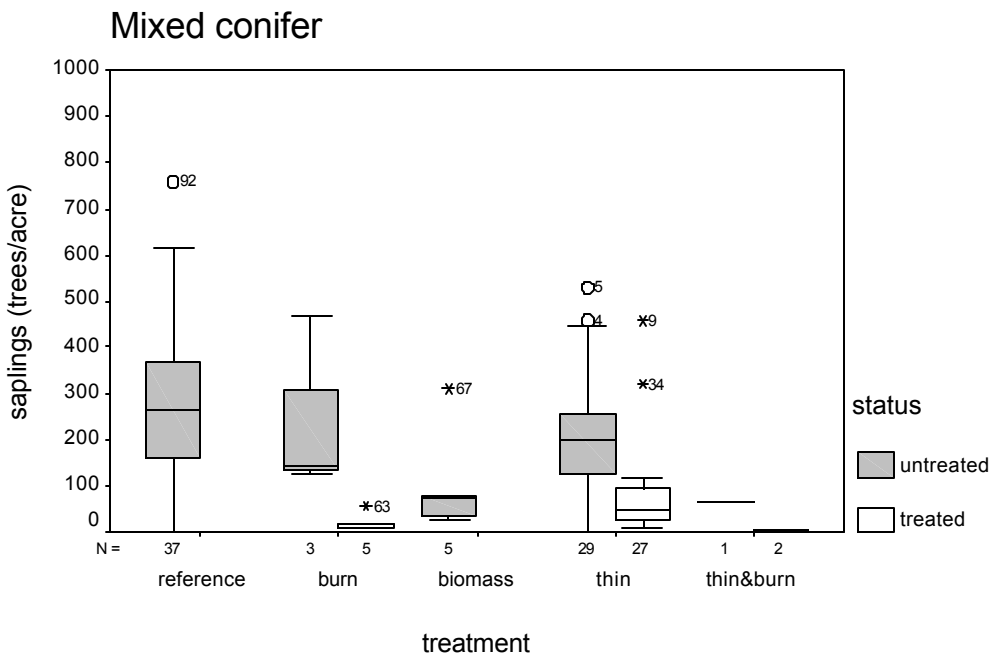
Densities of pole size trees displayed a similar range to those in eastside pine, varying primarily between 20 and 100 trees/acre (Figure 22). Small tree (12-24" dbh) densities ranged to higher levels than in the eastside pine, up to 80 and sometimes over 120 trees/acre. Median values were typically less than 60 trees/acre in the eastside pine but in the mixed-conifer sites planned for biomass and thinning treatments, the median values exceeded 70 trees/acre (Figure 23). Medium tree (24-30" dbh) densities were similar to eastside pine, generally ranging from 2 to 10 trees/acre but with maximum levels reaching 20 trees/acre (Figure 24). Densities of large trees (>30" dbh) exceeded those of the eastside pine on some sites, with values ranging up to 5 trees/acre or more, particularly at reference sites and thin treatment sites (Figure 25).

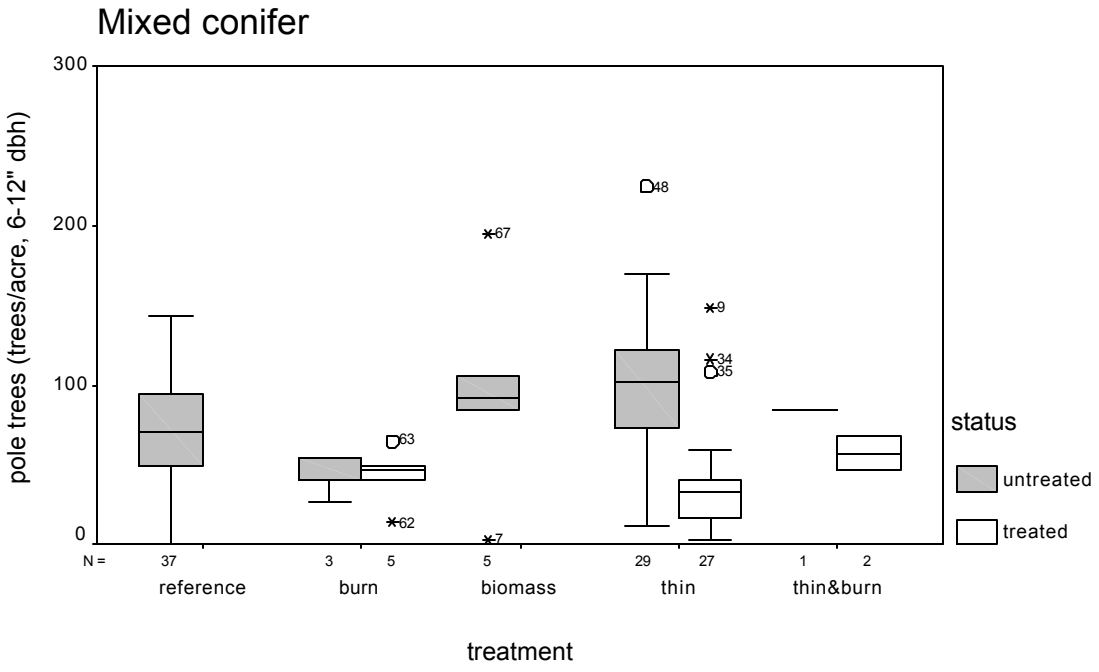
Differences in tree densities between different types of sites before treatment were most pronounced for seedlings in reference sites and medium trees in biomass sites. Median seedling densities

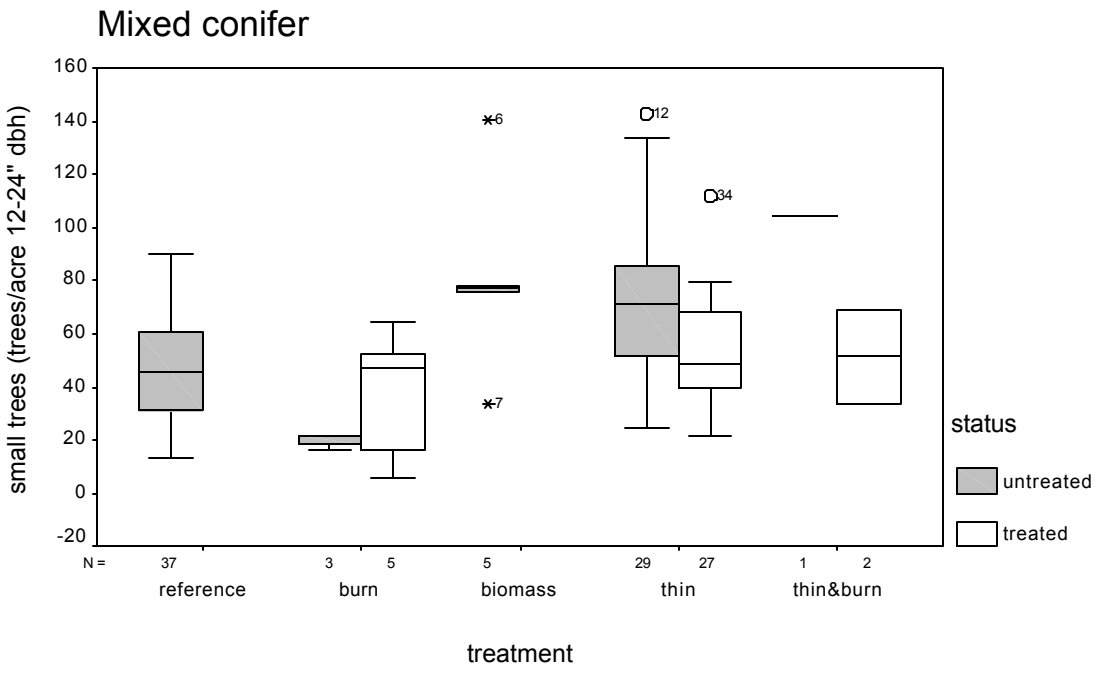
were over 500 for reference sites compared with the majority of other pre-treatment site 75%tile values less than 250 seedlings/acre. Sites selected for thinning or biomass had the highest median values and high ranges for pole, small and/or medium trees. Burn sites, either before or after treatment tended to have overall low tree densities in most size classes. The highest densities of large trees were measured in reference sites.

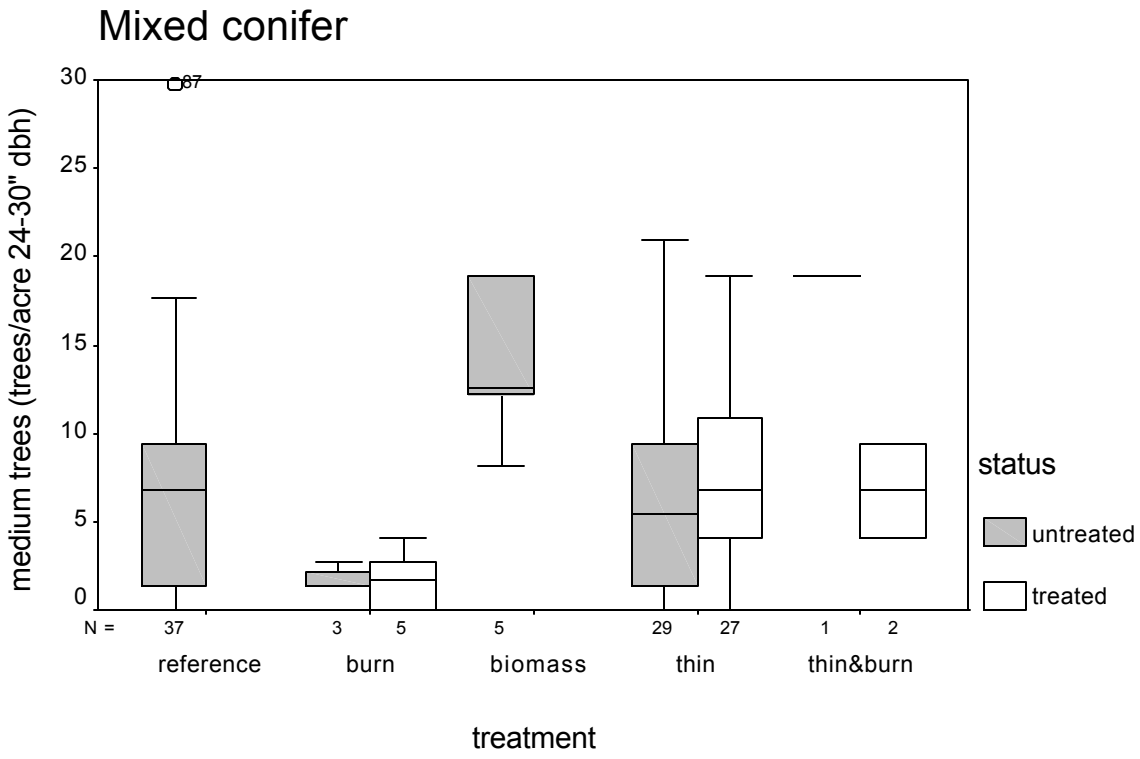
Figures 20-25. Box plot of tree density in FHP sample sites by dbh class, treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

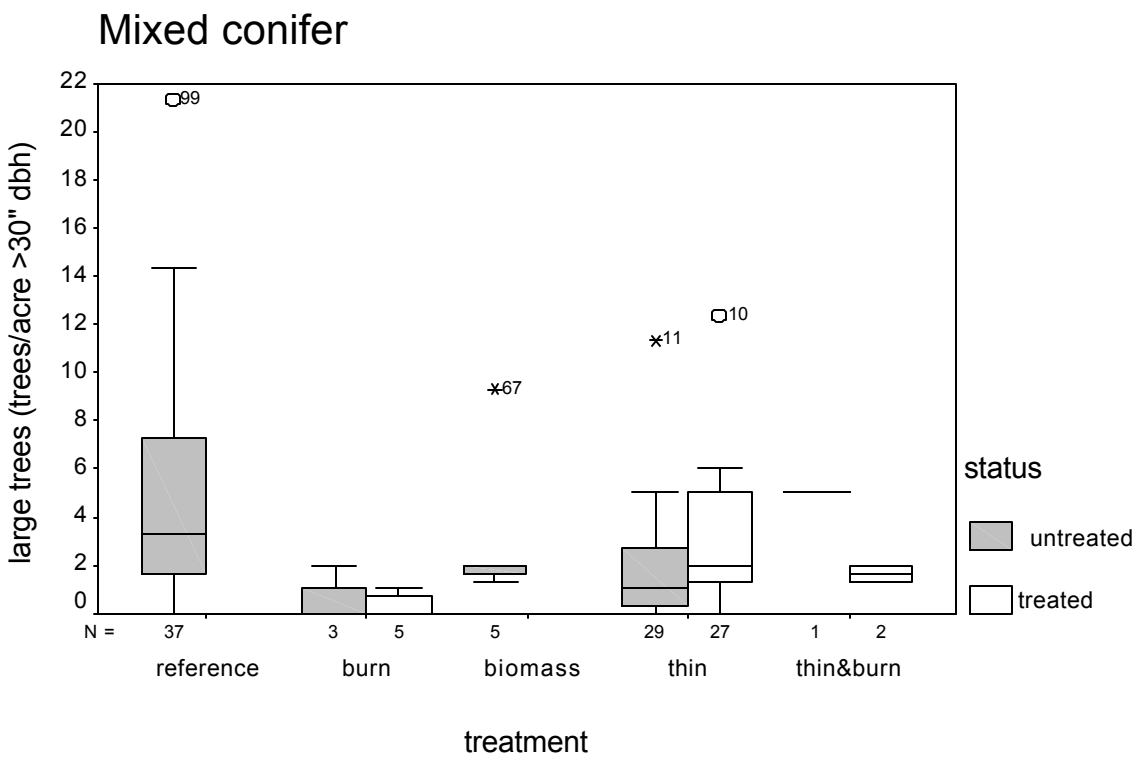



Mixed conifer
saplings (trees/acre)
1000
900
800
700
600
500
400
300
200
100
0
92
5
4
9
67
34
63
N =
37
3
5
5
29
27
1
2
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated


Mixed conifer
pole trees (trees/acre, 6-12" dbh)
300
200
100
0
48
67
9
34
35
63
62
7
N =
37
3
5
5
29
27
1
2
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated


Mixed conifer
small trees (trees/acre 12-24" dbh)
160
140
120
100
80
60
40
20
0
-20
6
12
34
7
N =
37
3
5
5
29
27
1
2
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated


Mixed conifer
medium trees (trees/acre 24-30" dbh)
30
25
20
15
10
5
0
67
N =
37
3
5
5
29
27
1
2
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated


Mixed conifer
large trees (trees/acre >30" dbh)
22
20
18
16
14
12
10
8
6
4
2
0
99
10
11
67
N =
37
3
5
5
29
27
1
2
reference
burn
biomass
thin
thin&burn
treatment
status
untreated
treated

California Wildlife Habitat Relations Types (CWHR)

Most of the sampled sites fell into the medium tree CWHR habitat types, with the majority of acres (>5,000) in the 4M and 4P types (Figure 26). A little over 1300 acres of sampled stands planned for treatment fell into the denser CHWR habitat types of 4D or 6.

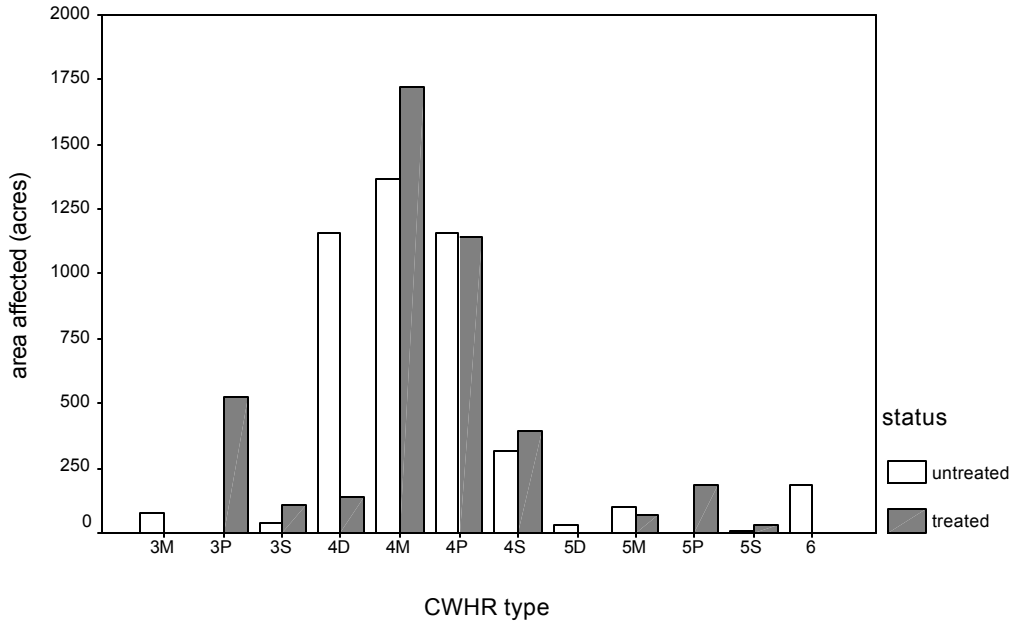


Figure 26. CWHR habitat types **within sampled** FHP treated areas, based upon FHP monitoring plot data.

Landscape Scale

California Spotted Owl Habitat and Locations

Defining Owl Locations and Modeling Homeranges

The term homerange refers to the primary area that a species uses for foraging and reproduction. Homeranges tend to be irregular in shape and unless radio-telemetry work is done, it is difficult to map homeranges well. Since telemetry data is expensive and time-consuming to collect, we often use proxies for homeranges, such as circular areas surrounding a known nest or roost location. This was the approach applied to assess potential effects to owl homeranges in the Sierra Nevada Framework EIS (USDA FS 2001) and that same approach is applied here. If we use the term homeranges, we are referring to circular proxies. We also use a more descriptive but sometimes awkward description, "areas surrounding owl locations".

The amount of suitable owl habitat (classed according to the CWHR types identified in the HFQLG [USDA FS 1999] and SNCF EIS's) that overlaps with the FHP treatment units was assessed using the vegetation map data from the HFQLG and SNCF EIS's. This data is based on the extrapolation of CWHR types assigned to forest inventory (FIA) plots to remote-sensing derived polygons. This vegetation data was used because only a portion of the FHP units were sampled for

monitoring and a cumulative assessment of the overlap is only possible by examining all of the FHP units. It is unknown whether this data reflects the treated or pre-treated condition of the treatment units, since treatment history was not used to update the layer except for clearcuts or large fires. Whether the treatments are reflected in the layer is based primarily upon whether the treatment occurred prior to the development of the vegetation layer. Since all of the treatments are in the last several years, and the imagery used is from the early to mid 1990s for these forests and inventory plots are from 1999 to 2000, most of the treatments occurred after the layer was developed. Most of the differences reported above size class (qmd) and tree canopy cover indicate that changes from treatment are primarily with canopy cover and not with size class. Since we do not have information on the changes in canopy cover from before to after treatment on the same site, we do not know specifically if individual sites had decreased canopy cover or whether the decrease was enough to cause a change in the CWHR canopy cover class.

We compared habitat estimates from three different sources of spatial vegetation data for a subset of the FHP area, in the Almanor Ranger District that overlaps with the California spotted owl demographic study area, to provide some relative estimate of the variability in estimates and indirect uncertainty (Figure 27). In addition to the linked remote sensing and FIA inventory plot data described above, we also compared a photo-interpreted layer and one derived with remote sensing alone (RSL). The estimate of total habitat was greatest from the photo-interpreted layer (75%) and lowest in the remote-sensing/FIA plot layer (63%). However, estimates of nesting habitat were greatest in the remote-sensing/FIA layer (43%) compared to 33% in the photo-interpreted layer and 22% in the RSL layer (Figure 27). These differences strongly indicate that there is a wide margin of uncertainty in estimates of owl habitat. Despite the ambiguities and uncertainties with the data, we still felt it was useful to provide an overall picture of the proportion of suitable habitat that overlapped with the FHP units. The overlap or effects within individual treatment units is far less important than the cumulative effects to an individual owl homerange and all of the owl homeranges

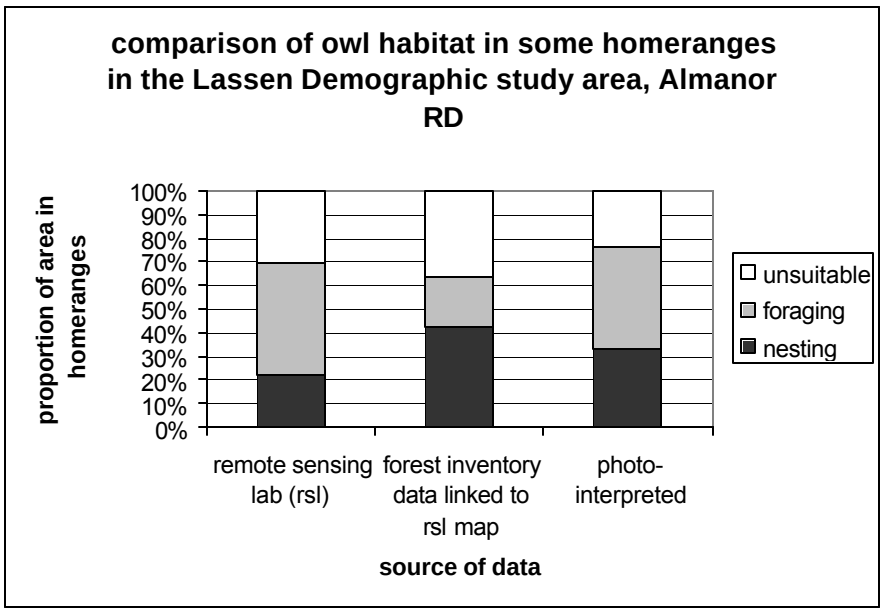


Figure 27. Comparison of owl habitat estimates within some California spotted owl homeranges in the Lassen demographic study area in the Almanor Ranger District from different vegetation map sources: 1) remote sensing lab (RSL) map is derived primarily from Landsat satellite imagry; 2) based upon vegetation data used in SNCF EIS and HFQLG EIS (forest inventory data [FIA] linked to remotely sensed vegetation polygons [RSL])—remote-sensing/FIA plot layer; 3) a photo-interpreted vegetation layer.

Estimates of Overlap between FHP Treatment Units, Owl Locations and Owl Habitat

A total of 443 areas surrounding owl locations (as mapped for the SNCF EIS, USDA FS 2001) occur within the FHP monitoring area. One hundred and ten of these homeranges, or 25%, overlapped with at least 1 acre of an FHP treatment unit. Six additional homeranges had less than 1 acre of FHP unit overlapping. These owl sites are based upon the current California Department of Fish and Game owl database. Many of these sites have not been verified since the mid 1990s. It is unknown how many of the sites are still occupied at this time.

Nearly half (46%) of the homeranges with overlapping foraging & nesting habitat had 5% or less of the habitat within the FHP units (Figure 28). Twenty-eight percent had more than 10% of the homerange habitat contained within the FHP units. The remainder of the homeranges had between 5 and 10% of the homerange habitat that fell within FHP units. The majority (65%) of homeranges with overlapping nesting habitat and FHP units (113) had 5% or less of the total estimated nesting habitat that occurred within FHP units. Twenty percent of the homeranges had more than 10% of the suitable nesting habitat overlap with the FHP units (Figure 29). It is unknown how these treatments might affect use or demography of the California spotted owl (USDA FS 2001).

We did not include timber harvest or fuel treatments from other projects that have occurred in the landscape. Therefore, this should not be considered a complete assessment of cumulative effects to owls.

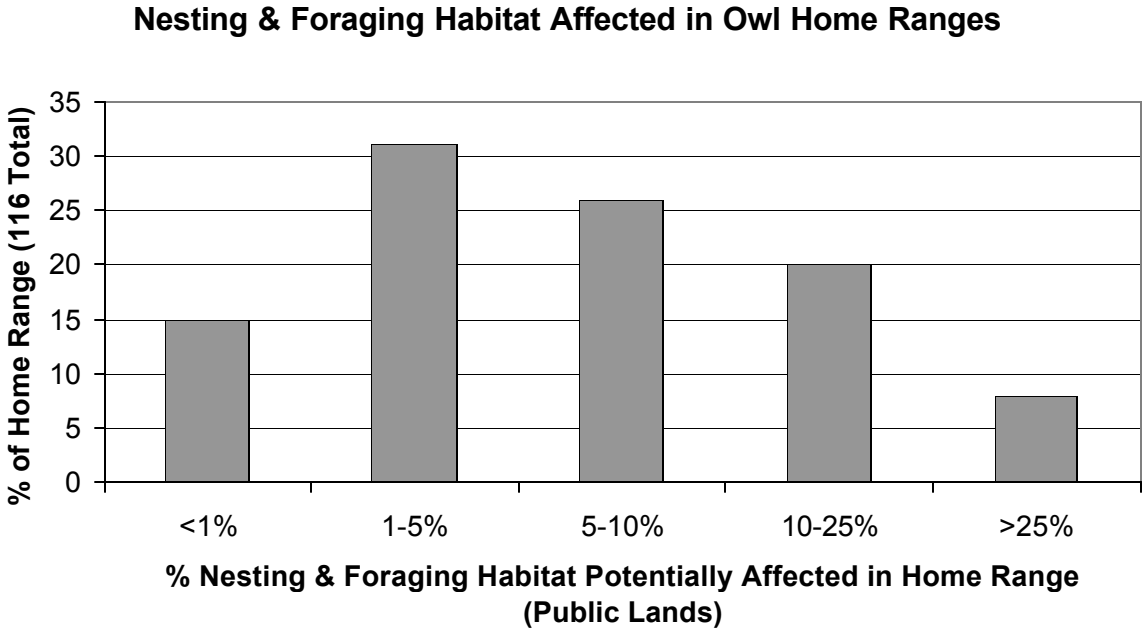


Figure 28. Proportion of nesting habitat in owl homeranges (non-overlapping, variable size from SNCF draft EIS) overlapping with FHP project units. Nesting habitat is based upon vegetation data used in SNCF EIS and HFQLG EIS (forest inventory data [FIA] linked to remotely sensed vegetation polygons [RSL]).

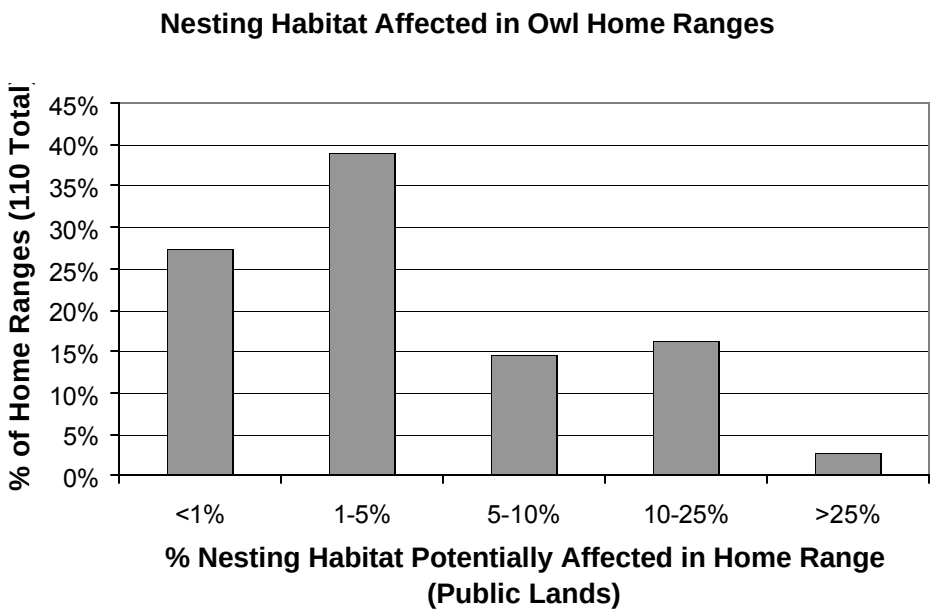


Figure 29. Proportion of nesting habitat in owl homeranges (non-overlapping, variable size from SNCF draft EIS) overlapping with FHP project units. Nesting habitat is based upon vegetation data used in SNCF EIS and HFQLG EIS (forest inventory data [FIA] linked to remotely sensed vegetation polygons [RSL]).

The proportion of acres with different treatments did not vary much with homeranges with different overlapping areas of FHP units (Figure 30). Most of the overlap was with thin treatments, since this was the dominant treatment applied.

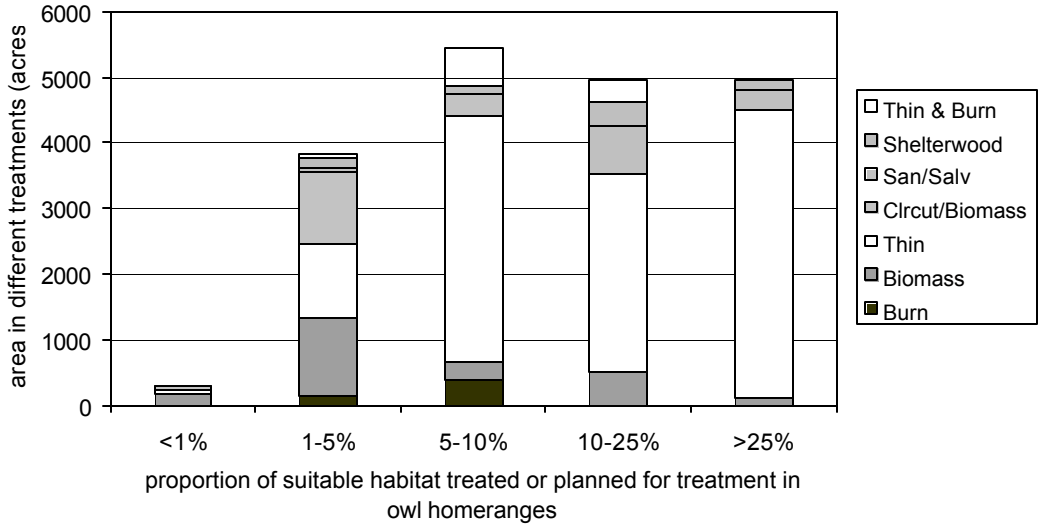


Figure 30. Area by treatment type by homeranges with different levels of suitable habitat overlapping with FHP treatment units.

Fuels and Predicted Fire Behavior

Site Scale

Crown Bulk Density

The relationship between crown bulk density and fire behavior is only beginning to be determined by fire behavior researchers. Most of the relationships included in current fire behavior models are based upon early crown fire experiments in uniformly sized jack pine stands in Canada (van Wagener 1977, van Wagener 1993). It is not well known how variable tree size and spacing, and consequently the amount and distribution of crown bulk density, affects the modeled relationships with fire behavior. Most of the stands in the FHP monitoring area are variable. However, the results here do serve to illustrate relative differences between sites treated or planned for treatment in different ways and between different forest types.

Eastside Pine

Overall Patterns

Most sampled sites had crown bulk densities (cbd) between .05 and .15 kg/m^3 (Figure 31). Untreated biomass and thin sites had the greatest cbd's, generally exceeding 0.8, with many sites higher than the randomly selected reference sites and greater than 0.10 kg/m^3. Sites sampled after treatment were below 0.10 kg/m^3, regardless of treatment type.

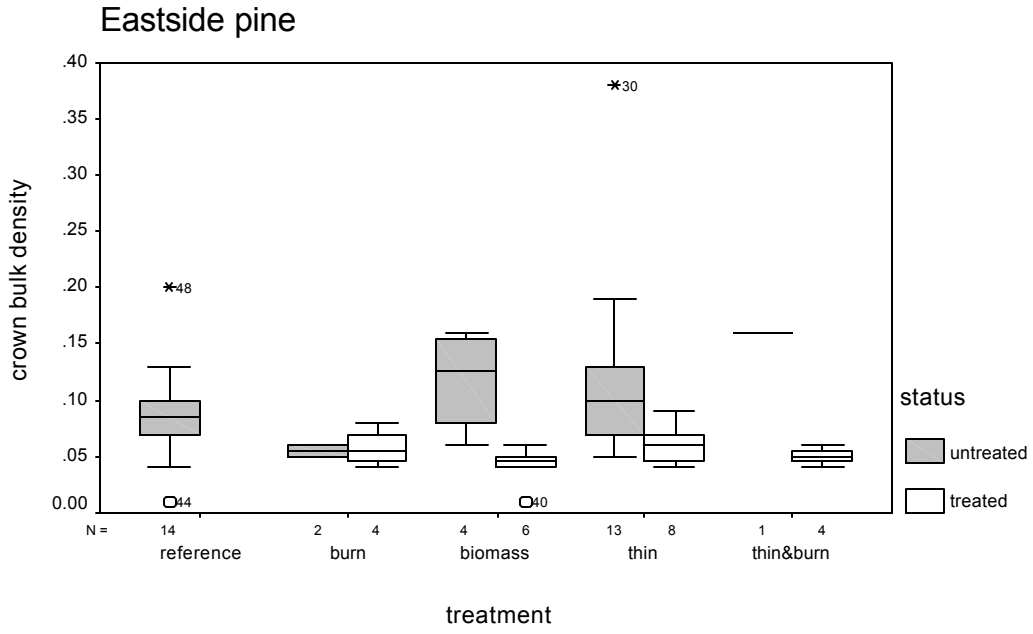


Figure 31. Box plot of crown bulk density in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Prior to treatment, there were no significant differences between treatment sites and reference stands (Table 12). However, median crown bulk densities for sites selected for burning were approximately half or more of those sites selected for other treatments. But only two burn sites were sampled and therefore, we do not know how representative this data is of burn treatment sites. Post-treatment cbd's of all treatment types were significantly lower than those of the reference sites. Median values were less than 0.07 kg/m^3 for all post-treatment sites, sites planned for burning and reference sites. In contrast, sites selected for thinning or biomass had crown bulk densities greater than 0.1 kg/m^3.

Table 12. Results of randomization test for determining differences between reference sites and pre- or post-treatment crown bulk density in eastside pine.

Eastside Pine									
Variable: crown bulk density (kg/m^3)									
Treatment	n	Median	Median Difference (treatment – reference)	One-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.10
Pre-Treatment									
Biomass	4	0.125	0.04	0.078	**Y**	N	0.110	N	N
Burn	2	0.055	-0.030	0.141	N	N	0.332	N	N
Thin & burn	1	0.160	0.075	0.102	N	N	0.136	N	N
Thin	13	0.100	0.015	0.219	N	N	0.412	N	N
Reference	14	0.085							
Post-Treatment									
Biomass	6	0.045	-0.040	0.025	**Y**	**Y**	0.062	**Y**	N
Burn	4	0.055	-0.030	0.061	**Y**	N	0.152	N	N
Thin & burn	4	0.050	-0.035	0.050	**Y**	N	0.129	N	N
Thin	8	0.060	-0.025	0.061	**Y**	N	0.131	N	N

Post-Treatment vs. Predicted Pre-Treatment Levels

There were no significant results from the IVRS tests.

Mixed Conifer

Overall Patterns

Crown bulk densities were higher than in eastside pine for almost all sampled categories in mixed conifer. Most of the sites had cbd's exceeding .10 kg/m3 and values ranged above .25. The exceptions were burn units, where those sampled both before and after treatment had cbd's that were less than .05 kg/m3 (Figure 32).

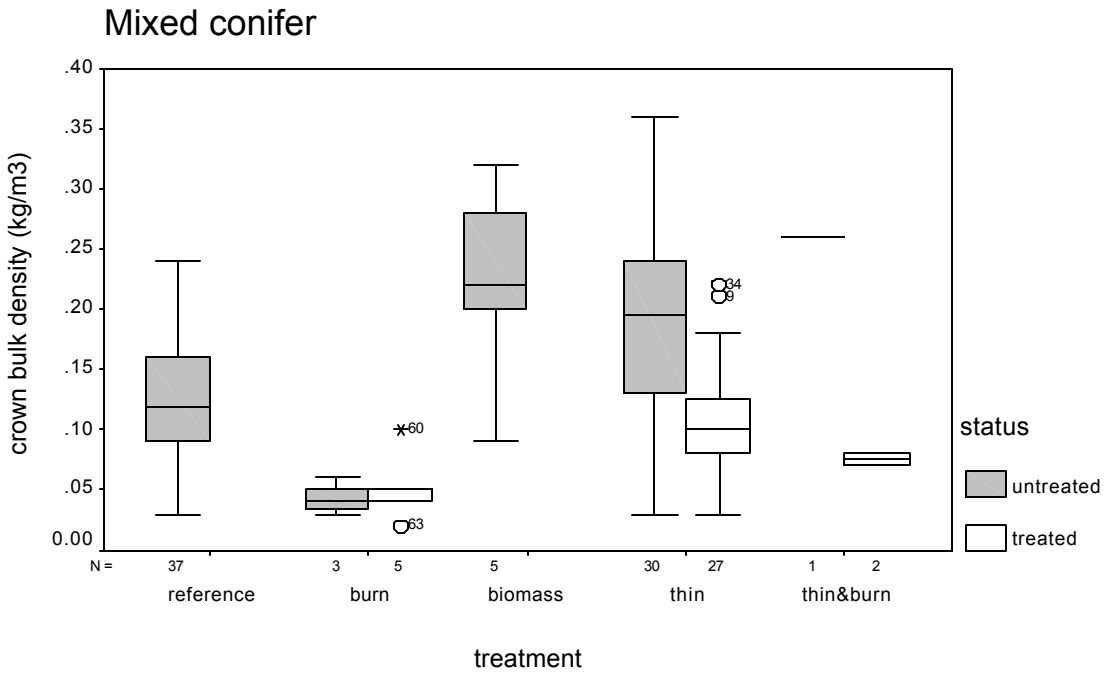


Figure 32. Box plot of crown bulk densities in FHP sample sites by treatment type and treatment status in mixed conifer and white fir forests in the westside and transition zones. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Median values of reference sites were 0.12 kg/m^3 and those selected for thinning or biomass all reached or exceeded 0.20 kg/m^3 (Table 13). Sites selected for burning had the lowest crown bulk densities, less than 0.05 kg/m^3. Prior to treatment, crown bulk densities were significantly lower in burn sites than reference stands. In contrast, sites selected for biomass or thinning had significantly higher crown bulk densities than reference sites. After treatment, only burned sites had significantly different and lower crown bulk densities than reference sites. This is probably because crown bulk densities were lower before treatment.

Table 13. Results of randomization test for determining differences between reference sites and pre- or post-treatment crown bulk density in mixed-conifer.

Mixed Conifer									
Variable: crown bulk density (kg/m^3)									
Treatment	n	Median	Median Difference (treatment – reference)	One-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.10
Pre-Treatment									
Thin-biomass	5	0.22	0.10	0.016	**Y**	**Y**	0.017	**Y**	**Y**
Burn	3	0.04	-0.08	0.035	**Y**	**Y**	0.066	**Y**	N
San./Salvage	1	0.09	-0.03	0.307	N	N	0.669	N	N
Thin & burn	1	0.26	0.14	0.043	**Y**	**Y**	0.043	**Y**	**Y**
Thin	30	0.195	0.075	< 0.001	**Y**	**Y**	0.001	**Y**	**Y**
Reference	37	0.12							
Post-Treatment									
Burn	5	0.050	-0.070	0.031	**Y**	**Y**	0.055	**Y**	N
San./Salvage	3	0.160	0.040	0.197	N	N	0.343	N	N
Thin & burn	2	0.075	-0.045	0.114	N	N	0.290	N	N
Thin	27	0.100	-0.020	0.153	N	N	0.302	N	N

Post-Treatment vs. Predicted Pre-Treatment Levels

The only significant differences between predicted pre-treatment levels were for reference sites (Table 14). A few of the sites (19%) had significantly (p=0.20) lower crown bulk densities than predicted prior to treatment.

Table14. Results of IVRS statistical tests for crown bulk density in mixed conifer.

		P=0.05		P=0.10		P=0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	27	0	0	0	0	0	0
Thin & Burn	2	0	0	0	0	0	0
Burn	5	0	0	0	0	0	0
Reference	37	3	3	3	3	3	19

Height to Live Crown

Similarly to crown bulk density, the relationship between height to live crown in a stand and fire behavior is only partly understood at this time by fire behavior researchers. The relationship between the height to live crown on individual trees and fire behavior is fairly well understood. As with the crown bulk density, the results presented here are best used to illustrate relative differences between units with different treatment types, status of treatment and amongst forest types.

Eastside Pine

Overall Patterns

Height to live crowns (hlc) varied widely amongst different treatment and status categories, ranging primarily from 3 to 15 feet. Randomly selected reference sites and those planned for thinning had the lowest values, with most units falling between 3 and 6 feet. Sites sampled after biomass or thin and burn treatments had the highest levels, ranging from 10 to 15 feet on most sites (Figure 33).

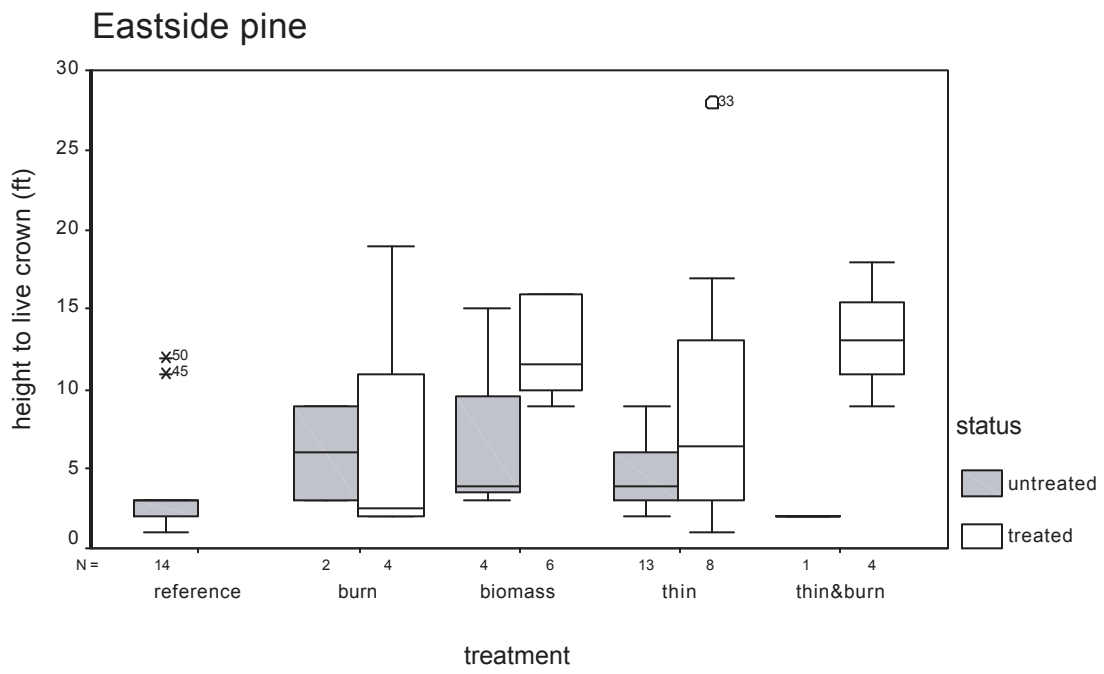


Figure 33. Box plot of FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

The only significant differences with reference sites were between sites treated with biomass and combined thinning and burning treatments (Table 15). At sites sampled after biomass or thinning and burning treatments, the median height to live crowns exceeded 12 feet.

Table 15. Results of randomization test for determining differences between reference sites and pre- or post-treatment height to live crown in eastside pine.

Eastside Pine									
Variable: height to live crown (ft)									
Treatment	n	Median	Median Difference (treatment – reference)	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
Biomass	4	4	1	0.26	N	N	0.45	N	N
Burn	2	6	3	0.40	N	N	0.43	N	N
Thin & burn	1	2	-1	0.30	N	N	0.59	N	N
Thin	13	4	1	0.24	N	N	0.45	N	N
Reference	14	3							
Post-Treatment									
Biomass	6	12	9	0.06	**Y**	N	0.09	**Y**	N
Burn	4	2.5	-0.5	0.37	N	N	0.76	N	N
Thin & burn	4	13	10	0.06	**Y**	N	0.07	**Y**	N
Thin	8	7	4	0.11	N	N	0.19	N	N

Post-Treatment vs. Predicted Pre-Treatment Levels

The only significant differences between predicted pre-treatment levels were for the biomass treatments and reference sites (Table 16). A few of the biomass sites (17%) had significantly (p=0.05) greater height to live crowns than predicted pre-treatment levels and one-third had significantly (p-0.20) lower height to live crowns. One of the reference sites had significantly lower height to live crowns.

Table 16. Results of IVRS statistical tests for height to live crown in eastside pine

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	8	0	0	0	0	0	0
Thin & Burn	4	0	0	0	0	0	0
Burn	4	0	0	0	0	0	0
Biomass	6	17	0	17	17	17	33
Reference	14	7	0	7	0	7	0

Mixed Conifer

Overall Patterns

The range of hlc's in mixed conifer was similar to those in eastside pine, with most sampled sites falling less than 15 feet (Figure 34). As with the eastside pine, although highly variable, in thin units, sites

sampled after treatment were higher than those sampled before treatment. Unlike the eastside pine, burned units generally had high hlc's.

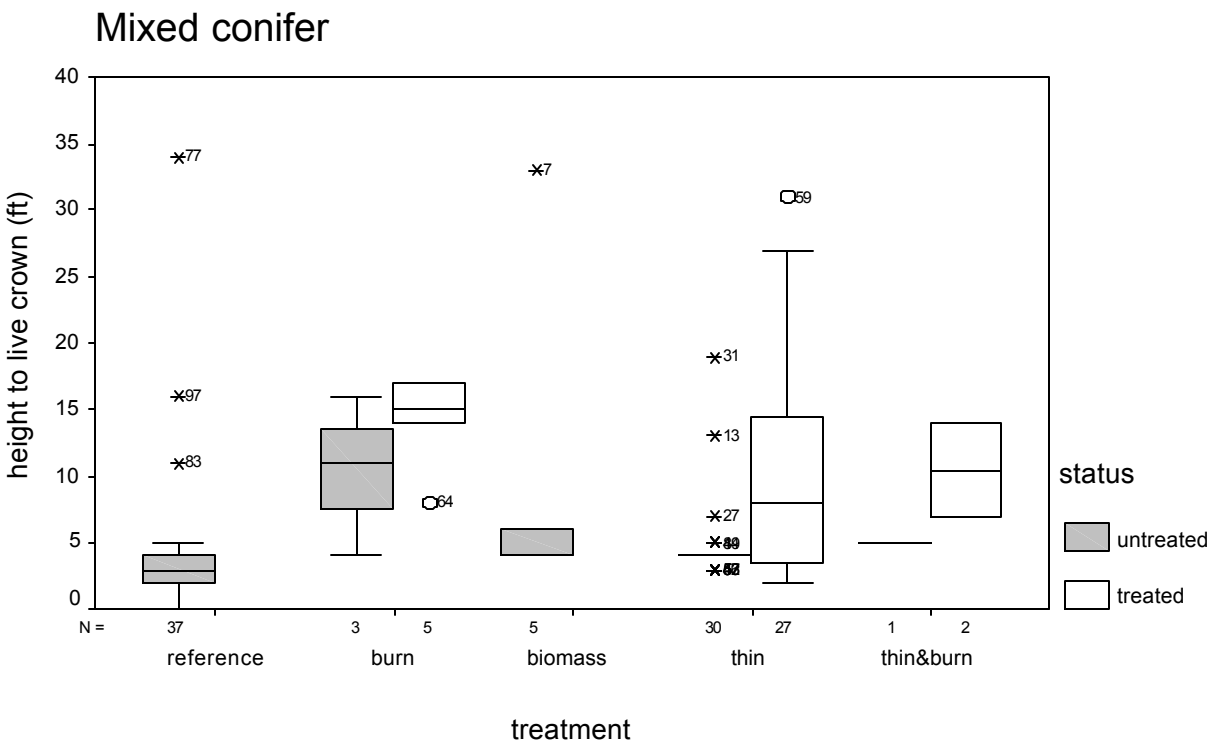


Figure 34. Box plot of FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Before treatment, only burn sites were significantly different than reference stands, with significantly higher height to live crowns (median of 11 feet) (Table 17). After treatment, both burned and thinned sites were significantly greater than reference sites. Burned site medians were 15 feet and thin sites had a median of 8 feet. Sites treated with thinning and burning both had median hlc's of 11 feet, significantly different at 0.20 but not 0.10 probability levels.

Table 17. Results of randomization test for determining differences between reference sites and pre- or post-treatment height to live crown in eastside pine.

Mixed conifer									
Variable: height to live crown (ft)									
Treatment	n	Median	Treatment median – reference median	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.10
Pre-Treatment									
Biomass	5	4	1	0.31	N	N	0.67	N	N
Burn	3	11	8	0.05	**Y**	**Y**	0.05	**Y**	**Y**
San./Salvage	1	3	0	0.50	N	N	0.50	N	N
Thin & burn	1	5	2	0.20	N	N	0.29	N	N
Thin	30	4	1	0.16	N	N	0.30	N	N
Reference	37	3							
Post-Treatment									
Burn	5	15	12	0.02	**Y**	**Y**	0.02	**Y**	**Y**
San./Salvage	1	3	0	0.50	N	N	0.50	N	N
Thin & burn	2	11	8	0.11	N	N	0.11	N	N
Thin	27	8	5	<0.01	**Y**	**Y**	<0.01	**Y**	**Y**

Post-Treatment vs. Predicted Pre-Treatment Levels

A few (11%) of the thinned sites had significantly lower hlc's than predicted levels prior to treatment (Table 18). Twenty-percent of the burned sites had significantly higher hlc's than predicted levels prior to treatment.

Table 18. Results of IVRS statistical tests for height to live crown in mixed conifer

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
San/Salv	3	0	0	0	0	0	0
Thin	27	0	11	0	11	0	11
Thin & Burn	2	0	0	0	0	0	0
Burn	5	20	0	20	0	20	0
Reference	37	3	3	3	3	3	3

Surface and Ground Fuels

1 hour fuels (0-1/4" diameter)

Eastside Pine

Overall Patterns

Loadings were generally similar across all sampled sites, ranging from 0.2 to 0.8 tons per acre (Figure 35). After biomass and thinning the highest levels were measured for some sites.

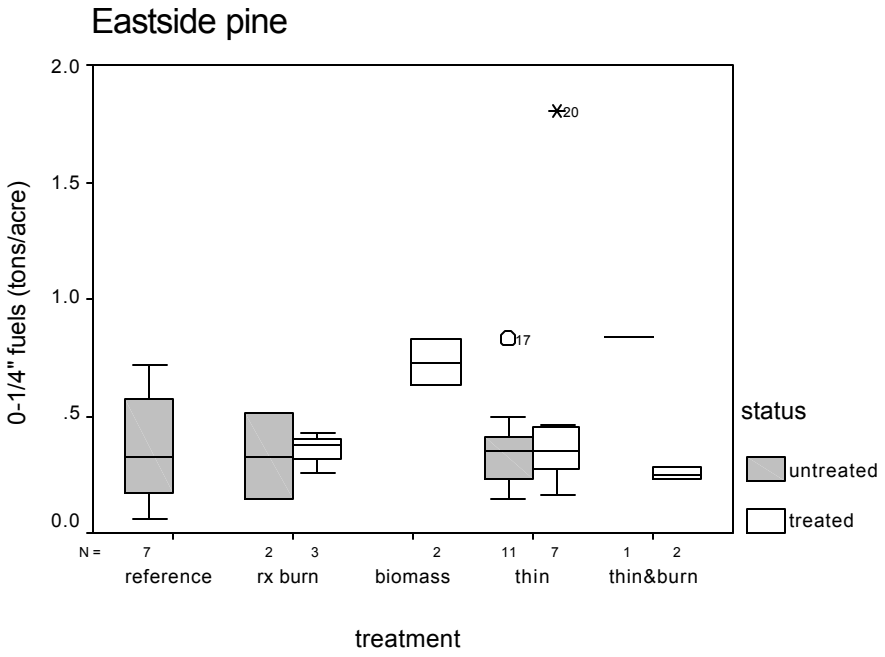


Figure 35. Box plot of 1-hour fuels in FHP sample sites by treatment type and treatment status in the eastside pine zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Only the one site planned for combined thin and burn treatments were significantly different (greater) than reference sites (Table 19). Prior to treatment, median values were greatest for sites planned for thinning and combined thin and burn treatments. After treatment, biomassed sites had significantly greater 1 hour fuels than reference sites.

Table 19. Results of randomization test for determining differences between reference sites and pre- or post-treatment 1 hour fuel loadings in eastside pine.

Eastside Pine									
Variable: 1 hour (0-1/4") fuel loading (tons/acre)									
Treatment	n	Median	Treatment median – reference median	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
Burn	2	0.33	0.00	0.34	N	N	0.50	N	N
Thin & burn	1	0.84	0.51	0.06	**Y**	N	0.09	**Y**	N
Thin	11	0.36	0.03	0.41	N	N	0.84	N	N
Reference	7	0.33							
Post-Treatment									
Biomass	2	0.73	0.4	0.08	**Y**	N	0.14	N	N
Burn	3	0.38	0.05	0.41	N	N	0.83	N	N
Thin & burn	2	0.26	-0.08	0.34	N	N	0.71	N	N
Thin	7	0.36	0.03	0.45	N	N	0.83	N	N

Post-Treatment vs. Predicted Pre-Treatment Levels

A few of the thinned units and all of the 2 biomass treatment units had significantly (p=0.20) greater 1-hour fuels than predicted prior to treatment (Table 20).

Table 20. Results of IVRS statistical tests for 1-hour fuels (0 to 1/4") in eastside pine.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	N	% +	% -	% +	% -	% +	% -
Thin	7	14	0	14	0	14	0
Thin&burn	2	0	0	0	0	0	0
Burn	3	0	0	0	0	0	0
Reference	7	0	0	0	0	0	0
Biomass	2	0	0	50	0	100	0

Mixed Conifer

Overall Patterns

In contrast to eastside pine, most of the mixed-conifer sites had 1-hour fuels that exceeded 0.5 tons/acre (Figure 36). The range of values varied between treatments and treatment status. The highest levels were found in those planned for thinning and biomass, exceeding 1 and 2 tons/acre, respectively for the majority of sites. Reference sites and those treated with burning or combined thin and burn treatments had the lowest median and ranges of data. The four sites treated with burning or thinning and burning had levels less than 0.5 tons/acre. Reference sites had a wider range of values but were skewed to those less than 1 ton/acre.

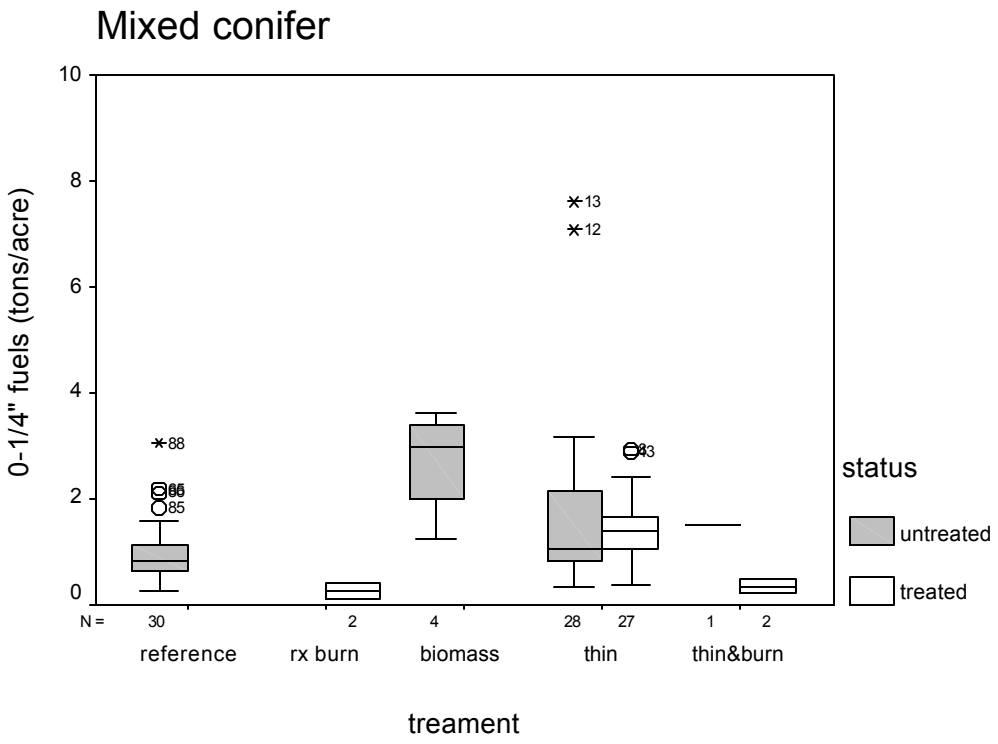


Figure 36. Box plot of 1-hour fuels in FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Prior to treatment, both the sites planned for biomass and thinning had significantly greater 1 hour fuel loadings than reference sites (Table 21). The magnitude of the difference was greatest (2 tons/acre) for the biomass sites. After treatment, all of the types were significantly different than reference sites. Sites treated with burning or combined thin and burn treatments had significantly lower 1 hour fuel loadings than reference sites. Sites treated with thinning alone had significantly greater 1 hour loadings. Because we did not sample the same sites before and after treatment, we do not know the contribution of activity fuels vs. higher initial levels to the higher post-treatment thin site fuel levels.

Table 21. Results of randomization test for determining differences between reference sites and pre- or post-treatment 1-hour fuel loadings in mixed conifer.

Mixed conifer									
Variable: 1 hour (0-1/4") fuel loading (tons/acre)									
Treatment	n	Median	Treatment median – reference median	One-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > t)	Sign. Prob. < 0.10	Sign. Prob. < 0.10
Pre-Treatment									
Biomass	4	2.9	2.0	0.01	**Y**	**Y**	0.01	**Y**	**Y**
Thin & burn	1	1.5	0.7	0.19	N	N	0.20	N	N
Thin	28	1.1	0.26	0.09	**Y**	N	0.15	N	N
Reference	30	0.8							
Post-Treatment									
Burn	2	0.25	-0.55	0.02	**Y**	**Y**	0.22	N	N
Thin & burn	2	0.34	-0.46	0.04	**Y**	**Y**	0.29	N	N
Thin	27	1.38	0.58	0.01	**Y**	**Y**	0.02	**Y**	**Y**

Post-Treatment vs. Predicted Pre-Treatment Levels

The only significant difference with predicted pre-treatment levels using the IVRS test was for a couple of reference sites (Table 22). One had significantly (p=0.20) lower levels and one significantly higher levels than predicted pre-treatment levels.

Table 22. Results of IVRS statistical tests for 1-hour fuels (0 to 1/4") in mixed conifer.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	27	0	0	0	0	0	0
Thin&burn	2	0	0	0	0	0	0
Burn	2	0	0	0	0	0	0
San/Salv	3	0	0	0	0	0	0
Reference	30	0	0	0	0	3	3

10 hour fuels

Eastside Pine

Overall Patterns

Ten-hour fuel loadings generally ranged between 0.5 and 2 tons/acre for most sites (Figure 37). Sites treated with biomass (only 2 sites) and one of the thinned sites had loadings exceeding 2.8 tons/acre.

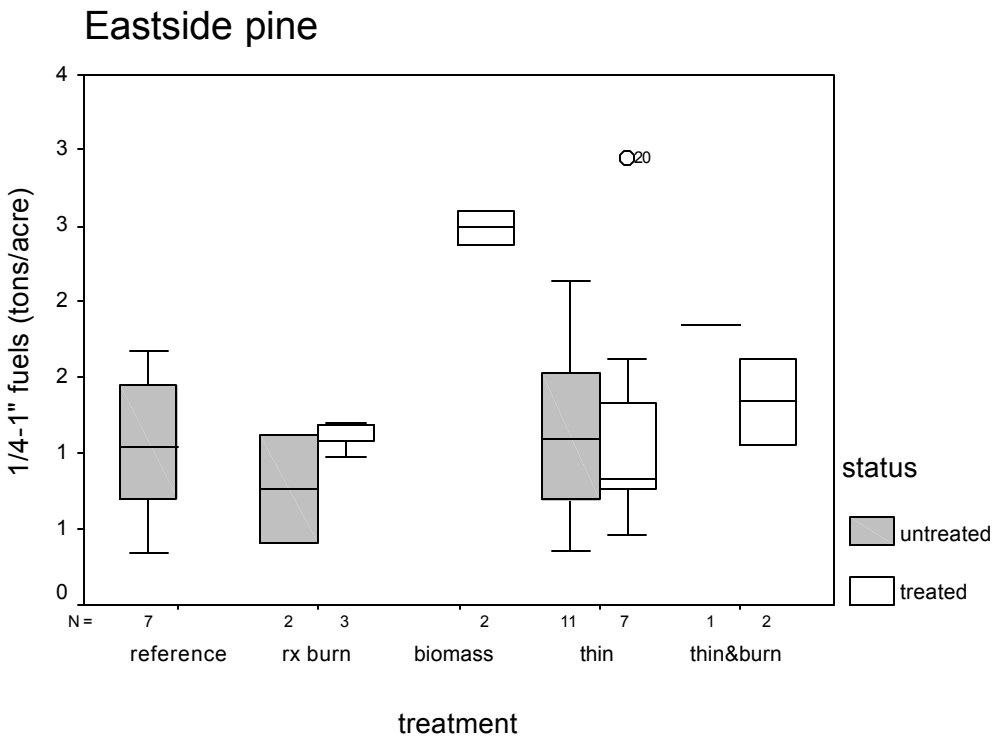


Figure 37. Box plot of 10-hour fuels in FHP sample sites by treatment type and treatment status in the eastside zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

Both of the 2 biomassed units had significantly (p=0.05) greater 10 hour fuels than the predicted pre-treatment levels (Table 23). Twenty-nine percent of the thinned units had significantly (p=0.20) greater and 14% significantly lower 10 hour fuel levels than predicted pre-treatment levels. Fourteen percent of the reference sites had significantly (p=0.20) greater 10 hour fuel loadings than predicted.

Table 23. Results of IVRS statistical tests for 10-hour fuels (1/4”to1”) in eastside pine.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	7	14	0	14	0	29	14
Thin&burn	2	0	0	0	0	0	0
Burn	3	0	0	0	0	0	0
Reference	7	0	0	0	0	14	0
Biomass	2	100	0	100	0	100	0

Mixed Conifer

Overall Patterns

Ten-hour fuel loadings generally ranged between 1.5 and 4 tons/acre for most sites (Figure 38). Sites selected for biomass had the highest median and range of values, exceeding 3 and ranging up to 6 tons/acre for most sites. Sites treated with burning or combined thin and burn treatments had the lowest levels, ranging from 0.5 to 2 tons/acre. Overall these levels are double that measured in eastside pine.

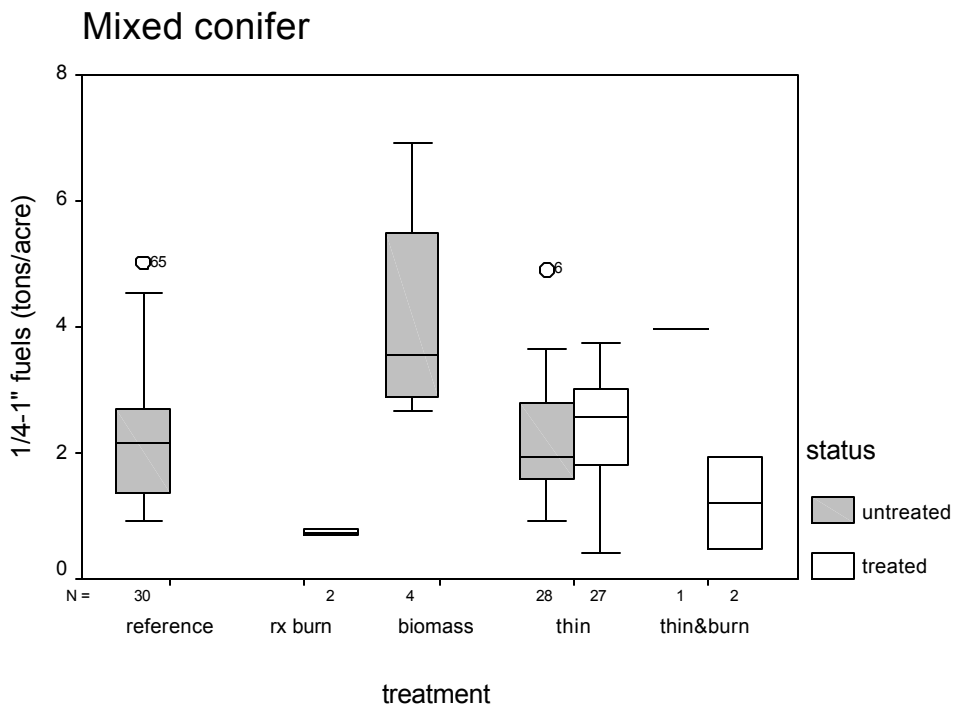


Figure 38. Box plot of 10-hour fuels in FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

Over half of the thinned and reference sites had significantly (p=0.10 and 0.20 respectively) greater 10 hour fuel loadings than predicted pre-treatment levels (Table 24). One of the three sites treated with sanitation and salvage had significantly greater loadings than predicted pre-treatment levels.

Table 24. Results of IVRS statistical tests for 10-hour fuels (1/4" to 1") in mixed conifer.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	27	26	0	56	0	59	0
Thin&burn	2	0	0	0	0	0	0
Burn	2	0	0	0	0	0	0
San/Salv	3	0	0	33	0	33	0
Reference	30	23	0	40	0	53	0

100-hour fuels

Eastside Pine

Overall Patterns

The 100-hour fuel loadings generally ranged from 0.5 to 3 tons/acre (Figure 39). The two sites treated with biomass had the greatest overall levels, exceeding 6 tons/acre. One of the thinned sites had loadings greater than 11 tons/acre.

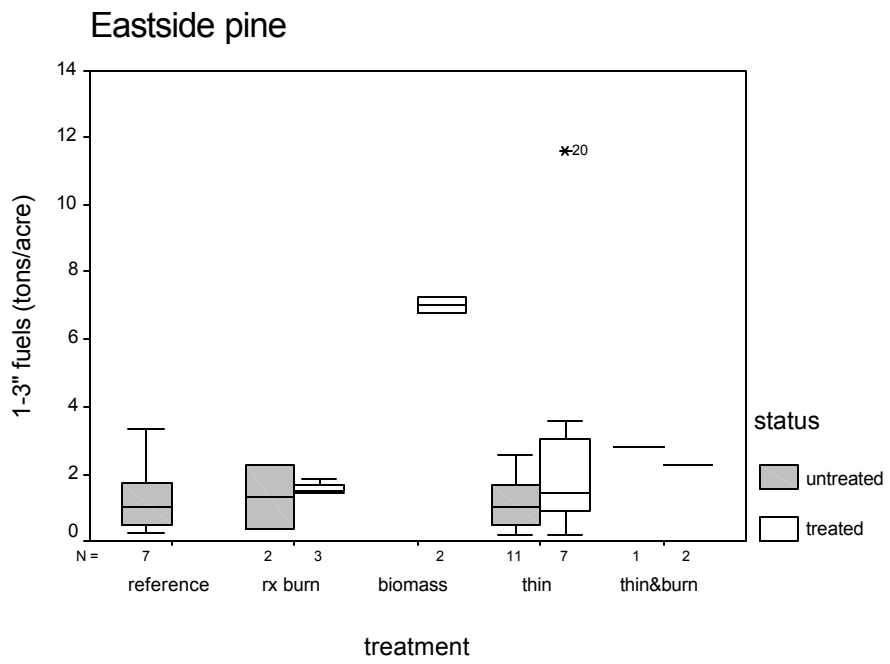


Figure 39. Box plot of 100-hour fuels in FHP sample sites by treatment type and treatment status in the eastside zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

Both the biomass treatment sites and 43% of the thinned sites had significantly (p=0.10) greater 100 hour fuel loadings than predicted pre-treatment levels (Table 25). Fourteen percent of the reference sites had significantly higher loadings as well.

Table 25. Results of IVRS statistical tests for 100-hour fuels (1" to 3") in eastside pine.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	7	29	0	43	0	43	0
Thin&burn	2	0	0	0	0	0	0
Burn	3	0	0	0	0	0	0
Reference	7	0	0	0	0	14	0
Biomass	2	100	0	100	0	100	0

Mixed Conifer

Overall Patterns

As with the 10 hour fuels, the 100 hour fuel loadings in mixed conifer were generally double that in eastside pine (Figure 40). Levels generally ranged from 2 to 8 tons/acre. Some of the thin and biomass sites had levels exceeding 10 and going up to 15 tons/acre, as did one of the reference sites. The four sites treated with burning or combined thin and burn treatments had the lowest levels, less than 3 tons/acre.

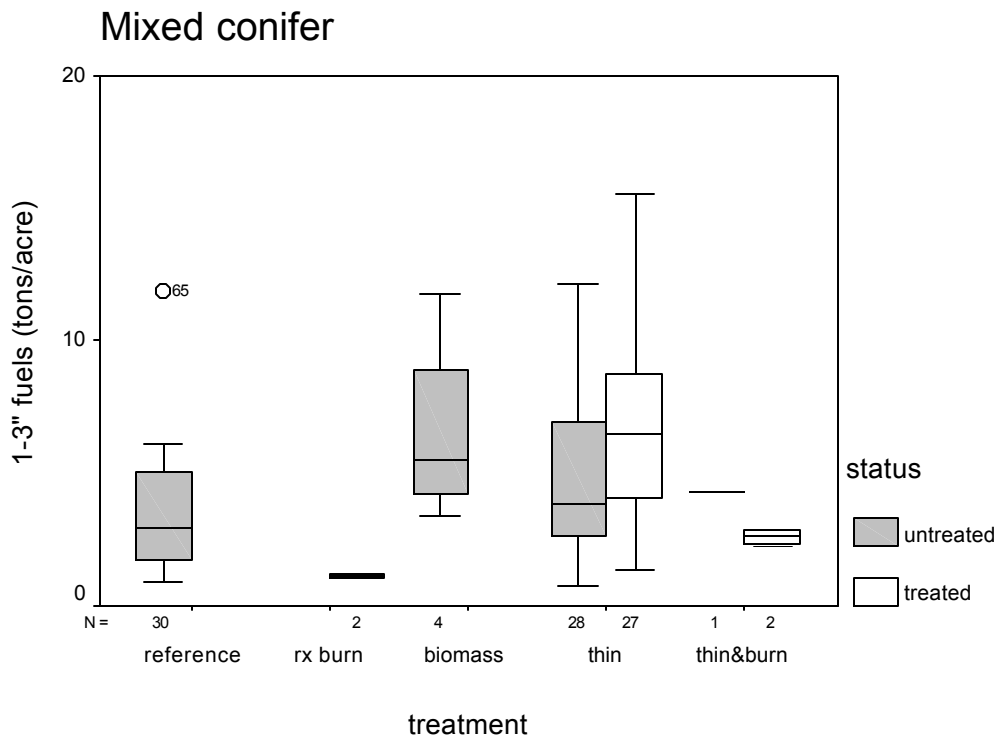


Figure 40. Box plot of 100-hour fuels in FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

One of the two burn sites had significantly lower 100-hour fuel loadings than predicted pre-treatment levels (Table 26). Twenty percent of the thinned sites had significantly greater and 4% significantly lower 100-hour fuel loadings than predicted pre-treatment levels.

Table 26. Results of IVRS statistical tests for 100-hour fuels (1" to 3") in mixed conifer.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	27	19	0	19	0	22	4
Thin&burn	2	0	0	0	0	0	0
Burn	2	0	0	0	50	0	50
San/Salv	3	0	0	0	0	0	0
Reference	30	0	0	0	0	3	0

Litter and duff

Eastside Pine

Overall Patterns

Litter and duff weights generally ranged between 0.8 and 2 tons/acre (Figure 41). Sites treated with biomass or thinning had some higher levels ranging up to 3.4 tons/acre. The reference sites had the greatest proportion at lower levels, with some reaching less than 0.2 tons/acre.

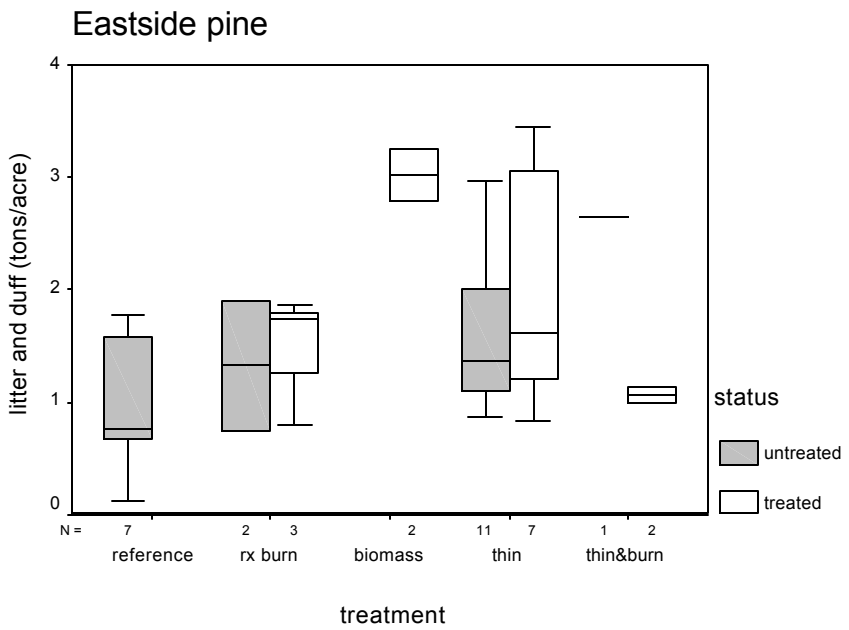


Figure 41. Box plot of litter and duff loadings in FHP sample sites by treatment type and treatment status in the eastside zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

Both of the 2 biomassed sites and 43% (p=0.10) of the thinned sites had significantly greater litter and duff weights than predicted levels prior to treatment (Table 27). One of the thinned sites and two of the reference sites had significantly lower litter and duff weights than predicted pre-treatment levels.

Table 27. Results of IVRS statistical tests for litter and duff in eastside pine.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	7	29	0	43	0	43	14
Thin&burn	2	0	0	0	0	0	0
Burn	3	0	0	0	0	0	0
Reference	7	0	0	0	14	0	29
Biomass	2	50	0	100	0	100	0

Mixed Conifer

Overall Patterns

As with the other fuel loadings, litter and duff weights were generally higher in mixed conifer than in eastside stands regardless of treatment. The majority of sites had loadings less than 5 tons/acre. Some of the sites selected for thinning had loadings exceeding 12 tons/acre. Sites selected for biomass, thinning or after thinning had the greatest medians and overall levels ranging primarily from 2 to 7 tons/acre. Reference sites were generally less than 5 tons per acre. The 4 sites treated with burning or combined thin and burn treatments had the lowest range of levels, between 1 and 2 tons/acre (Figure 42).

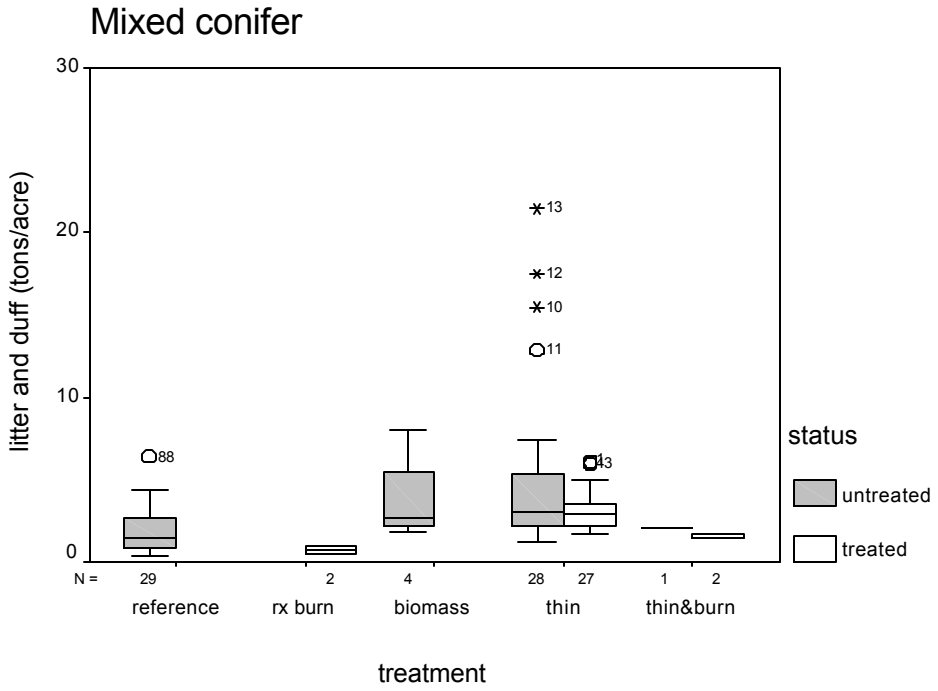


Figure 42. Box plot of 1-hour fuels in FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

One each of the burn and sanitation/salvage treatment sites had significantly lower litter and duff levels than predicted prior to treatment (Table 28).

Table 28. Results of IVRS statistical tests for litter and duff in mixed conifer.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	27	0	0	0	0	0	0
Thin&burn	2	0	0	0	0	0	0
Burn	2	0	0	0	0	0	50
Reference	30	0	0	0	0	0	0
San/Salv	3	0	0	0	0	0	33

All surface fuels <3" diameter

Eastside Pine

Overall Patterns

Most sampled sites had small surface fuels less than 5 tons/acre (Figure 43). The exceptions were the two sites treated with biomass that had 10 tons/acre and one of the thinned sites with loadings exceeding 15 tons/acre.

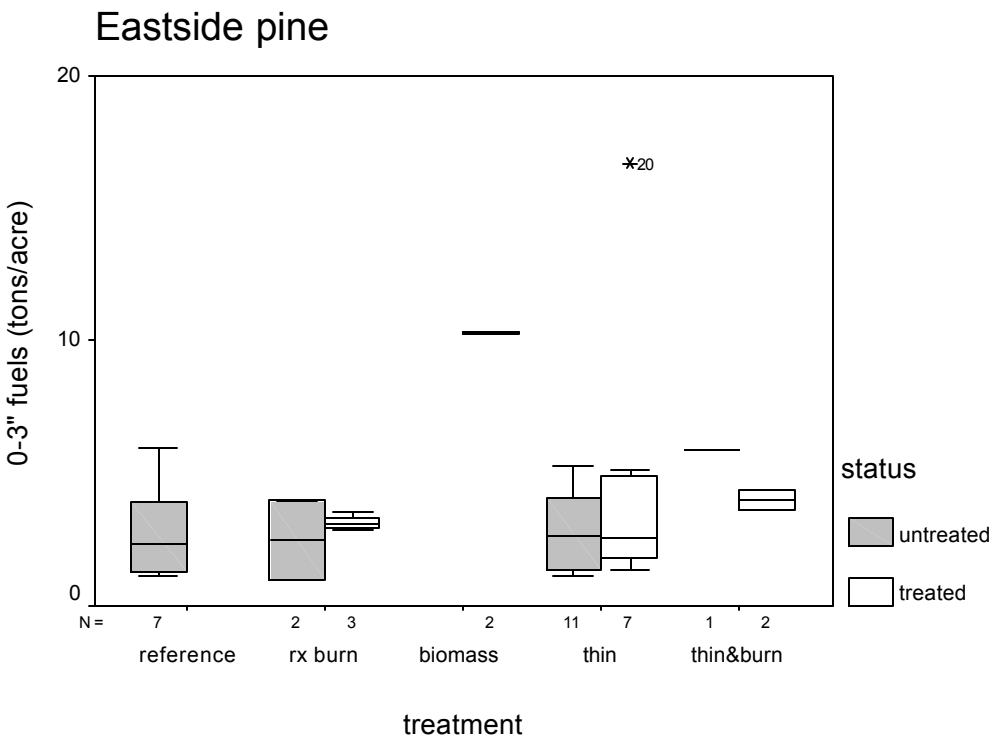


Figure 43. Box plot of total surface fuels in FHP sample sites by treatment type and treatment status in the eastside zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

The only significant differences with reference sites were between the biomass treatments (Table 29). The biomass sites had significantly greater fuel loadings (median difference of 8 tons/acre) than reference sites.

Table 29. Results of randomization test for determining differences between reference sites and pre- or post-treatment total surface fuel loading in eastside pine.

Eastside Pine									
Variable: surface fuel loading (tons/acre <3" diameter)									
Treatment	n	Median	Median Difference (treatment -reference	One-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
Burn	2	2.5	0.12	0.47	N	N	0.50	N	N
Thin & burn	1	5.9	3.5	0.12	N	N	0.15	N	N
Thin	11	2.6	0.31	0.36	N	N	0.75	N	N
Reference	7	2.3							
Post-Treatment									
Biomass	2	10.3	8.0	0.02	**Y**	**Y**	0.03	**Y**	**Y**
Burn	3	3.1	0.8	0.25	**N**	N	0.54	N	N
Thin & burn	2	4.0	1.7	0.17	**N**	N	0.30	N	N
Thin	7	2.5	0.19	0.40	**N**	N	0.84	N	N

Post-Treatment vs. Predicted Pre-Treatment Levels

Most of the thinned sites and reference sites (81 and 87% respectively) and one of the thin & burn sites had significantly greater total surface fuel loadings than predicted pre-treatment levels (Table 30).

Table 30. Results of IVRS statistical tests for total fuels (0 to 3") in eastside pine.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	7	56	0	70	0	81	0
Thin&burn	2	0	0	0	0	50	0
Burn	3	0	0	0	0	0	0
Reference	7	60	0	77	0	87	0

Mixed Conifer

Overall Patterns

Total surface fuel loadings were more than 2 to 4 times greater across the mixed conifer sites than the eastside pine sites. Low levels were 2 to 5 tons/acre (Figure 44). Most of the reference sites had less than 10 or 15 tons/acre. The sites planned for thinning and especially biomass had a higher range of levels, from 15 to 22 tons respectively. The sites treated with prescribed burning, either alone or after thinning, had the lowest range and median values, both less than 5 tons/acre.

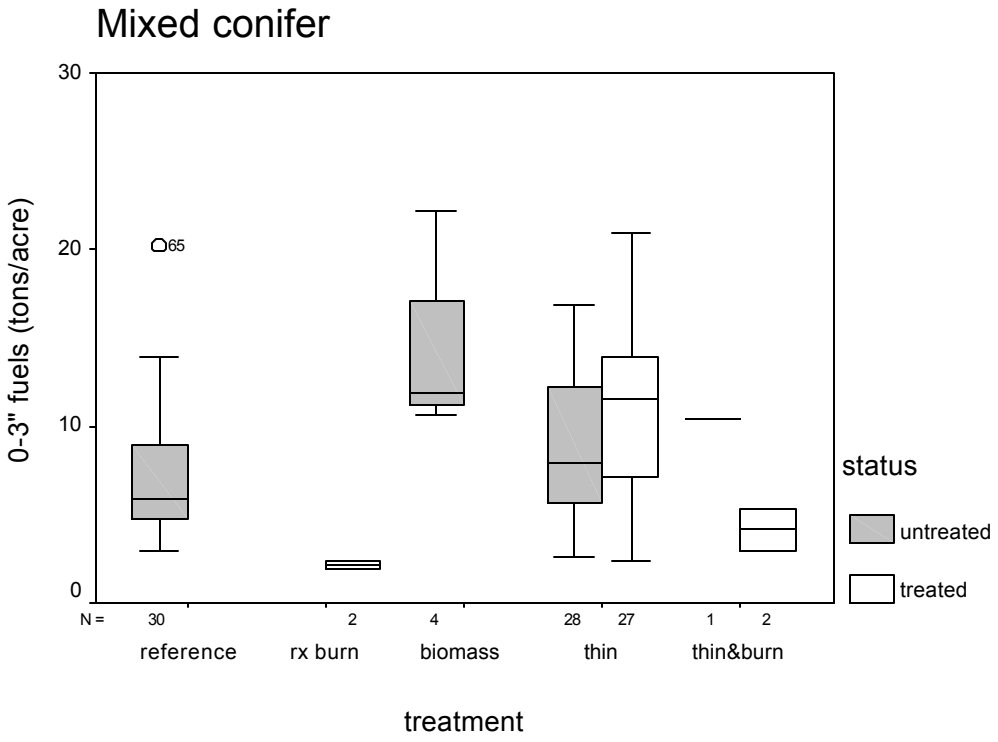


Figure 44. Box plot of total surface fuels in FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Prior to treatment, both the sites planned for biomass and thinning had significantly greater total surface fuel loadings than reference sites (Table 31). The magnitude of the difference was much greater for biomass sites (6 tons/acre) than thin sites (2 tons/acre). After treatment, the burned sites had significantly lower total surface fuel loadings (-4 tons/acre) and thin sites significantly greater (6 tons/acre) than reference sites.

Table 31. Results of randomization test for determining differences between reference sites and pre- or post-treatment overstory tree canopy cover in eastside pine.

Mixed Conifer									
Variable: surface fuel loading (tons/acre <3" diameter)									
Treatment	n	Median	Median Difference (treatment - reference	One-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
Biomass	4	11.9	5.9	0.03	**Y**	**Y**	0.03	**Y**	**Y**
Thin & burn	1	10.4	4.4	0.17	N	N	0.18	N	N
Thin	28	7.8	1.9	0.06	**Y**	N	0.12	N	N
Reference	30	6.0							
Post-Treatment									
Burn	2	2.1	-3.8	0.01	**Y**	**Y**	0.17	**N**	N
Thin & burn	2	4.1	-1.8	0.11	N	N	0.46	N	N
Thin	27	11.6	5.6	0.00	**Y**	**Y**	0.00	**Y**	**Y**

Post-Treatment vs. Predicted Pre-Treatment Levels

A majority of the thinned sites (81%), the sanitation/salvage sites (67%) and the reference sites (87%) had higher surface fuel loadings than predicted pre-treatment levels (Table 32). One of the two sites treated with combined thinning and burning also had significantly greater loadings than predicted pre-treatment levels.

Table 32. Results of IVRS statistical tests for total fuels (0 to 3") in mixed conifer.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	27	56	0	70	0	81	0
Thin&burn	2	0	0	0	0	50	0
Burn	2	0	0	0	0	0	0
San/Salv	3	67	0	67	0	67	0
Reference	30	60	0	77	0	87	0

Fuel Depth

Measurement of fuel depth is the least well studied fuel characteristic, yet one of the most critical and sensitive inputs to fire behavior models. The model levels rarely match actual measured levels using the best available current techniques. The measured values are usually lower than those depicted in the fire behavior models. These limitations should be kept in mind when interpreting the absolute values. We will focus on the relative differences between different types of sites.

Eastside Pine

Overall Patterns

There was a wider range of different patterns of fuel bed depths between different treatment categories than other surface fuel variables (Figure 45). Most of the treated sites and reference sites had medians between 1 and 2 inches in depth. The sites treated with biomass had the highest median values, greater than 2 and the sites selected for prescribed burning, the lowest, less than 1.

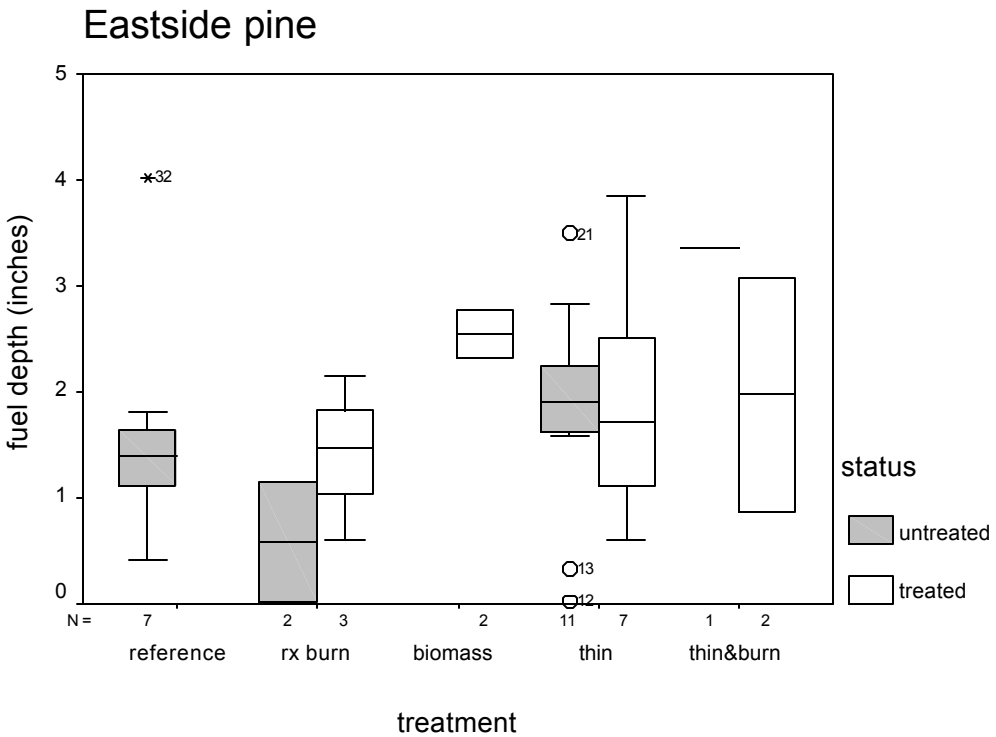


Figure 45. Box plot of fuel depth in FHP sample sites by treatment type and treatment status in the eastside zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

One-third of the thinned sites, one of the two thin and burn sites, and both of the two biomass sites had significantly (p=0.20) greater fuel depths than predicted pre-treatment levels (Table 33).

Table 33. Results of IVRS statistical tests for fuel depth (inches) in eastside pine.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	n	% +	% -	% +	% -	% +	% -
Thin	7	0	0	14	0	29	0
Thin&burn	2	0	0	0	0	50	0
Burn	3	0	0	0	0	0	0
Reference	7	0	0	0	0	0	0
Biomass	2	0	0	0	0	100	0

Mixed Conifer

Overall Patterns

Concurrent with higher fuel loadings, the fuel depths were greater in mixed conifer than eastside pine sites overall (Figure 46). Values generally ranged from 2 to 6 inches for most sites. The sites treated with burning, alone or in combination with thinning, had the lowest levels, with both less than 1" on all of the 4 sites.

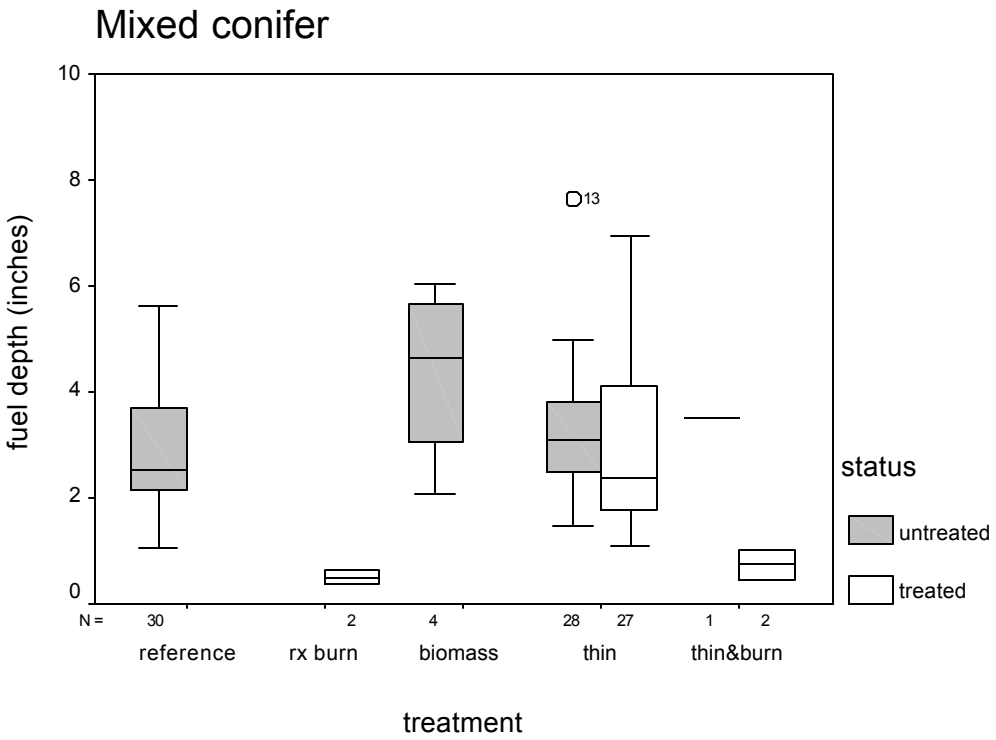


Figure 46. Box plot of fuel depth in FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Post-Treatment vs. Predicted Pre-Treatment Levels

Both of the two burned sites and one of the two thin and burn sites had significantly lower fuel depths than predicted pre-treatment levels (Table 34). Three of the thinned sites had significantly lower fuel depths and four significantly greater fuel depths than predicted pre-treatment levels. One of the three sanitation/salvage sites had significantly lower fuel depths than predicted pre-treatment levels.

Table 34. Results of IVRS statistical tests for fuel depth (inches) in mixed conifer.

		P = 0.05		P = 0.10		P = 0.20	
Treatment	**n**	**% +**	**% -**	**% +**	**% -**	**% +**	**% -**
Thin	27	4	0	7	0	15	11
Thin&burn	2	0	0	0	0	0	50
Burn	2	0	0	0	50	0	100
San/Salv	3	0	0	0	0	0	33
Reference	30	0	3	3	3	3	7

Fuel Models

Fuel models are generalized categories based upon characterization of the type, amount and configuration of fuels that best represent how fire would behave. To date, there is no automated modeling system that assigns fuel models based upon inventory data. Since there are at least six different factors (Table 35) that are characterized in each fuel model, determining which model best applies when only some of the factors match fuel model characteristics is dependent upon expert knowledge of how individual factors will influence fire behavior. Further, little work has been done to rigorously evaluate how well standard fuel inventory techniques (Brown 1972) capture the levels of fuel characteristics important in assigning a fuel model. Brown (1972) states that the inventory technique he developed is not meant for use in fire behavior modeling. Some of the fuel model factors that are most critical in influencing fire behavior, such as fuel bed depth and 1 hour fuel loadings are particularly difficult to obtain adequate samples in (Sapsis pers. comm.). This is partly because very intensive sampling is required to obtain precise results. It is also because of similar reasons to crown bulk density measurement vs. modeling ambiguities. We know that fuel bed depth is very important to the physics of fire behavior but we don't necessarily know how to measure or characterize field measurements in a way that is best related to the way it is used in fire behavior models. For example, it may be that the 85%tile fuel bed depth for a site reflects the fire behavior more than the mean fuel bed depth.

Because of these ambiguities, the inventoried fuel characteristics described previously and the levels that are specified in the fuel models do not always have an exact match. We dealt with this ambiguity by having two independent, experienced fire behavior analysts assign fuel models based upon both the inventory data, photographs of example sites and their knowledge of how fire behaves in different vegetation conditions. The fuel modelers were not given any information on the treatment type or status of the sites, in order to eliminate bias in assignment of fuel models by treatment type or status. One way that variability in individual fuel model factors is often handled is construction of custom fuel models. Given the difficulty of dealing with ambiguity between inventory data and fuel models, the fire behavior analysts felt this would add too much additional unwarranted specificity and therefore restricted their assignments to the standard 13 fuel models (Anderson 1982).

Table 35. Standard Fuel Models used in Fire Behavior by Albini (1976).

Fuel Model	Typical Fuel Complex	Fuel loading (tons/acre)				Fuel bed depth (ft)	Moisture of Extinction of dead fuels (%)
		1 hour	10 hours	100 hours	Live		
1	Short grass	0.74	0.00	0.00	0.00	1.0	12
2	Timber (grass & understory)	2.00	1.00	0.50	0.50	1.0	15
3	Tall grass	3.01	0.00	0.00	0.00	2.5	25
4	Chaparral (6 feet)	5.01	4.01	2.00	5.01	6.0	20
5	Brush (2 feet)	1.00	0.50	0.00	2.00	2.0	20
6	Dormant brush, hardwood slash	1.50	2.50	2.00	0.00	2.5	25
7	Southern rough	1.00	1.87	1.50	0.37	2.5	40
8	Closed timber litter	1.50	1.00	2.50	0.00	0.20	30
9	Hardwood litter	2.92	0.41	0.15	0.00	1.0	25
10	Timber (litter and understory)	3.01	2.00	5.01	2.00	1.0	25
11	Light logging slash	1.50	4.51	5.51	0.00	1.0	15
12	Medium logging slash	4.01	14.03	16.53	0.00	2.3	20
13	Heavy logging slash	7.01	23.04	28.05	0.00	3.0	25

Eastside Pine

Fuel models 8 and 9 were the most common across different sites (Figure 47). Fuel models 5, 10 and 11 were second most common. Treated sites were more commonly modeled as 9, 10 or 11 than untreated sites.

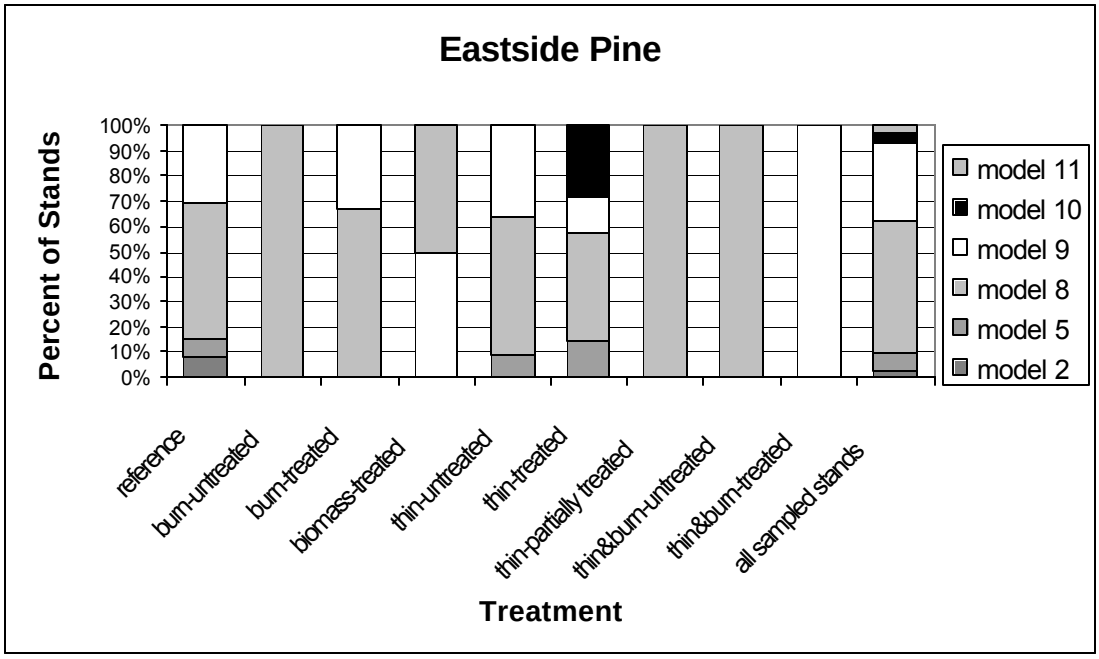


Figure 47. Distribution of assigned standard fuel models to FHP sample units by treatment unit type and status in eastside pine.

Mixed Conifer

Unlike eastside pine, fuel model 10 was one of the most prevalent fuel models assigned and a small proportion of the sites were model 12 and 13 (Figure 48). Sites treated with thinning and burning or burning alone had the highest proportion of fuel models 8 or 9 amongst the treatment units. Mechanically treated sites were more variable but tended to have higher proportion of fuel model 10 assignments.

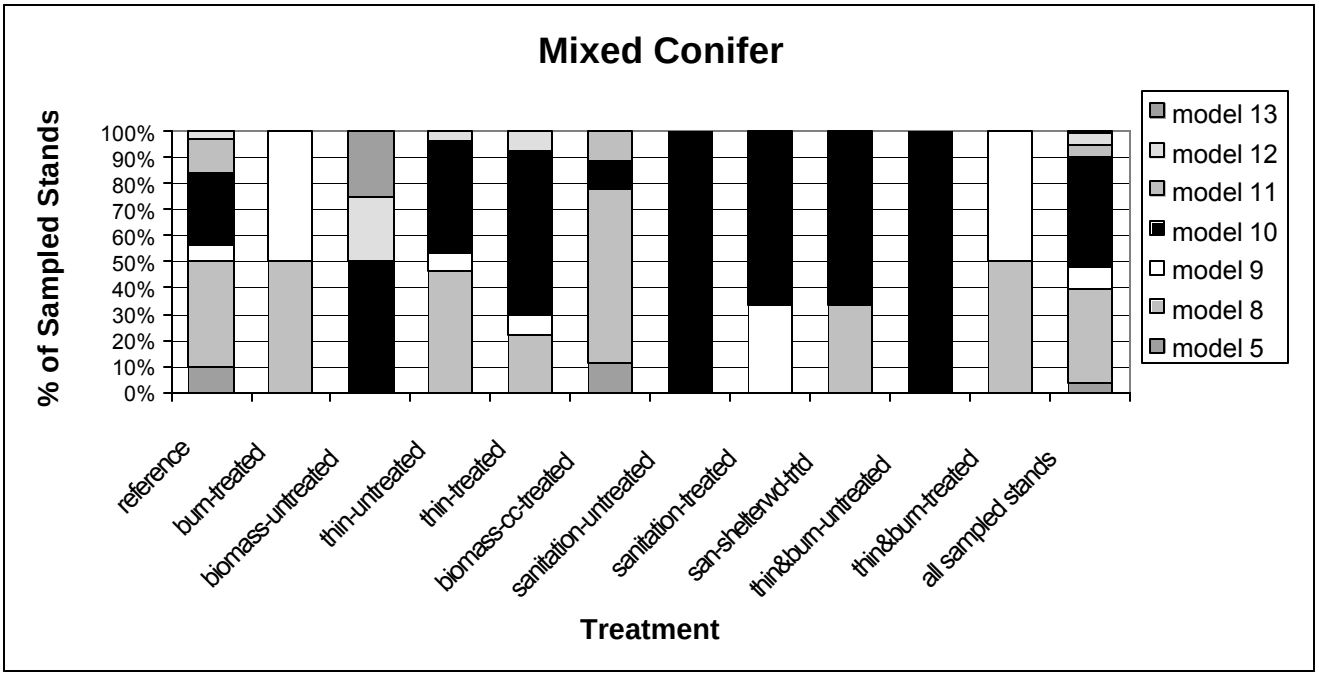


Figure 48. Distribution of assigned standard fuel models to FHP sample units by treatment unit type and status in eastside pine.

Predicted Fire Behavior

Predicted fire behavior is a function of four different factors: fuel model, weather, fuel moistures and topography (slope). The weather and fuel moistures were held constant across the different sample sites for this fire behavior modeling effort. This was because we wanted to make relative comparisons amongst fuel conditions of the sites. Fuel model and slope varied with the conditions in each individual treatment unit. One important caution with the approach used here is that fuel moistures vary with vegetation type and moisture conditions on different sites. Eastside sites generally have lower fuel moistures than westside sites and, north or east aspects and lower slope positions have higher moistures than south or west aspects or higher slope positions. Therefore, fire behavior may be underestimated for drier sites (particularly eastside and transition zone sites) and slightly overestimated for sites on north or east aspects or lower slope positions.

Flamelength

Eastside Pine

Predicted flamelengths under high weather conditions (93rd percentile) were greatest in randomly selected reference sites, with a maximum estimate of nearly 12 feet. These sites may be higher productivity than many sites in the eastside, since at the beginning of the project we assumed that treatments most often occurred in stands with greater than 40% canopy cover and therefore the pool of sites used to select the reference stands came from these denser stands. Many stands in the eastside have lower canopy cover but are still in need of fuels reductions and are selected for treatment. These lower density stands often occur on lower productivity sites, would tend to have lower fuel levels and consequently lower predicted flamelengths. Amongst the sites selected for treatment, the thin units had the highest predicted flamelengths in those sampled before treatment (Figure 49). The biomass unit sampled before treatment had high predicted levels as well, but it is difficult to draw conclusions from one stand. In units sampled after treatment, the burned units had lower predicted flamelengths than the thinned units; although many of the thinned sites had predicted flamelengths lower than the 4 or 6-foot flamelength desired conditions from the HFQLG and SNCF EIS's.

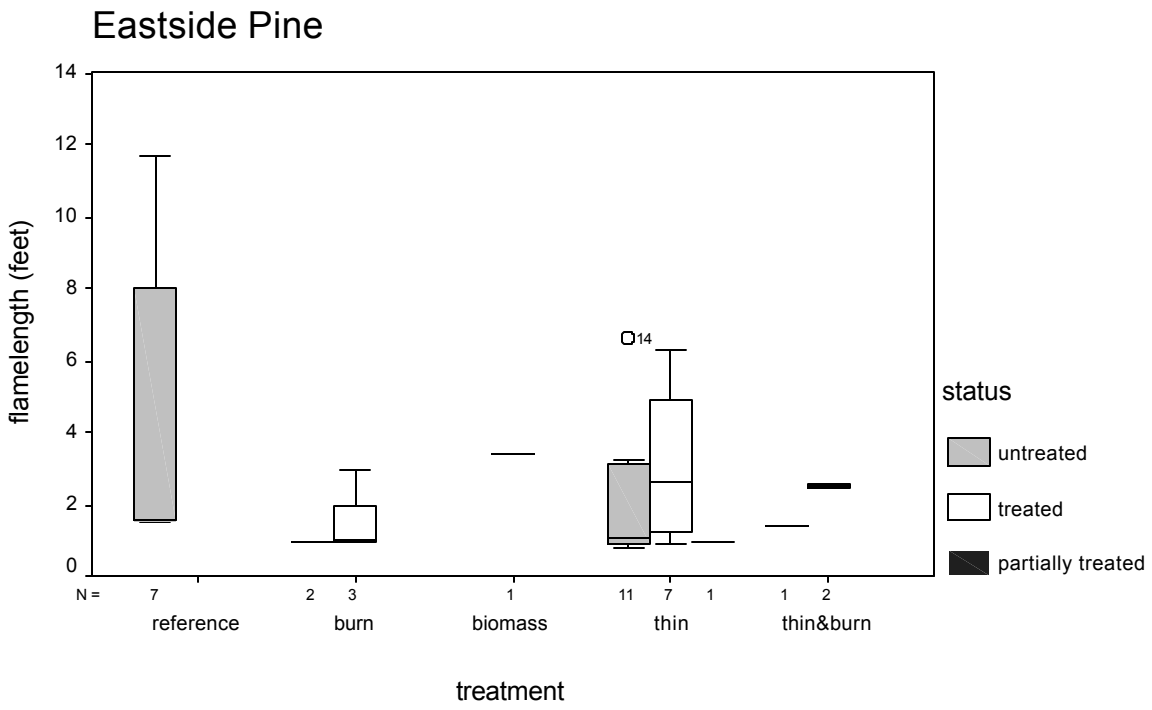


Figure 49. Box plot of predicted flamelengths in FHP sample sites by treatment type and treatment status in the eastside zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

There were no significant differences between any of the treatment sites and reference sites (Table 36).

Table 36. Results of randomization test for determining differences between reference sites and pre- or post-treatment predicted flamelengths in eastside pine.

Eastside Pine									
Variable: flamelength (m)									
Treatment	n	Median	Median Difference (treatment -reference	One-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
Burn	2	0.3	-0.2	0.12	N	N	0.50	N	N
Thin & burn	1	0.4	-0.06	0.23	N	N	0.56	N	N
Thin	11	0.3	-0.15	0.30	N	N	0.57	N	N
Reference	7	0.5							
Post-Treatment									
Biomass	2	1.4	0.65	0.39	**N**	**N**	0.49	N	N
Burn	3	0.31	-0.17	0.25	N	N	0.57	N	N
Thin & burn	2	0.77	0.28	0.47	N	N	0.65	N	N
Thin	7	0.80	0.31	0.24	N	N	0.59	N	N

Mixed Conifer

Predicted flamelengths in the mixed conifer sample sites reached higher levels than in the eastside pine. This is likely due to two reasons. First, the mixed conifer is higher in productivity and as a result has higher potential fuel loadings. Overall higher fuel loadings in mixed conifer compared to eastside pine were observed and described above in the previous sections. In addition, the same fuel moisture levels were used in the modeling for both mixed conifer and eastside pine zones, but they are likely an underestimate for eastside pine. If we had lowered the fuel moisture values for eastside pine, despite the lower fuel loadings, the flamelengths would have been more similar.

The reference and especially the untreated biomass units had the highest predicted flamelengths (Figure 50). The treated burn and thin and burn units had the lowest predicted flamelengths. Approximately 75% of the thinned units had flamelengths less than the 6 feet set as desired conditions for most allocations in the SNCF EIS but less than half were lower than the 4 foot flamelength desired condition in the HFQLG EIS. It is important to note that these FHP projects were planned prior to the issue of the NEPA documents and therefore the DFC's and standards and guidelines do not apply. They are mentioned here because these standards have come out while the FHP projects are still underway. Since many if not most of the thin and biomass units also have planned second treatments of burning, it is likely that they will meet these new standards once the second treatment has been applied.

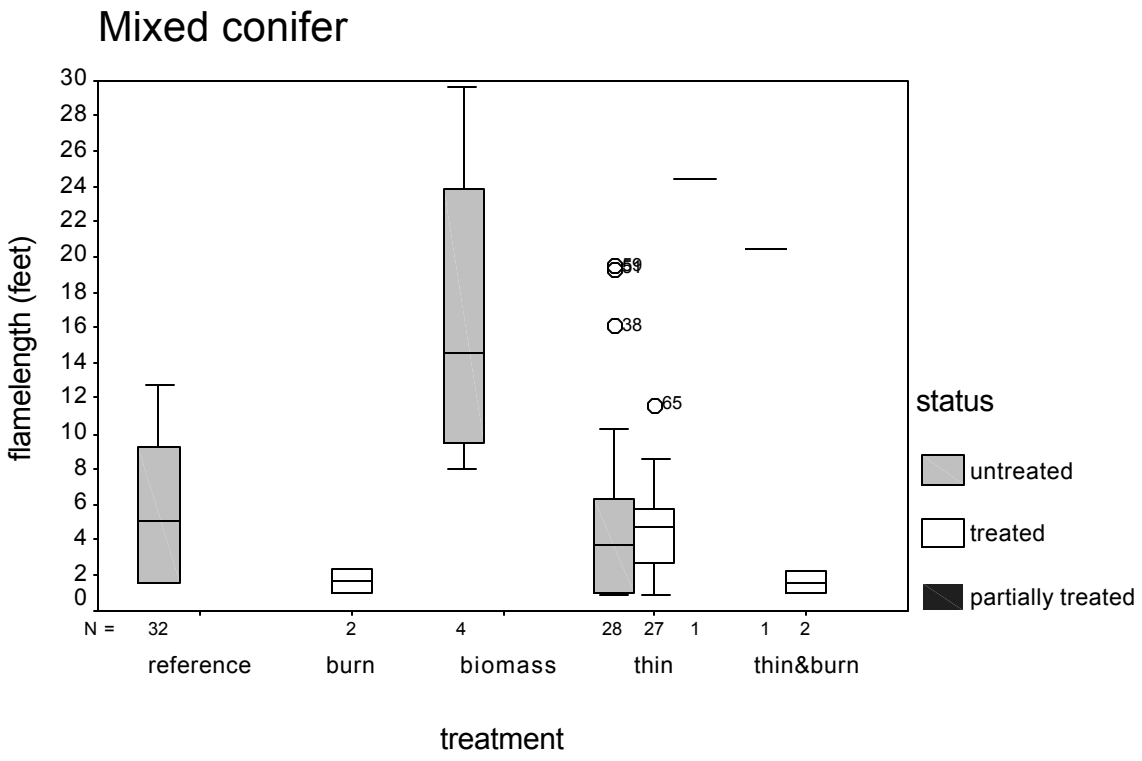


Figure 50. Box plot of predicted flamelengths in FHP sample sites by treatment type and treatment status in the mixed conifer zone. The center horizontal line denotes the median, the upper and lower boundaries of the boxes the 25th and 75th percentiles and the upper and lower horizontal lines the maximum and minimum values, except where values exceeded twice the standard deviation. The latter values are shown individually.

Comparison of Treatment Sites with Reference Stands – Randomization Test

Prior to treatment, sites planned for biomass and thin and burn treatments had significantly greater predicted flamelengths than reference sites (Table 37). After treatment, the thin and burn sites had significantly (p=0.10) lower flamelengths (-1 meter) than reference sites. The burned sites were significantly lower but at a probability level of p=0.12.

Table 37. Results of randomization test for determining differences between reference sites and pre- or post-treatment predicted flamelengths in mixed-conifer.

Mixed Conifer									
Variable: flamelength (m)									
Treatment	n	Median	Median Difference (treatment - reference	One-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05	Two-tailed Sign. (Prob. > F)	Sign. Prob. < 0.10	Sign. Prob. < 0.05
Pre-Treatment									
Biomass	4	4.5	2.9	< 0.01	**Y**	**Y**	.0074	**Y**	**Y**
Sanitation	1	1.5	0	0.50	N	N	0.9890	N	N
Thin & burn	1	6.2	4.7	0.02	**Y**	**Y**	0.0186	**Y**	**Y**
Thin	28	1.3	-0.4	0.25	**N**	**N**	0.4890	**N**	**N**
Reference	32	1.5							
Post-Treatment									
Burn	2	0.5	-1.2	0.12	**N**	**N**	0.3712	N	N
Sanitation	3	1.6	0.1	0.42	N	N	0.8454	N	N
Thin & burn	2	0.5	-1.0	0.10*	**Y**	**Y**	0.3552	N	N
Thin	27	1.5	-0.087	0.3486	N	N	0.72	N	N

Predicted Fire Type Under High Weather Conditions

Predicted fire type is primarily a function of the predicted flamelengths and the height to live crown. Both passive and active crown fire types will result in high mortality levels. The surface fire type can also result in high mortality levels if there are heavy large fuels (>3”), deep duff accumulations, and/ or younger trees or tree species with less resistance to fire. These two fuel elements are not part of the fire behavior models but can produce high heat or a long duration of heat that can result in high plant tissue death.

Eastside Pine

The passive crown fires were the most commonly predicted fire type in the eastside pine sample sites. Treated biomass units and units where burning is planned had the greatest proportion of predicted surface fire. As described previously, the sites selected for prescribed burning alone often have lower fuel levels and less dense vegetation that is more conducive to implementation of prescribed burning with low likelihood of escapes and minimizing levels of mortality.

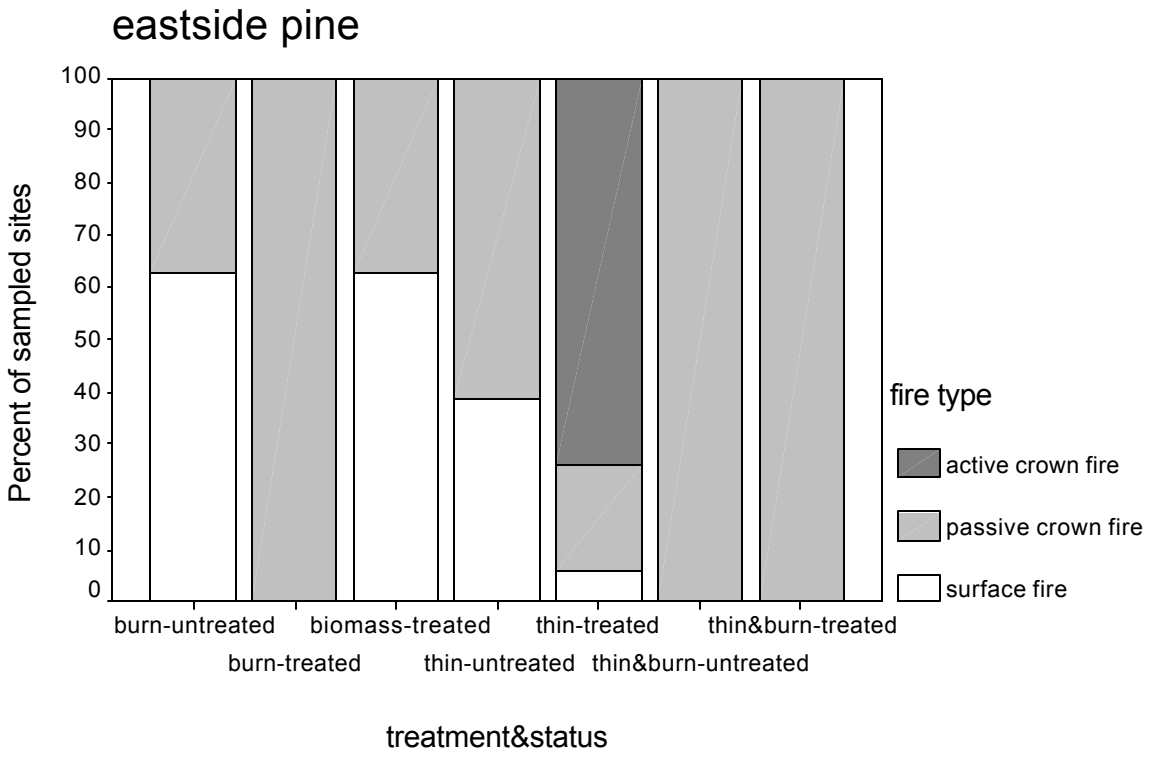


Figure 51. Predicted fire type in sampled FHP treatment units in the eastside zone. Predictions were developed using FLAMMAP under high (93rd percentile) weather conditions.

Mixed Conifer

A higher proportion of the sampled sites in mixed conifer were predicted to have active crown fire or either kind of crown fire than in the eastside pine sites. This is due to the overall higher productivity of the mixed conifer zone and the resulting higher fuel loadings and denser vegetation described in previous sections. The sites treated with either burning or a combination of heavy previous overstory removal and recent biomass treatments had the greatest proportion of sites with predicted surface fire types. While there were some lower levels of active crown fire in thin sites sampled after treatment compared to those sampled before treatment, the overall levels of crown fire remained similar. As mentioned several times previously, many of these sites have planned second treatments of burning and this will likely result in more substantial reduction in the proportion predicted to have crown fires.

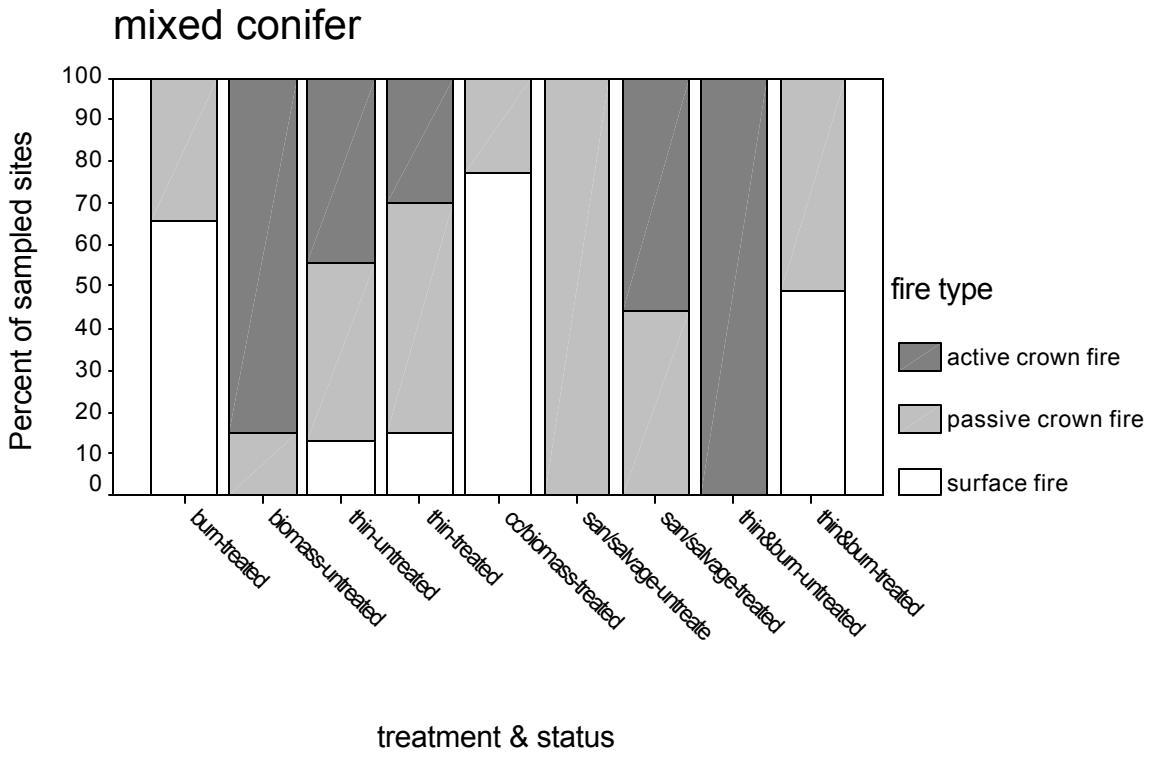


Figure 52. Predicted fire type in sampled FHP treatment units in the mixed conifer zone. Predictions were developed using FLAMMAP under high (93rd percentile) weather conditions.

Landscape Scale

A map display of proportion of the landscape treated with different amounts of FHP treatments is irregular and clumped (Figure 53 in map package). Most of the landscape (80%) has few or no FHP treatments (Figure 54). A little over 10% of the landscape has 5% or less of the area treated or planned for treatment with FHP units. Approximately 8% of the landscape has between 5 and 30% of the landscape treated. These results only include the FHP units. Other projects in the past 10 years may have also contributed to changed fuel conditions at the landscape scale but these were not tracked with this monitoring effort. A more detailed 10 year history of timber harvest and fuel treatments on a portion of the Almanor Ranger District overlapping with the California spotted owl demographic study area indicates that for that District, the FHP units represent less than one-third of the cumulative projects over time. In addition, we did not account for areas in the landscape with naturally low fuel levels, such as rock outcrops or that because of typically high moisture levels, such as wet westside meadows, often form fire barriers.

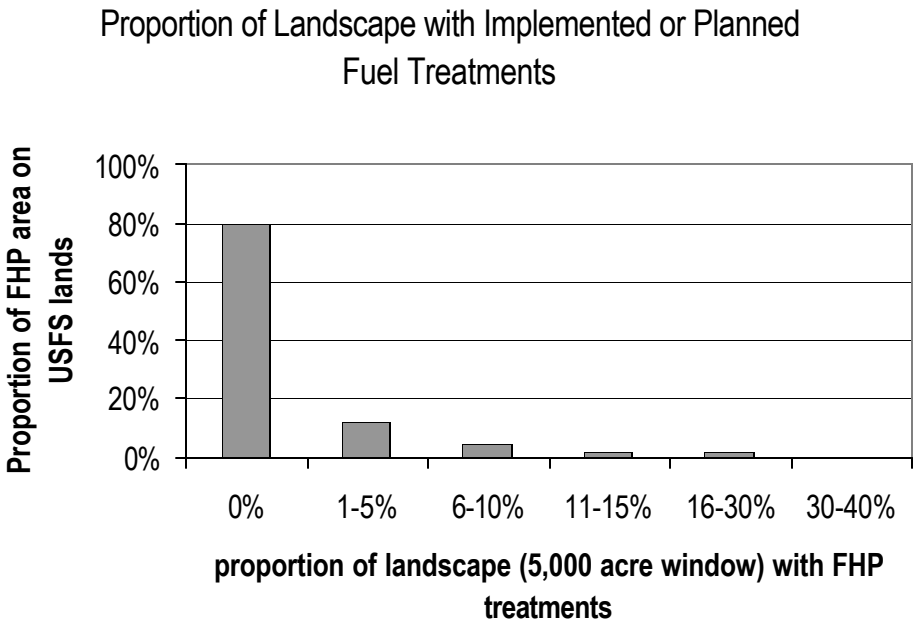


Figure 54. Proportion of landscape (from 5,000 acre moving window analysis in GIS) with different levels of planned and implemented FHP treatments. The landscape used in estimates is USFS lands only.

IV. ADAPTIVE MANAGEMENT:
Implications for Management including Future Monitoring

The purpose of monitoring is to assess changes and provide insight for better management. In order to do this, we discuss the management implications of monitoring findings and what we learned about improving both monitoring and management.

Effectiveness of Treatments in Reaching Fire/Fuels Goals

There are three important aspects to evaluating the effectiveness of treatments in reaching fire goals. First are the fuel conditions at both site and landscape scales. Second are the assumptions on weather used to model predicted fire behavior. Third are the thresholds used to evaluate effectiveness of treatments. We address each of these aspects below.

Importance of Assessing Effectiveness at Multiple Spatial Scales

We assessed the effects of treatments in achieving the goals of reducing fire effects at the site and landscape scales. Reducing fire effects is a function of both fire behavior and condition of vegetation (i.e. size and species of trees). There are two different aspects to interpreting the results in terms of effects on fire behavior. One is what the differences in fuel conditions mean in terms of differences in fire behavior within the treated unit. The second is the spatial extent of the treatments and their effects on fire behavior across the landscape. The latter or landscape scale is most important in the long-run because fires operate at the landscape scale. However, the landscape effects of treatments starts at the site scale, so both scales are important. In addition to the fuel conditions at the site and landscape scales, the other important factors dictating potential fire behavior are assumptions on fire weather.

Influence of Fire Weather Assumptions in Interpreting Effectiveness

The interpretation of how fuels affect fire behavior varies with the fire weather conditions considered. For purposes of the interpretations presented here, we have focused on the high (93rd percentile) weather conditions. We have chosen these conditions because at the most extreme weather conditions, there may be very little difference in fire behavior between fuel conditions, since the fire is driven more by weather than the fuels. At the high conditions, fire behavior is determined by both the fuels and the weather more equally. We held fire weather and fuel moisture constant across all of the sites, whether they were in westside, transition or eastside ecological and climate zones. This approach has strengths and weaknesses. The strength is that it allows the most consistent comparisons of predicted fire behavior across sites. The weakness is that it does not portray differences across the landscape in fuel moisture that may influence fire behavior. Specifically, the eastside areas and the transition zone areas receive less precipitation than the westside areas do. This tends to occur as broad and fuzzy changes going from east to west in most of the FHP area because there is an ill-defined crest and weather patterns, such as average annual precipitation, change gradually rather than abruptly. There are an insufficient number of weather stations and fuel moisture sample locations across the gradient to model the changes in fuel moisture and fire season that are concurrent

with changes in weather in a detailed manner. However, we know that the fire season is longer in the eastside than westside forests because of the drier conditions throughout more of the fire season. We also know that fuel moistures reach lower levels in the eastside than in the westside forests many times. The implications are that it takes less fuel in the eastside forests to achieve a certain flamelength than it does in westside forests at most times of the year.

Overall we found that fuel levels in the eastside were half or more that measured in mixed conifer in westside or transition zones. This means that if we apply the same weather conditions, that predicted fire behavior will be less in eastside forests. If we were able to reliably vary weather conditions and fuel moistures across the climate gradients, we would use drier inputs for the eastside and transition areas and resulting predicted fire behavior would be greater than is reported here. Future research and monitoring efforts need to address our ability to assign reliable estimates of variation in fuel moistures.

Thresholds to Interpret Data Results

At the time of the forest health pilot, when the projects were planned, there were no quantitative thresholds for fuel treatments that were in place in planning documents across the entire area. Since the time the pilot was initiated, two large planning efforts have been undertaken that have provided specific, quantitative standards for fuel treatments, the Herger-Feinstein Quincy Library Group Forest Recovery Act (HFQLG) EIS and the Sierra Nevada Forest Plan Amendment (SNCF) EIS. Since these decision documents were not in effect at the time of the FHP project planning, it is not appropriate to hold the projects to the fuel treatment standards in these EIS's. However, from an adaptive management standpoint, it is useful to evaluate the projects in relation to the thresholds so that the Forests and Districts can determine how much they need to alter or stay on course with previous fuel treatments.

Site Scale

Fuel Conditions

Sites treated with mechanical treatment versus prescribed burning tended to differ in surface, ladder and crown fuel conditions both before and after treatment. Surface fuel loadings and depths, and crown bulk densities or tree canopy cover tended to be lowest in sites planned for prescribed burning than at sites planned for thinning or biomass. Surface fuel loadings after treatments were often greatest at sites treated with thinning or biomass but we do not know how much of this higher loading was contributed by higher levels prior to treatment and how much to added activity fuels from the mechanical treatment. It is clear, although from a small sample of sites, that stands treated with burning alone or with burning after thinning had the lowest surface fuel loadings and depths. The patterns in height to live crown were variable between treatments and within treatments.

Overall, it seems that Districts were selecting different sites to apply different treatments depending upon fuel conditions. Sites selected for burning alone generally had low amounts of fuels. Sites selected for thinning and especially biomass had higher amounts of fuels. This makes sense from a managerial viewpoint but is affirmed by the monitoring results. What is also strongly indicated, although from a small sample, is that prescribed burning as a primary or secondary treatment following mechanical treatment, is the most effective at achieving low surface fuel loadings. At the time of the compilation of final project status in late may, one-third of the FHP units had received a second surface fuel treatment following a first mechanical treatment. We were

unable to determine how many additional sites have planned secondary fuel treatments but based upon conversations with some of the managers, a substantial number of additional second treatments to reduce surface fuels are planned or are in the process of being implemented.

How many of the second treatments will be prescribed burning of some kind is unknown. Our survey of second treatments to date, show that many of them involve mechanical piling, especially near roads. In querying one manager as to the reason for choosing mechanical versus prescribed burning as second treatments, they indicated that the choice was due to a large back-log of units to treat and that it was easier to contract out mechanical surface fuel treatments. Additional monitoring or research would be useful to compare the effectiveness and environmental consequences of secondary fuel treatments of burning versus mechanical means. At the time of this pilot effort, there were too few of the secondary treatments to make this comparison.

Predicted Fire Behavior

Flamelengths

Thresholds for the HFQLG EIS and SNCF EIS for fuel treatment areas are summarized in Table 38 below. They are similar. Most of the fuel treatment sites in the eastside met the desired flamelengths of 4 feet or less. The exceptions were some of the thinned sites. Approximately one-third of the thinned sites had predicted flamelengths greater than 4 feet. The discussion above on fuel moisture assumptions suggests that the predicted flamelengths were underestimated for eastside pine and some of the transition zone sites and that a greater proportion may be outside of the current standards. The results were very different at the mixed conifer sites. The only treatments that yielded predicted fire behavior on most or all of the sites below the 4' flamelength threshold were the sites with prescribed burning as a primary or secondary treatment. About one-third of the reference sites also met the threshold.

Fire Type and Crown Fuel Conditions

The FlamMap program used to predict fire behavior and fire type results in three types of predicted fire types. They are surface fire, passive crown fire and active crown fire. Surface fuel conditions cause flamelengths and the amount of heat to vary. The determining factor between a surface fire and a crown fire (either passive or active) are how close the flames are to the crowns. This is influenced by both the flamelength and the height to live crown. Height to live crowns were generally low across all forest types and treatment conditions. In general, they were all lower than the standards in the SNCF EIS of 15 to 25'. In eastside pine forests, the biomass and combined thin and burn treatments had the most sites with height to live crowns greater than 10'. Some of the sites treated with burning or thinning alone also had higher levels but only a portion of these types of treatment units. In the mixed conifer forests, the results were similar. Therefore, despite the fact that many of the eastside pine sites had flamelengths that met the thresholds, they still were predicted to have a substantial amount of crown fire (Figure x.). Similar results were observed for the mixed conifer sites, although this was more expected because both predicted flamelengths were high and height to live crowns were low.

In summary, the monitoring results strongly indicate that second fuel treatments following initial mechanical crown fuel treatments are critical to achieving current fuel treatment standards and desired conditions. These results also indicate that in addition to the necessity of second fuel treatments for surface fuels in most cases, more attention needs to be paid to increasing height to live crown.

Table 38. Summary of current fuel treatment standards and desired conditions in the HFQLG and SNCF EIS's in fuel hazard reduction areas.

Fuel Treatment Type and zone	Surface Fuels	Height to Live Crown	Crown Fuels	Other criteria
HFQLG EIS				
DFPZ's	Flamlengths ≤ 4 feet; ≤ 5 tons/acre <11" diameter; ≤ 15 tons/acre > 11" diameter	Primary corridor -above height that would result in crown fire initiation; 2ndary corridor, less than 10% area has potential for crown fire initiation	Spacing of trees and clumps of trees that reduces the potential for crown fire spread	Primary corridor - ≤ 1 snag/acre; 2ndary corridor, ≤ 8 snags/acre
SNCF EIS				
Defense zone	Flamlengths ≤ 4 feet (90% -tile weather)	15-25 feet		Achieve across 90% of stand
Threat Zone	Flamlengths ≤ 6 feet (90% -tile weather)	15-25 feet		Achieve across 85% of stand
Splats in General forest	Flamlengths ≤ 6 feet (90% -tile weather)	15-25 feet		Achieve across 75% of stand

Changes Over Time

One of the possible differences in the treatments will be the length of time that treatments are effective. Burned units have a shift in fuel loading after 5 or more years. Standing dead ladder fuels (shrub skeletons) or snags start to fall over onto the ground, increasing surface fuels. Decomposition of fuels in thinned units may differ from reference sites but it is not known if the rates would be higher or lower. Our monitoring design includes re-measurement of permanent plots at 5-year intervals but with the release of the HFQLG and SNCF EIS's and associated monitoring plans, it is unknown whether any additional monitoring on the FHP units will occur.

Landscape Scale

Fuel treatment patterns at the landscape scale are important when trying to meet the goal of reducing wildfire effects at the landscape scale. Two critical aspects are the proportion of area treated and the amount and type of treatment within each landscape. The arrangement of treatments is also important (HFQLG EIS and SNCF EIS) but is not addressed here.

For the most part, only a small fraction of the landscape (less than 10%) have been or are planned for more than 5% fuel treatments. Over half of the area is classified as moderate to high fire hazard and risk (USDA FS 2001). We did not analyze the overlap of the hazard and risk index map with the FHP treatments but it is likely that the FHP treatments are concentrated for the most part in the portion of the landscape that has

higher fire hazard and risk. If we assume this, then we could assume that as much as one-fifth of the area of moderate to high hazard and risk may have FHP units implemented or planned. However, using the same assumptions, only 1/10 of the moderate-high hazard and risk area would have been treated with more than 10% of the landscape, a minimal proportion for what is considered to be effective at the landscape scale in recent key fire/fuel analyses (SNCF EIS, Finney 2000). As mentioned previously, we did not take into account additional past fuel treatments from other projects or areas in the landscape that may naturally contribute to reduced fire behavior. Therefore, these estimates are conservative and likely underestimates.

Environmental Effects

Wildlife Habitat Types and the California Spotted Owl

Most of the treated acres to date (Figure 25) fell into the CWHR types 4P and 4M. Most of the acres planned for treatment fell into the same CWHR 4P and 4M types but also nearly one-third in the 4D type. Few acres of the large size class (5) stands are planned for treatment or have been treated.

Most of the habitat treated was mature, with medium diameter trees, few large trees, and moderate canopy cover. Although most of the acres treated were thinned with the intention of reducing canopy cover, the range of canopy cover generally remained within the moderate canopy cover class (40-60% cover). The greatest differences are in the mid- and understories, which are not reflected in the CWHR types. Thinned stands had a more open mid- and understory than reference stands, with lower seedling and sapling densities, and higher crown base heights than reference units. The only other consistent difference was the higher density of large trees (>30" dbh) in reference stands. This suggests that few if old growth stands were selected for FHP treatments. There was high variability in the density of small diameter (12-24" dbh) trees in reference stands and in stands planned for thinning, compared to the lower variation observed in thinned and burned units in eastside forests. There was also high variability in understory vegetation cover. In mixed-conifer forest, reference stands had the highest levels of shrub and low vegetation cover and variability, while stands treated with thinning had the highest cover in eastside pine forests. Sampling conditions before and after treatment would provide better information on how habitat has changed as a result of treatments in contrast to pre-treatment conditions.

<u>California Spotted Owl</u>

There are three key aspects to assessing affects on spotted owls. First, what habitat was affected and how? Secondly, how much habitat was affected within home ranges and how many home ranges were affected? Finally, what are the likely effects on prey species? We address the first two aspects below.

One of the key adaptive management conclusions on spotted owls is that we can say or conclude very little about what the results mean because despite over 20 years of demographic studies, little is known about habitat relationships, prey-habitat relationships and effects of harvest or treatments on owls, their habitat or prey. The use of the term "affected" becomes controversial in relation to owls and fuel treatments because there is so much uncertainty underlying the interpretation of any changes in habitat or conditions caused by the

treatments on owl demography, survival and habitat use. We use the term affected here in neither a positive or negative sense, since information is lacking to denote either connotation in most situations.

What Habitat Was Affected and How?

The most direct way to answer the first question would be to have data on habitat types before and after treatment. This has not been possible to date with the monitoring pilot, as some of the projects had already been treated at the time of sampling and the rest that have been sampled prior to treatment have either not yet been treated or have not been resampled since treatment. However, analysis of WHR types from our monitoring plot data collected at sites that had not yet been treated give some indication of the types of sites selected for treatment. These data indicate that most of the habitat affected was foraging habitat, with little nesting habitat treated to date. Further, analysis of the large tree (>30" dbh) density data indicates that few old growth stands were selected for treatment. The implications of the treatments on foraging habitat are not known, since little or no research has addressed this question. We can only make indirect inferences based upon the habitat components themselves.

Important habitat elements for the California spotted owl include: large trees, high canopy cover, canopy layering or volume, snags, and forest type (Verner et al. 1992, North et al. 2000). In the mixed conifer forests, medium trees (>24" dbh) were present at low levels in all sampled units and canopy cover in thinned units or units planned for thinning was mostly >40%, suggesting that they still meet criteria for foraging habitat. Further, size class did not change and most of the units fell into the WHR size class 4. The greatest difference between thinned units and other units was in crown base height, which was greatest in thinned units. This indicates that there is less crown volume in the lower canopy layers. While canopy layering is considered an important aspect of California spotted owl habitat, the importance of layering in the lower canopy relative to that in the higher canopy is unclear. Research in the southern Sierra Nevada owl demography area suggests that crown volume above nest height in nesting stands may be most critical (North et al. 2000). Research on the effects of treatments on owl reproduction and survivorship is necessary to answer this question more thoroughly.

How Much Habitat Was Affected within Home Ranges and How Many Home Ranges Were Affected?

One-hundred and sixteen out of 494 (23%) of the areas surrounding owl locations used as homerange proxies (see previous caveats and discussion) had planned or implemented treatment units within them. There are unknown levels of uncertainties in the estimates of suitable habitat within the modeled owl homeranges as described in the results section. We used the same habitat data set as was used in the HFQLG and SNCF EIS documents, a combined remote sensing and forest inventory plot layer.

Twenty-four percent of the modeled areas surrounding owl locations had more than 10% of the nesting habitat overlapping with FHP units. Twenty-six percent of the owl sites had 5-10% of the suitable habitat overlapping with FHP units. Nearly half of the sites had less than 5% of the suitable habitat overlapping with FHP units. It is not known what the effects of different levels of treatments are on California spotted owls. We also do not know the effects of different treatments on habitat if the habitat remains within the same CWHR type. The implications of the monitoring results are difficult to interpret because of these unknown factors. Monitoring owls simultaneously would enable us to address effects on owls directly and provide insight into relationships with landscape effects of treatments.

Monitoring Operations:
Design, Indicators, Field Methods, Data Analysis, Costs and Time

Evaluation of the monitoring operations may be as important as the results themselves for this pilot. This is because few if any such comprehensive multiple project monitoring programs have ever been conducted for forest health or fuel treatment programs on Forest Service or other Federal Lands. It is critical to understand what worked or didn't work and why in order to reduce the costs and improve the timeliness in producing monitoring reports in the future for large monitoring efforts. We will discuss what worked, didn't work and what changes are needed for future similar monitoring in terms of the design, indicators, field methods, data analysis, costs and time.

Design: Pre-existing Conditions and Retrospective Design

One of the key limitations to the monitoring we were able to conduct for the FHP was that we were unable to measure before and after treatment on the same site. As a result, we cannot determine if the cause in differences in post-treatment conditions between different treatments, such as burning or thinning, are due to the treatments themselves or to differences in conditions prior to treatment.

There may be differences in post-treatment conditions by treatment because different pre-existing conditions may be preferentially selected for certain treatments. For example, areas selected for burn treatments may have lower initial fuel loadings than areas selected for mechanical treatment. Our analysis of untreated stands indicates that this may be the case. Stands selected for burning tend to have lower stand densities, lower fuel loadings, and a lower proportion of fir. Stands selected for thinning tend to have higher stand densities, higher fuel loadings, and a higher proportion of pine.

It would be optimal to make measurements before and after treatments to allow differences prior to treatment to be taken into account. However, given the limited duration and scope of this project, this was not possible in most cases. This is a limitation of retrospective monitoring that has been identified as a limitation of past monitoring protocols. We designed the protocol so that before and after comparisons could be made on the same site. A large number of the sampled sites had not been treated at the time of sampling. At this time, the future of the monitoring pilot is unknown, making it uncertain whether the untreated plots will be followed up with repeated measurements after treatment.

Having different monitoring programs associated with individual NEPA documents or projects, limits the resources available to conduct long-term or pre- and post-treatment monitoring. Currently, in addition to the FHP monitoring pilot, there is a separate monitoring program for the HFQLG and the SNCF EIS's. This means that it more difficult and less likely to allocate resources for the planned, follow-up FHP monitoring sampling. This is inefficient, since a large amount of resources were put into the FHP monitoring pilot and because the initial portion has been conducted, it is most likely to yield results on changes in vegetation and fuel response over time in the near-term.

Effectiveness of Monitoring Indicators

The types and measures of indicators selected were reviewed on whether they contributed to answering the key monitoring questions. Additional monitoring indicators that could be considered are identified that would improve addressing the monitoring questions. One of the biggest aspects of selecting monitoring indicators is the funding level available to monitor. It is not feasible to monitor all indicators considered. Prioritization is necessary to implement the monitoring. We prioritized indicators based upon their addressing the monitoring questions, their potential impact on management, and ability to interpret and measure.

Fire and Fuels

Measures for fuel monitoring were well suited for fire behavior modeling interpretations. However, there was limited information for fire effects. Large woody debris can cause local fire effects with longer and more intense heating and landscape effects as fire ember receptors and fire suppression production rates. There is information from the soils portion of the monitoring pilot on tons/acre of large woody debris, but not on the spatial arrangement. Piles of logs will cause different effects than distributed logs. We have not incorporated landscape fire maps from the recent wildfires on the Plumas, Lassen, and Tahoe National Forests. A system for rapid update with corporate fire event data is needed. The other possibly omitted indicator is fuel accumulation rates. Measurement of fuel accumulation rates directly would enable better predictions of how long a treatment was likely to be effective.

Environmental Effects

There are three types of environmental effects that have not been covered to date and wildlife effects that have been indirectly addressed. Wildlife effects have been assessed using habitat elements and types as indicators. There have been no direct measurements of wildlife responses (i.e. distribution or demography) for key focal species (California spotted owl, goshawk, Pacific fisher and pine marten). Given the uncertainty with aspects of habitat modeling for these species, it makes it difficult to interpret the implications of changes in habitat on species populations without direct measurements.

The three environmental indicators that were considered in the planning but have not been implemented to date include: pathogen and insect disturbance; fungi; and understory flora. Pathogen and insect disturbances contribute to wildlife habitat and fuel for fire. Their rates can change the condition of a site over time. Knowing the disturbance rates can improve the ability to track changes over time on a site. We had planned to monitor hypogeous fungi and saprophytic plants as indicators of soil ecosystem health, but had insufficient funds and difficulty finding a mycologist to assist us. For the understory flora, we planned to track exotic abundance, and understory plant composition and diversity, but were unable to due to insufficient funds.

Overall

Photographs and GPS locations of the sample sites would improve overall interpretations of conditions and relocation. We did end up taking some photographs of sites earlier this year because of the need to use them in making correct fuel model assignments.

Field Methods

Three aspects of the field methods need revisiting. One is the measurement technique applied to canopy cover and fuels. The second is quality assurance of sampled data. The third is sampling intensity within individual treatment units.

Canopy Cover

There are numerous ways to measure canopy cover. We chose to use spherical densiometers, since this is the most prevalent means used in California spotted owl habitat research. However, there are limitations to spherical densiometer measurements that need to be acknowledged. Spherical densiometer measurements may produce higher estimates of canopy cover than other methods, such as a moosehorn. This is because of the concave shape of the mirror apparatus that includes canopy from the periphery, not just above. Although some wildlife biologists have argued that for wildlife habitat evaluation purposes, the spherical densiometer may reflect canopy as sensed by wildlife. Other more consistent and less biased methods of measuring canopy cover might be more appropriate, such as a moosehorn apparatus. However, this would make interpretation of the results in relation to existing owl research more difficult. In addition, some field comparisons we have made between moosehorn and spherical densiometer apparatus showed that it requires much more intensive sampling to get a precise estimate of canopy cover with a moosehorn apparatus than a spherical densiometer. That is, without a large number of measurements in a stand, the standard errors are large.

Fire and Fuels Measurements

As described in the fire/fuels method and results sections, there are some limitations to current, widely used fuel inventory measurement techniques. There is a disconnect between measured fuel conditions and fuel models used in fire behavior model predictions. Research is needed to address this disconnect. Most current fire and fuel thresholds are described or defined in terms of fire behavior (e.g. flamelength or rate of spread) or fire effects (severity or degree of vegetation mortality). Refinement and improvement of fuel measurement techniques and better calibration of field measurements with fire behavior fuel models are critical to being able to adequately assess the effectiveness of treatments in meeting these current thresholds defined in terms of fire behavior.

The measurement protocol was partly deficient for the estimation of height to live crown. Crown ratios or height to live crown of individual trees was only observed or measured for those trees >15” dbh. Trees less than 15” dbh can be primary contributors to height to live crown estimates. We had to use predictions from FVS Wessin variant to dub in these missing values. Direct measurement of height to live crown or at a minimum, crown ratio should be completed for all trees with dbh. In order to compute crown bulk density and height to live crown, it was necessary to have a tree height for every tree. Tree height estimates were made using regression equations in FVS that utilize dbh, species, crown position and site class. We did not measure or record crown position or site class and had to estimate these levels using information on tree size, species and ecological type.

Data Quality Assurance

There were problems with some of the data collected, primarily missing data and possible different interpretations of the understory sampling protocol. This problem could be addressed by ensuring independent inspection of sampling for a random subset of all sampled units and more oversight of the field sampling. All of the contracted units were subject to inspection. None of the in-house units sampled by the Forest Service were. Monitoring teams from four different Ranger Districts sampled across seven Districts. More ongoing

training, supervision and feedback from inspections would have improved the completeness and consistency of data collected. Data recorders would have improved the quality and consistency of the data as well as reducing the data preparation time. We have adopted the use of data loggers on other monitoring projects in the Region and found that they greatly reduce data inconsistency, missing data and especially data preparation time. This requires an upfront cost for monitoring that is often not planned for.

Sampling Intensity Within Treatment Units

We did not analyze the data with respect to the adequacy of the number of replicates within individual treatment units. We randomly placed three plots within each treatment unit to provide a minimum estimate of central tendency and variability. It could be that fewer or more samples are needed to adequately capture within-treatment variation.

Differences Between Ecological Groups

The original design included separation of ten distinct ecological types. There were insufficient sample sizes to permit statistical analysis of the ten individual types. Therefore, all of the mixed conifer was lumped, irregardless of aspect, elevation or location within the area (westside versus transitional, drier areas). These finer breakdowns may have resulted in more significant differences between treatments in the mixed-conifer type or differences in results between mixed-conifer ecological types that are currently masked.

Tracking Projects

One of the most basic types of project monitoring data is that about the projects themselves. This turned out to be the most difficult, costly and time-consuming parts of this pilot. In order to select a random sample of projects for monitoring and to assess landscape effects we compiled a complete project database and GIS layer including the identification, location, treatment, forest and ecological type and current status. We estimate that at least one-third or more ($250,000) of the total cost of this portion (vegetation) of the monitoring pilot was due to difficulty in developing an accurate project database and in tracking changes in projects and treatment status. We ended up conducting the statistical analysis 3 times and revising the report 2 times because of changes in the database that we determined were undetected and needed addressing. It took 6 months alone to complete the last round of checking for accuracy and updating the project database and GIS layer.

There are no current USFS corporate databases that at that time or currently provide all of this information. There are several efforts that are beginning to address some of these information needs but not in a comprehensive or spatially explicit manner that tracks them from planning to implementation. The National Fire Plan database includes many of the current fuel treatments, including both mechanical and burn treatments but is not spatially explicit. The Region 5 stand record card system has recently been updated to a more spatially explicit system but it does not include prescribed burn treatments and at least in the recent past the spatial component and associated treatment history was tied to stand boundaries and not treatment unit boundaries. This makes it impossible to track spatially multiple treatments in time. For example, on the Almanor Ranger District, we found that some stands in the SRS database had parts of one or more treatments and some individual treatment units occurred within several different SRS stands. The National Resource Inventory System (NRIS) is supposed to have a couple of project tracking components but we were unable to obtain any detail on them at this time. They are still under development. Further, the fact that there are at least several separate national efforts to track projects makes us suspect that none of them are comprehensive.

One of the primary reasons that the task was so difficult was that in the course of the monitoring pilot, many of the projects had changed prescriptions and units. In order to monitor projects before the treatments occur, it is necessary to sample some of them while they are in the planning phase, before associated NEPA documents are completed or they are sold to contractors to implement. A normal course of project planning is that proposed treatments are changed or dropped because of environmental concerns and mitigation or because a contractor fails to purchase or bid on them. This happened to a number of the project units. Some were dropped because of concerns with owl habitat for example. Others had locations and/or treatments change because they failed to get purchased after the NEPA document was issued.

A second reason that the task was so difficult is that each individual district or sometimes an entire forest has a separate and often varying means of tracking projects. On some District or Forest units, a project unit is given one number and name identifying it in the pre-NEPA process, another in the NEPA document and another once it is sold as a contract. Sometimes projects are linked in a NEPA document but later separated as separate contracts. This makes it very difficult to accurately track an individual project unit or even project from its planning inception through implementation. Sometimes individual treatment units are treated twice under two separate NEPA documents or contracts.

Our proposed remedies for these difficult but real project tracking challenges are that: 1) a comprehensive (includes all types of treatments from planning to completion) corporate, spatially explicit project tracking system is used; 2) direct involvement of District personnel in populating and tracking the database is essential; and 3) a full-time data manager is assigned to improve efficiency of assembling project data and tracking changes in projects. Key district personnel were often extremely busy and had great difficulty finding the time to help us check the accuracy of the data. An important step in greatly reducing time to assemble data and track changes accurately would be to require GPS mapping of project unit boundaries at the time of planning and entry of the data into a corporate data system. This would have helped us respond to changes in projects more rapidly. However, even if our response time was more rapid, there is a remaining problem of monitoring real projects that are not static in time.

Analysis

There are two key aspects to analysis of the monitoring data that are especially relevant to consider in light of adaptive management. One is the difficulty in choosing an appropriate statistical analysis method and the paucity of appropriate choices. The second are the limitations of the design imposed by available data at multiple scales and lack of scientific information to produce meaningful thresholds.

Statistical Analysis

The issue of appropriate statistical analysis approaches was discussed in some detail in the methods section. Basically, given small sample sizes and ambiguity as to the nature of the sampling populations and means for selecting treatments, standard, parametric stastistical analysis approaches are not appropriate. However, it is difficult to find other options. We were fortunate to be able to get some assistance from statisticians from the USFS Pacific Southwest Research station. They are not obligated to assist the management branch of the Forest Service in this regard. However, this assistance was limited throughout most of the pilot and it was only at the very end that clear advice on some appropriate alternative statistical approaches was provided. Our goal all along has been to conduct monitoring that is scientifically credible and this means statistically sound. We were not satisfied with a simple cataloguing of conditions. The limited access to PSW statisticians and in general the paucity of appropriate statistical approaches for this type of data resulted

in changing statistical approaches and thus re-analyzing the data three different times. We estimate that the additional expense for the several modifications of statistical approaches was approximately $100,000. This added to the expense and especially the length of time to produce the final report. In order to remedy these limitations in the future, we recommend that a more formal arrangement for more in-depth statistical involvement by PSW or other statisticians be made.

Differences in Data Between Landscape and Site Scales

It was difficult to analyze and interpret changes in conditions at the landscape scale because of limitations of applying the landscape –level data to the site scale. Timber inventory data and layers are designed for non-site specific landscape scale analysis. There are two ways to improve this aspect of the monitoring design. One is to use remotely sensed data to detect differences before and after at the landscape scale. A project jointly funded by NASA, the Joint Fire Science Program, and the Sierra Nevada Ecosystem Project Monitoring Effort is currently underway to test this technique with multiple types of imagery (RADAR, LYDAR, hyperspectral) (AMSET 2001). The second means would be to develop a landscape layer that could be applied at both broad and site-specific scales.

Thresholds for Interpreting Results

Developing ecologically meaningful thresholds is hindered by limited research and historic information. Fire thresholds for fire behavior at the site scale can be quantitatively developed depending on objectives but thresholds at the landscape scale are less certain, particularly related to the pattern of treatment. For example there is considerable debate about the merits of strategically placed area treatments and defensible fuel profile zones. With California spotted owl effects, we lack information on landscape level thresholds as well. The amount and configuration of habitat required at landscape scales to maintain populations is not known. We have limited information on historic densities of different sized trees and landscape vegetation patterns, and none on canopy cover or snags. This is an area where widespread scientific and public involvement would improve the monitoring design and assessment.

Costs and Time Involved and Value Derived

Costs and Time

This monitoring pilot cost an estimated $950,000. The majority of the money was spent on the vegetation/fuels/wildlife habitat portions. Less than $250,000 was spent on the actual field sampling for the forest health pilot. At least half of the total amount was spent on tracking the projects, data analysis and compilation of the preliminary and final reports. We estimate that at least 2/3 of the money spent on these latter three tasks was due to difficulty tracking projects accurately and in selecting an appropriate statistical analysis approach.

The proportion of total time to complete different parts of the monitoring pilot was commensurate with the breakdown of costs. The most time-consuming aspects were accurate project tracking and resulting required re-analysis of data and selection and application of alternate statistical analysis approaches.

Value

While the cost and time undertaken to complete this pilot are high, the value of the results and insight gained for future monitoring are great. This is the most comprehensive set of quantitative fuels treatment condition data that has ever been collected and compiled. It has already been applied to design of fuels

monitoring for Region-wide and Sierra Nevada efforts. The data were used for analysis of sampling statistics necessary to determine the sampling intensity necessary to detect changes in fuels from treatments Sierra Nevada-wide. The canopy cover data is currently being analyzed in relation to currently used canopy projections derived from tree inventory data to test applied in the SNCF and HFQLG EIS's (GAMMA program) and to calibrate these projections for future modeling efforts. We have used this pilot as a key example to WO staff that are involved in design of fuel business tool design and National Fire Plan database improvements. For several current region-wide monitoring programs, we have implemented digital monitoring data capture and are able to produce the results within several months of collecting the data. We are also in the process of taking the programming developed to compute response variables from the raw data and formatting that so that it can be applied to analyze monitoring data immediately following downloading from data loggers and post the results within one day to several weeks on a web site.

Finally, and perhaps most importantly, this monitoring pilot demonstrates the commitment of the Forest Service to support of quantitative and scientifically credible monitoring. It would have been easy for managers to eliminate the pilot as the costs and length of time to produce the final report increased. However, they continued their support of this effort. In addition, additional public credibility has been gained through this effort that is difficult to put a value on. Late this summer, a presentation was made on the final results of the monitoring pilot to the public. In attendance were representatives of the Quincy Library Group, local and national environmental groups, and the California Timber Association. All of these different groups applauded and were in support of this pilot effort.

V. SUMMARY AND KEY FINDINGS

Projects, Treatments and Current Status

- 85 projects with a total of 993 individual treatment units in them were tracked and used to randomly select sample sites.
- 45,791 acres occur within the 993 treatment units.
- Most of the units have mechanical treatment as the primary prescription, with 29,662 acres thinned or are planned for thinning, 8,280 acres with biomass treatments, 2,183 acres treated or planned for treatment with sanitation/salvage prescriptions, 3,135 acres burned or planned for prescribed burning alone, and 2,531 acres that have been both thinned and burned.
- Although most of the treatments are mechanical thinning or biomass, follow-up surface fuel treatments such as burning or mechanical piling are planned in many of these, but most have not been completed at the date of this report. Therefore, many of the thinned units could be considered partially treated thin and burn units but could not readily be analyzed as a third level of treatment status.

Vegetation Structure and Habitat

- Most sampled sites had mean stand diameters between 12 and 22" dbh, falling into the CWHR size class 4, medium trees. Treated sites either had similar or increased diameters to untreated sites.
- Mixed conifer Canopy cover was generally higher in mixed conifer sites than eastside pine, exceeding 40% on most sampled sites. Reference sites were mostly greater than 60% canopy cover. Burned sites, sampled either before or after treatment mostly had canopy cover lower than 40%, indicating that sites may be partly selected for burning based upon lower canopy cover.
- Eastside Pine Overstory tree canopy cover mostly ranged from 20 to 60% across all treatments and treatment status, except for reference sites. Reference sites had higher canopy cover, ranging up to 90% cover. Reference sites were selected from those sites with >40% cover, which likely contributed to the higher levels sampled.
- One-hundred and sixteen of the 494 areas surrounding owl sites (based on the California Department of Fish and Game database used in the SNCF EIS) in the FHP monitoring area overlapped with at least 1 acre of an FHP treatment unit.
- The majority (65%) of homeranges with overlapping nesting habitat and FHP units (116) had 5% or less of the total estimated nesting habitat that occurred within FHP units. Twenty percent of the homeranges had more than 10% of the suiTable nesting habitat overlap with the FHP units .

Fuels and Predicted Fire Behavior

- Sites selected for burning treatments generally had lower canopy covers, tree densities and crown bulk densities than those selected for biomass or thinning treatments. Sites selected for biomass treatments generally had the highest canopy cover, or tree density and crown bulk density of all treatment categories.
- Predicted fire type is primarily a function of the predicted flamelengths and the height to live crown. Both passive and active crown fire types will result in high mortality levels. The surface fire type can also result in high mortality levels if there are heavy large fuels (>3"), deep duff accumulations, and/ or younger trees or tree species with less resistance to fire. These two fuel elements are not part of the fire behavior models but can produce high heat or a long duration of heat that can result in high plant tissue death.

- Eastside Pine The passive crown fires were the most commonly predicted fire type in the eastside pine sample sites. Treated biomass units and units where burning is planned had the greatest proportion of predicted surface fire. As described previously, the sites selected for prescribed burning alone often have lower fuel levels and less dense vegetation that is more conducive to implementation of prescribed burning with low likelihood of escapes and minimizing levels of mortality.
- Mixed Conifer A higher proportion of the sampled sites in mixed conifer were predicted to have active crown fire or either kind of crown fire than in the eastside pine sites. This is due to the overall higher productivity of the mixed conifer zone and the resulting higher fuel loadings and denser vegetation described in previous sections. The sites treated with either burning or a combination of heavy previous overstory removal and recent biomass treatments had the greatest proportion of sites with predicted surface fire types. While there were some lower levels of active crown fire in thin sites sampled after treatment compared to those sampled before treatment, the overall levels of crown fire remained similar.

Adaptive Management Implications

Achievement of Fuels Objectives

- At the time the FHP projects were planned, there were no uniform or quantitative fuel treatment standards in place. We have evaluated the effectiveness in relation to recent NEPA documents, the HFQLG and SNCF EIS's, but it needs to be noted that these did not apply to the FHP projects when planned. We apply them though, so that we can determine what changes need to be made in project planning and implementation since the FHP projects.
- Eastside Pine Many of the treated sites had predicted flamelengths less than 4 feet under high weather conditions, which is the current threshold for HFQLG and SNCF EIS fuel treatment areas. Height to live crowns were lower than current thresholds and as a result, predicted fire type tended to be crown rather than surface. Flamelengths may be underestimated because we used a constant set of weather and fuel moisture conditions across the entire FHP area to enable consistent and comparable estimates across all forest types. Fuel conditions in the eastside are always drier.
- Westside Mixed Conifer Flamelengths generally exceeded current fuel treatment standards and height to live crowns were much lower, even in most treated stands, than current requirements. As a result, most of the predicted fire types were crown.
- Units that had burning as a primary or secondary treatment had the most desirable levels of surface fuel conditions and low flamelengths. Second surface fuel treatments following initial mechanical fuel treatments would best achieve current desired fuel conditions. As mentioned several times previously, many of these sites have planned second treatments of burning and this will likely result in more substantial reduction in the proportion predicted to have crown fires. Units treated with biomass had the most consistently high height to live crowns. Some of the thinned units and some of the burned units had higher height to live crowns but it was inconsistent.
- Only a small proportion of the landscape (an estimated 10% of less) has had enough FHP treatments planned or implemented to be effective at the landscape scale. This estimate is most likely an underestimate, since only FHP projects were included. On two districts the FHP units comprised 60% of the total treated acres in a 10 year time frame. However, it is unknown whether these other acres were treated with fuels objectives in mind or not. It is

clear that in order for these treatments to be effective at the landscape scale that the second surface fuel treatments are required.

Environmental Effects

- Few if any conclusions can be drawn about the environmental effects to the California spotted owl or its habitat because there are so many scientific uncertainties regarding habitat relations and effects of treatment activities on habitat or owls directly.

Cost, Effort and Time-Future Monitoring Recommendations

- Costs This monitoring pilot cost an estimated $950,000. The majority of the money was spent on the vegetation/fuels/wildlife habitat portions. Less than $250,000 was spent on the actual field sampling for the forest health pilot. At least half of the total amount was spent on tracking the projects, data analysis and compilation of the preliminary and final reports. We estimate that at least 2/3 of the money spent on these latter three tasks was due to difficulty tracking projects accurately and in selecting an appropriate statistical analysis approach.
- Value-Improved Monitoring, NEPA Modeling and Assessment While the cost and time undertaken to complete this pilot are high, the value of the results and insight gained for future monitoring are great. This is the most comprehensive set of quantitative fuels treatment condition data that has ever been collected and compiled. It has already been applied to design of fuels monitoring for Region-wide and Sierra Nevada efforts. The data were used for analysis of sampling statistics necessary to determine the sampling intensity necessary to detect changes in fuels from treatments Sierra Nevada-wide. The canopy cover data is currently being analyzed in relation to currently used canopy projections derived from tree inventory data to test applied in the SNCF and HFQLG EIS's (GAMMA program) and to calibrate these projections for future modeling efforts. We have used this pilot as a key example to WO staff that are involved in design of fuel business tool design and National Fire Plan database improvements.
- Value-Public Credibility This monitoring pilot demonstrates the commitment of the Forest Service to support of quantitative and scientifically credible monitoring. It would have been easy for managers to eliminate the pilot as the costs and length of time to produce the final report increased. However, they continued their support of this effort. In addition, additional public credibility has been gained through this effort that is difficult to put a value on. Late this summer, a presentation was made on the final results of the monitoring pilot to the public. In attendance were representatives of the Quincy Library Group, local and national environmental groups, and the California Timber Association. All of these different groups applauded and were in support of this pilot effort.

Appendix A.

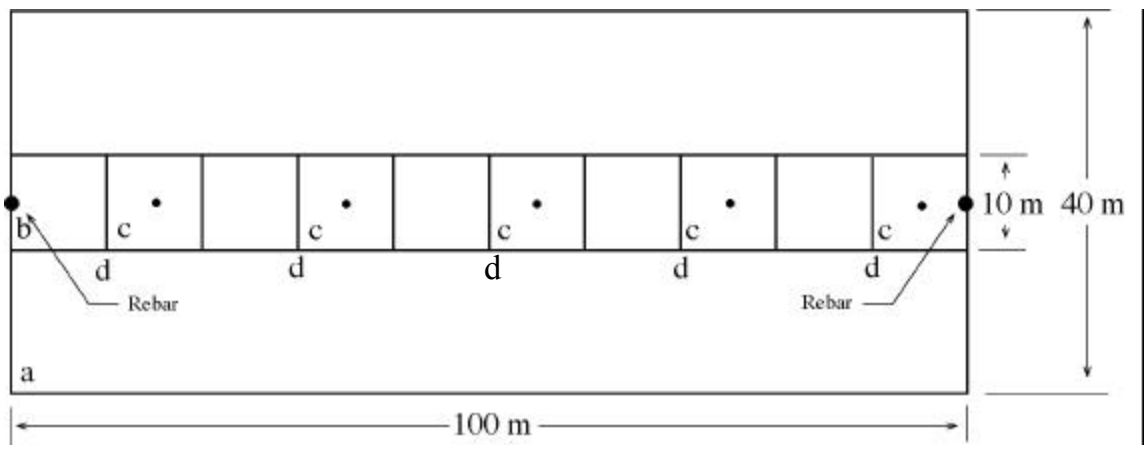
Detailed Description of Field Sampling Protocols And Data Processing Methods and Models

Field Measurements

Data Collection

Units, also called stands, were the sampling units in this study. Each unit contained three, randomly placed, 0.4 ha (100 x 40 m) replicates, called plots. Located within each plot were three types of subplots: one Large Tree Plot, one Medium Tree Plot, and five Small Tree Plots (Diagram 1). All units are located within the boundaries of the Plumas and Lassen National Forests, and on the Sierraville District of the Tahoe National Forest. General vicinity maps as well as detailed stand maps are included in the digital format of the report on CD.

Diagram 1. Layout of permanent vegetation monitoring plots.



a – Large tree plot (40 x 100 m; 0.4 ha) in which the density of all live trees and snags > 30 in. dbh were sampled.

b – Medium tree plot (10 x 100 m; 0.1 ha) in which the density of all live trees (15.7-29.9 in. dbh) and snags (> 4.7 in. dbh) were sampled.

c – Small tree plot (10 x 10 m; 0.05 ha) in which the density of all live trees (5-15.6 in. dbh), all seedlings and saplings (> 2 years and < 5 in. dbh) and saprophyte plants were sampled.

d - Five 10 m line intercepts used to measure the cover of deciduous shrubs, evergreen shrubs, and all vegetation less than 6.6 ft. tall (sampled by two height classes: < 1.64 ft. tall and 1.64 – 6.6 ft. tall).

• - Average of four spherical densiometer readings of canopy cover taken in each cardinal direction.

Location of Plots

The starting point of the first plot was randomly located along a unit access road or trail (if no access road was present a random point along the perimeter of the unit). The direction of this plot was randomly determined prior to entering the unit. The direction of subsequent plots was randomly determined while in the unit.

From the end of the first plot, the starting point of the second plot was determined by choosing a random bearing and traversing along the bearing for 150 m (or 75 m if within a small unit). If this direction resulted in a plot location that extended beyond the unit boundary, or that was too close to the edge of a unit or road (see

below), another random bearing was selected. The starting point of the third plot was determined by a random bearing from the end of the second plot. The random selection procedure of the starting points was documented on the Site Reference Information Sheets.

The boundaries of all plots were ≥25 m from the edge of a unit and ≥50 m from major roads, unless the plot was located in a linear defensible fuel profile zone (DFPZ) that did not contain suitable area at this distance from roads. Plots within DFPZ's were located ≥5 m from major roads. Skid roads and trails caused by management activities were not avoided when locating plots. In large units (>10 acres), plots were spaced at intervals ≥150 m. In smaller units (<10 acres), plots were spaced at intervals ≥100 m whenever possible, but spacing was sometimes as close as 75 m.

Before recording data from each plot, the plot's center axis was flagged with wire pin flags at 10-m intervals. A tree was considered "in" the plot when the center of the bole of the tree at dbh height was within the plot boundary. The distance and bearing from the rebar marking the end of the plot's center axis to the nearest large, tagged live tree was recorded. If no large tree was near the plot's center axis, a racer tag was put on the nearest medium tree (not marked for removal).

Establishment of Reference Points

A reference point (RP) was established for each stand. The RP was an identifiable feature on the ground and on aerial photographs. The RP was marked by placing a racer tag on a bole of a tree, and yellow paint was sprayed around the racer tag. Two to three foot lengths of yellow flagging were tied onto the tree or a nearby shrub. The stand number and distance (m) and bearing to the selected point were written on the flagging in waterproof ink. The RP number, distance, and bearing from the RP to the corner of one of the plots in the stand were recorded on the Site Reference Information Sheets.

Tree Plots

The Large Tree Plot (LTP) was a 0.4 ha (100 x 40 m), fixed area plot for large (≥76 cm [≥30"] dbh) live trees and snags (Liegel 1994). Species were recorded using the two digit codes in the Forest Inventory and Analysis User's Guide (FIAUG) (Johnson et al. 1997), Section 420.

Live trees were recorded as "F" and snags as "D" in the Record Type field. Plot Factor was recorded as 1000, equivalent to 0.4 ha or 1 acre in area. Diameters at breast height (dbh) were recorded for all live trees and snags ≥76 cm dbh, following the FIAUG protocol, Section 535.

Each tree ≥76 cm dbh was tagged with an aluminum tag with a unique number for that plot. The tag was nailed into the tree bole at dbh height with an aluminum nail. Crown ratio (Husch et al. 1982) was recorded for all large trees, using ocular estimates. Dead trees were assigned a decay class, following the FIAUG protocol, Section 420, Figure 4.1.

The Medium Tree Plot (MTP), was a 0.1 ha (100 x 10 m), fixed-area plot for live trees 40-76 cm dbh and snags 12-76 cm dbh. Tree species, crown ratio, dbh, and live trees were measured and recorded as described above. The Plot Factor was recorded as 247, equivalent to 0.1 ha or 0.247 acre in area.

The Small Tree Plots (STP), were five 0.05 ha (10 x 10 m) subplots for trees 13-40 cm dbh. Also included were all saplings <13 cm dbh and ≥ 2 m tall, and seedlings <13 cm dbh and ≤ 2 m tall. Tree species was recorded as above. Diameters and crown ratios were not recorded. Saplings were recorded as "S" and seedlings as "X" in the Record Type field. Counts were made and recorded for saplings and seedlings of each species. The Plot Factor was recorded as 123.5, equivalent to 0.05 ha, or 0.1235 acre in area.

Canopy Cover Data

A line intercept transect (Bonham 1989) was placed along one side of each of the STPs. Canopy cover of vegetation <2m tall that crossed the line transect was recorded. Cover was recorded separately by physiognomic/size class represented by the following categories: deciduous shrubs, evergreen shrubs, total vegetation <0.5 m tall, and total vegetation 0.5-2 m tall. Cover was determined for 5 m segments of each 10 m line transect, and then summed for recording by each 10 m transect.

Overstory canopy cover was measured at the center of each STP using the average of four spherical densiometer (Lemmon 1957) measurements taken in the cardinal directions. The spherical densiometer was held at a height of 4.5'.

Surface Fuels Monitoring

Surface fuels were monitored using planar intercept transects (Brown 1974, Brown et al. 1982). Fuels were inventoried as litter, duff and twigs, branches or logs by diameter classes. At the end of the plot, five 50-foot fuels transects were established along an axis extending from the plot. These transects went off of the axis in an alternating order. The direction was determined randomly. Aspect and slope were measured for each fuel transects.

Fuels were tallied if they crossed or touched the vertical plane of the transect tape. Particles qualifying for tally included downed, dead woody material (twigs, stems, branches and bolewood) from trees and shrubs. Dead branches attached to boles of standing trees were omitted because they are not downed vegetation. A particle was considered down when it had fallen to the ground or was severed from its original source of growth. Cones, bark flakes, needles, leaves, grass, and forbs were not counted. Dead woody stems and branches still attached to standing brush or trees were not counted.

Twigs or branches lying in the litter layer and above were counted. If the sampling plane intersected the end of a piece, it was tallied only if the central axis of the piece was crossed. If the sampling plane intersected a curved piece more than once, each intersection was tallied. Wood slivers and chunks left from logging, as well as rotten logs, were tallied. Such pieces were visually molded into cylinders for determining size class or estimating diameters.

From 0 to 6 feet along each transect, the number of sticks and stems 0-0.25” and 0.25”-1” in diameter were tallied and recorded. From 0 to 12 feet along the transect, sticks 1”-3” were also tallied. For all fuels ≥3” in diameter, individual pieces were tallied as solid or rotten, and recorded by diameter measurement. Along the first three feet of each transect, the high intercept depth was recorded for three intervals: 0-1’; 1’-2’; and 2’-3’. The high intercept depth was defined as the height in inches of fuels from the bottom of the litter layer to the highest intersected dead particle for each interval along the transect tape.

Litter and duff were measured at points along the transect, at 10, 20, 30, 40, and 50 feet. Litter and duff were both measured to the nearest 0.1”. Litter is defined as the surface layer of the forest floor and consists of freshly fallen leaves, needles, twigs, bark and fruits, and was measured to the nearest whole inch. Duff is defined as the fermentation and humus layers of the forest floor. It does not include freshly cast material in the litter layer. The top of the duff is where needles, leaves, and other castoff vegetative material have noticeably begun to decompose. Individual particles are usually bound by fungal mycelium. When moss is present, the top of the duff is just below the green portion of the moss. The bottom of the duff is mineral soil. Duff was measured to the nearest 0.1”.

Data Analysis

Preparation and Storage of Plot Data

Most of the data were processed in SPSS (1999) and coded and organized in a Paradox (1996) database. A description of the databases and data are included in the digital version of the report on CD. A summary of the calculations by response variable are shown below.

Table A-1. Summary of equations and analysis by response variable.

Response variable	Source of equations or methodology	Program used	reference
Canopy cover (overstory trees, shrubs and understory)	Project, average from plot data	Programmed for by project in SPSS (1999)	Lemmon 1957; ITR 1996
QMD (quadratic mean diameter)	GAMMA	GAMMA	USDA FS 2001
Tree density by dbh class	Project, from plot data	Programmed for by project in SPSS (1999)	
CWHR type	GAMMA	GAMMA	USDA FS 2001
Ground fuels	Regressions based on litter, duff and fuel depth	Programmed for by project in SPSS (1999)	Van Wagtendonk et al. 1998
Surface fuels	Brown 1974	Programmed for by project in SPSS (1999)	
Crown fuels	GAMMA, based on FVS and Keane 1999.	GAMMA	USDA FS 2001
Fuel models	Fire Behavior Analyst Expert Opinions (Sapsis, Hood, Bahro)		Anderson 1982
Flamelengths and ROS	FARSITE, Finney 1998	FLAMMAP	Finney 2001
Fire Type	FARSITE, Finney 1998	FLAMMAP	Finney 2001

<u>Quadratic Mean Diameter and CWHR</u>

Quadratic mean diameter was calculated using dbh data using the GAMMA program, which applies an algorithm using the diameter which dominates the basal area. CWHR types were assigned using the same programs and methodology described in the Sierra Nevada Framework EIS (USDA FS 2001).

Surface and Ground Fuels

Brown's Calculations (Brown 1974, and Brown et al. 1982) were used to compute tons/acre for each size class of surface fuels. The van Wagtendonk et al. (1998) equations for Sierra Nevada fuels were used to calculate ground fuels (litter and duff weights) based upon measured depths. Comparisons of the fuel loadings (tons/acre) of the surface fuels calculated using the Brown's equations and van Wagtendonk equations were made but few differences were found. Although the van Wagtendonk equations were developed for the Sierra Nevada and the Brown's calculations are from a larger area of the intermountain west, the Brown's calculations include treated areas and the van Wagtendonk equations did not. Therefore, we continued to utilize the Brown's equations.

Crown Fuels

Crown bulk density is the density of crown fuels per unit volume of crown per unit area of ground. Crown bulk density was originally calculated using the IPC Program (Keane 1999) but since the time of the draft, three other programs have become available for calculating crown bulk density. They are related but have differences that produce different results. We ran each and compared them. The IPC program was based upon crown weight equations from Rocky Mountain tree species and locations. A new program, FMA (Carlton 2001) allows use of either Rocky Mountain or Pacific Northwest equations. The third program, GAMMA, incorporates additional equations on California hardwoods. The latter was the program chosen because it had equations most specific to California forests. All of these programs are based upon the equations in the draft version of the Forest Vegetation Simulator (FVS 2001), fuels extension. The GAMMA program has the noted modifications for California hardwoods.

All of the crown bulk density (CBD) programs calculate the values in the same manner. A crown weight and volume are calculated for each tree in a plot, based on equations using species, diameter and crown ratio. The crown ratio is the proportion of the total tree height that has living crown. The crown bulk density is derived by creating a 3-D "view" of the stand and slicing through it at different heights, calculating a running mean of the CBD for slices of different lengths (ie. 15' or 1' crown height increments). The value of CBD produced by the program is the ***maximum running mean in the profile,*** not the total crown bulk density. This is because when a crown fire spreads through a forested stand, it is thought that the rate of spread is dependent upon the densest portion of the canopy. Little information exists on interpreting thresholds of crown bulk density for varied forest types. Ongoing research is occurring to address this deficiency.

The height to live crown is an important concept in determining how much crown scorch will occur in trees for a given fire condition and whether the fire will move from a surface to a crown fire. Despite the importance of this concept, ongoing research is underway into the best ways to characterize it and relate it to fire behavior. The method used here is the one applied most often and utilized in the FVS program and other programs based on it (FMA). It is calculated from the same "3-D" profile data used for crown bulk density. The height to live crown is the lowest height where a minimum "threshold" of crown bulk density is reached. The threshold used here was .0278 kg/m^3, which was the threshold used for the SNCF EIS (Barber pers. comm..)

Fuel and Fire Behavior Modeling

Standard fuel models (Anderson 1982) were assigned to each sampled unit, using the average data for the 3 plots at each site. Two fire behavior analysts assigned the fuel models using: surface fuel loading, surface fuel depths, overstory tree canopy cover, tree composition, shrub cover, and pictures of some of the sites. There is no program currently available that objectively assigns fuel models from plot data. The models were assigned based upon expected fire behavior compared to predicted fire behavior of the standard fuel models.

Predicted fire behavior was modeled using FlamMap. FlamMap utilizes standard fire behavior calculations at a specific point in time for a specific point in a landscape. The same fire behavior calculations that are incorporated in FARSITE (Finney 1998) are applied in FlamMap. It incorporates slope and its effects on flamelengths and rate of spread. Weather data input was the same as that used for the HFQLG and SNCF EIS's, from the Mt. Elizabeth weather station, high weather conditions (91-97%tile) except for wind. A 20' wind speed of 20 mph, with the direction always upslope and a conditioning period from August 1 at 1100 to August 3 at 1100 were used.

Table A-2. The fire weather data used to calculate fire behavior in FlamMap, FARSITE, BEHAVE, and FOFEM model runs

Station: 043605: Mt. Elizabeth	**Variable: SC**		**Model: 7G3PE3**	
Data Years: 1961 – 1996				
Date Range: July 1 - September 30				
Wind Directions: N, NE, E, SE, S, SW, W, and NW				
Percentiles, Probabilities, and Midpoints				
Variable/Component Range	**Low**	**Mod**	**High**	**Ext**
Percentile Range	0 - 15	16 - 90	91 - 97	98 - 100
Climate. Probability	15	75	7	3
Mid-Point SC	8 - 8	13 - 13	21 - 21	25 - 99
Calculated Spread Comp.	8	12	20	27
Calculated ERC	51	72	79	84
Fuel Moistures				
1 Hour Fuel Moisture	7.29	4.51	3.73	3.28
10 Hour Fuel Moisture	8.59	5.49	4.66	4.25
100 Hour Fuel Moisture	10.72	7.20	6.10	5.27
Herbaceous Fuel Moisture	72.36	39.22	33.71	32.45
	Determine from monitoring data, closest location			
Woody Fuel Moisture	120	120	100	80
20' Wind Speed	5.56	6.57	10.50	13.15
1000 Hour Fuel Moisture	11.86	8.38	7.40	6.74

Proportion of Landscape Treated for Fuels Reduction

How treatments are distributed, whether as defensible fuel profile zones or large blocks, is important in determining the effectiveness of fuel treatments at the landscape scale. In order to determine this, we did a spatial analysis of the proportion of areas in the landscape treated. We utilized a moving window of 5000 acres in size with a focal mean operation.

Changes in California Wildlife Habitat Relations Types

California Spotted Owl and Northern Goshawk

In draft versions of the report, treated units with statistically significant changes in canopy cover or quadratic mean diameter were used to update a layer of existing California Wildlife Habitat Relations (CWHR) types derived from Forest Inventory (FIA) plots and timber inventory layers. However, this approach was problematic because the methods used to derive the two different CWHR assignments, FHP plots and the FIA/Timber Inventory plots and maps are different. Changes could be due to either or both changes in habitat and differences in habitat typing approaches. Consequently, we limited the analysis to two separate displays of the projects in relation to each individual CWHR data set.

In the first analysis, we used the FHP monitoring plot data to generate CWHR types, using the methodology described in the Sierra Nevada Framework EIS (USDAFS 2001). We then graphed the sampled acres by treatment status and CWHR type.

For the second analysis, we overlaid the mapped project units and the CWHR types cross-walked from the FIA/ timber inventory layer. The CWHR types were then cross-walked to California spotted owl and northern goshawk habitat suitability types (Table A-3). The proportion of owl homeranges in suitable habitat and the amount and type of habitat affected by planned and implemented treatments were computed and graphed. Because of the limited sampling design, without pre-treatment sampling for treated units, we are unable to show whether the CWHR types were changed by the treatments for each unit.

Table A-3. California Wildlife Habitat Relations (CWHR) type classification for California spotted owl and northern goshawk.

CWHR type	Tree Canopy cover (%)	Average tree diameter (inches)	Owl habitat suitability	Goshawk habitat suitability
6	>60%	>24”	Nesting, Foraging	Nesting, Foraging
5D	>60%	>24”	Nesting, Foraging	Nesting, Foraging
5M	40-59%	>24”	Nesting, Foraging	Nesting, Foraging
5P	25-39%	>24”		Foraging
5S	10-24%	>24”		Foraging
4D	>60%	12-24”	Foraging	Nesting, Foraging
4M	40-59%	12-24”	Foraging	Nesting, Foraging
4P	25-39%	12-24”		
4S	10-24%	12-24”		

Appendix B. Project and Unit Treatment and Status Database

Projects and units sorted in alphabetical order. Data is current as of May 2001. Coding for ecotype column is shown below.

Ecotype			
WMCM=	west-mcon-low/mid elev-moist	TEYP=	transition- yellow pine
WMCD=	west-mcon-low/mid elev-dry	EYPM=	eastside - yellow pine- mesic
WHMCM=	west-mcon-high elev-moist	EYPD=	eastide - yellow pine - dry
WHMCD=	west-mcon-high elev-dry	RF=	red fir
TMCM=	transition-mcon-moist	LP=	lodgepole pine
TMCD=	transition-mcon-dry	ASP=	aspen
TEWF=	transition/eastside - white fir		

* relates to numeric assignment in GIS may differ from code in SRS or sale map.

Project Name	National Forest	Unique* Unit ID	Ecotype	Current Staus	Primary Treatment	Primary Treatment Date	Sampled	Sampled Before or After Treatment	Second Treatment	Second Treatment Date	ACRES
96 Biomass	Tahoe	1	EYPD	treated	thin	10/ /1997	no		prescribed	10/ /2000	92
96 Biomass	Tahoe	2	EYPD	treated	thin	11/ /1997	no		prescribed	10/ /2000	337
96 Biomass	Tahoe	3	EYPD	treated	thin	11/ /1999	yes	before			175
96 Biomass	Tahoe	4	EYPD	treated	thin	9/ /1998	yes	before	prescribed	10/ /2000	128
96 Biomass	Tahoe	5	EYPD	treated	thin	11/ /1999	no				41
96 Biomass	Tahoe	6	EYPD	treated	thin	11/ /1999	no		prescribed	10/ /2000	41
96 Biomass	Tahoe	7	EYPD	treated	thin	9/ /1998	no				22
Arkansas	Plumas	17	RF	treated	thin	7/ /1999	yes	before	pile and burn	11/ /1998	18
Arkansas	Plumas	27	RF	treated	thin	11/ /1998	no		pile and burn	11/ /1998	13
Arkansas	Plumas	31	WHMCM	treated	thin	9/ /1998	no		pile and burn	11/ /1998	31
Arkansas	Plumas	38	WHMCM	treated	thin	7/ /1999	no		pile and burn	11/ /1998	25
Arkansas	Plumas	39	WHMCM	treated	thin	11/ /1998	no		pile and burn	11/ /1998	4
Arkansas	Plumas	48	WHMCM	treated	thin	8/ /1999	no		pile and burn	11/ /1998	13
Arkansas	Plumas	49	RF	treated	thin	7/ /1999	no		pile and burn	11/ /1998	1
Arkansas	Plumas	54	WHMCM	treated	thin	10/ /1998	no		pile and burn	11/ /1998	24
Arkansas	Plumas	56	WHMCM	treated	thin	9/ /1999	no		pile and burn	11/ /1998	6
Arkansas	Plumas	58	WHMCM	treated	thin	7/ /1999	no		pile and burn	11/ /1998	56
Arkansas	Plumas	61	WHMCM	treated	thin	9/ /1998	no		pile and burn	11/ /1998	27

Arkansas	Plumas	62	WHMCM	treated	thin	9/ /1998	no		pile and burn	11/ /1998	24
Arkansas	Plumas	64	WHMCM	treated	thin	11/ /1998	no		pile and burn	11/ /1998	23
Arkansas	Plumas	102	WHMCM	treated	thin	9/ /1998	no		pile and burn	11/ /1998	10
Arkansas	Plumas	103	WHMCM	treated	thin	9/ /1998	yes	unknown	pile and burn	11/ /1998	4
Arkansas	Plumas	104	RF	treated	thin	/ /1999	yes	before	pile and burn	11/ /1998	3
Bailey DFPZ	Lassen	4	WHMCM	treated	thin	/ /1998	yes	after			14
Bailey DFPZ	Lassen	5	WHMCM	treated	thin	7/ /1998	yes	after	roadside piles	10/ /2000	39
Bailey DFPZ	Lassen	6	WHMCM	treated	thin	7/ /1998	yes	after	roadside piles	10/ /2000	13
Bailey DFPZ	Lassen	7	WHMCM	treated	thin	10/ /1998	no				23
Bailey DFPZ	Lassen	8	WHMCM	treated	thin	7/ /1998	no		roadside piles	10/ /2000	28
Bailey DFPZ	Lassen	10	WHMCM	treated	thin	/ /1998	no				10
Bailey DFPZ	Lassen	11	WHMCM	treated	thin	/ /1998	no				29
Bailey DFPZ	Lassen	17	WHMCM	treated	thin	/ /1998	no				35
Bailey DFPZ	Lassen	18	WHMCM	treated	thin	/ /1998	no				40
Bailey DFPZ	Lassen	21	WHMCM	treated	thin	/ /1998	no				60
Bailey DFPZ	Lassen	23	WHMCM	treated	thin	/ /1998	no				57
Bailey DFPZ	Lassen	24	WHMCM	treated	thin	/ /1998	no				21
Bailey DFPZ	Lassen	27	WHMCM	treated	thin	/ /1998	no				19
Bailey DFPZ	Lassen	32	WHMCM	treated	thin	/ /1998	no				83
Bailey DFPZ	Lassen	33	WHMCM	treated	thin	/ /1998	no				4
Bailey DFPZ	Lassen	34	WHMCM	treated	thin	/ /1998	no				4
Bailey DFPZ	Lassen	35	WHMCM	treated	thin	/ /1998	no				46
Bailey DFPZ	Lassen	39	WHMCM	treated	thin	/ /1998	no				38
Bailey DFPZ	Lassen	41	WHMCM	treated	thin	/ /1998	no				12
Bailey DFPZ	Lassen	122	WHMCM	treated	thin	/ /1998	no				31
Bailey DFPZ	Lassen	123	WHMCM	treated	thin	/ /1998	no				30
Bailey DFPZ	Lassen	162	WHMCM	treated	thin	/ /1998	no				12
Bailey DFPZ	Lassen	163	WHMCM	treated	thin	/ /1998	no				6
Bailey DFPZ	Lassen	252	WHMCM	treated	thin	/ /1998	no				10
Bailey DFPZ	Lassen	253	WHMCM	treated	thin	/ /1998	no				15
Bailey DFPZ	Lassen	254	WHMCM	treated	thin	/ /1998	no				20
Bailey DFPZ	Lassen	302	WHMCM	treated	thin	/ /1998	no				31
Bailey DFPZ	Lassen	381	WHMCM	treated	thin	/ /1998	no				16

Bailey DFPZ	Lassen	382	WHMCM	treated	thin	/ /1998	no				24
Bailey DFPZ	Lassen	383	WHMCM	treated	thin	/ /1998	no				18
Bailey DFPZ	Lassen	812	WHMCM	treated	thin	/ /1998	no				55
Bailey DFPZ	Lassen	813	WHMCM	treated	thin	/ /1998	no				41
Beckwourth	Plumas	16	EYPM	treated	precom thin	8/ /1996	no				40
Beckwourth	Plumas	90	EYPM	treated	precom thin	8/ /1996	no				157
Beckwourth	Plumas	91	EYPM	treated	precom thin	8/ /1996	no				91
Beckwourth	Plumas	92	EYPM	treated	precom thin	11/ /2000	no				44
Beckwourth	Plumas	93	EYPM	treated	precom thin	11/ /2000	no				32
Beckwourth	Plumas	94	EYPM	treated	precom thin	11/ /2000	no				85
Beckwourth	Plumas	95	EYPM	treated	precom thin	11/ /2000	no				22
Ben DFPZ	Lassen	78		treated	thin	/ /1998	no				93
Ben DFPZ	Lassen	79		treated	thin	/ /1998	no				64
Ben DFPZ	Lassen	82	WMCD	treated	thin	10/16/199	no		machine piles	10/ /1998	43
Ben DFPZ	Lassen	83	WMCD	treated	thin	10/16/199	no		machine piles	10/ /1998	42
Ben DFPZ	Lassen	85	WMCD	treated	thin	7/ /1998	yes	after	roadside piles	10/ /1998	34
Ben DFPZ	Lassen	841	WHMCM	treated	thin	10/16/199	no				17
Ben DFPZ	Lassen	842	WHMCM	treated	thin	10/16/199	no				37
Ben DFPZ	Lassen	843	WHMCM	treated	thin	10/16/199	no				10
Ben DFPZ	Lassen	844	WHMCM	treated	thin	10/16/199	no				48
Benner Biothin	Lassen	1	WHMCD	treated	thin	7/ /1995	yes	after	roadside piles	10/ /1998	129
Benner Biothin	Lassen	2	WHMCD	treated	thin	12/ /1997	no		machine piles	10/ /1998	85
Benner Biothin	Lassen	3	WHMCD	treated	thin	12/ /1997	no		roadside piles	10/ /1998	19
Benner Biothin	Lassen	4	WHMCD	treated	thin	12/ /1997	no		roadside piles	10/ /1998	109
Benner Biothin	Lassen	5	WHMCD	treated	thin	10/ /1995	yes	after	roadside piles	10/ /1998	178
Benner Biothin	Lassen	10		treated	thin	/ /1999	no				87
Cal Mtn	Lassen	1	EYPD	treated	biomass	8/ /1998	yes	after			32
Calpine CDZ	Tahoe	1	TMCD	treated	thin	10/ /1997	yes	after			42
Calpine CDZ	Tahoe	2	TMCM	treated	thin	6/ /1996	no				66
Calpine CDZ	Tahoe	3	TMCM	treated	thin	10/ /1997	yes	after			93
Carmen Valley	Tahoe	1	EYPD	treated	prescribe burn	10/ /99	no				20
Carmen Valley	Tahoe	2	EYPD	treated	prescribe burn	10/ /1999	yes	before			43
Carmen Valley	Tahoe	3	EYPD	treated	prescribe burn	5/ /1998	no				72
Chance	Plumas	1	TEYP	treated	thin	9/ /1996	no		prescribed	/ /98	30

Chance	Plumas	2	EYPM	treated	thin	9/ /1996	no		prescribed	/ /98	49
Chance	Plumas	5	TEYP	treated	thin	9/ /1996	no		prescribed	/ /98	64
Chance	Plumas	6	EYPM	treated	thin	10/ /1997	no		prescribed	/ /98	213
Chance	Plumas	16	TEWF	treated	thin	10/ /1997	yes	after	prescribed	/ /99	35
Chance	Plumas	17	TEYP	treated	thin	10/ /1996	no		prescribed	/ /99	30
Chance	Plumas	29	EYPM	treated	thin	10/ /1996	no		prescribed	/ /94	52
Chance	Plumas	30	TEWF	treated	thin	10/ /1997	no				48
Chance	Plumas	32	TEWF	treated	thin	10/ /1997	no		prescribed	/ /99	212
Chance	Plumas	33	TEWF	treated	thin	10/ /1997	no				50
Chance	Plumas	34	EYPM	treated	thin	10/ /1997	yes	after	prescribed	/ /94	39
Chance	Plumas	35	TEYP	treated	thin	10/ /1997	no		prescribed	/ /94	22
Chance	Plumas	36	TEYP	treated	thin	10/ /1997	no		prescribed	/ /99	19
Chance	Plumas	37	EYPM	treated	thin	10/ /1997	no		prescribed	/ /99	14
Chance Clover	Plumas	1	TEYP	treated	prescribe burn	5/ /1997	yes	after			7
Claireville	Plumas	55	TEYP	treated	thin	9/ /1996	yes	after			99
Claireville	Plumas	56	TEYP	treated	thin	9/ /1996	no				61
Claireville	Plumas	57	TEYP	treated	thin	9/ /1996	no				41
Claireville	Plumas	58	TEYP	treated	thin	9/ /1996	no				21
Claireville	Plumas	59	TEYP	treated	thin	9/ /1996	no				52
Clarks Creek	Plumas	33	EYPD	treated	precom thin	10/ /1996	no				27
Clarks Creek	Plumas	36	EYPD	treated	precom thin	10/ /1996	no				75
Clarks Creek	Plumas	37	EYPD	treated	precom thin	6/ /1997	no				25
Clarks Creek	Plumas	38	EYPD	treated	precom thin	10/ /1996	no				29
Clarks Creek	Plumas	125	EYPD	treated	thin	6/ /1997	no				51
Clarks Creek	Plumas	126	EYPD	treated	thin	6/ /1997	no				24
Corners	Plumas	1	WMCD	treated	biomass	9/ /1998	no		machine piles	11/ /1999	4
Corners	Plumas	4	WMCD	treated	biomass	9/ /1998	no		machine piles	11/ /1999	9
Corners	Plumas	6	WMCM	treated	biomass	9/ /1998	no		machine piles	11/ /1999	11
Corners	Plumas	7	WMCD	treated	biomass	9/ /1998	yes	after	machine piles	11/ /1999	6
Corners	Plumas	13	WMCM	treated	biomass	9/ /1998	yes	before	machine piles	11/ /1999	15
Corners	Plumas	14	WMCM	treated	precom thin	9/ /1998	no		machine piles	11/ /1999	4
Corners	Plumas	17	WMCD	treated	biomass	9/ /1998	no		machine piles	11/ /1999	16
Corners	Plumas	19	WMCM	treated	biomass	9/ /1998	yes	after	machine piles	11/ /1999	5

Corners	Plumas	20	WMCD	treated	biomass	9/ /1998	no		machine piles	11/ /1999	2
Crash1	Lassen	153	TEYP	treated	thin	9/ /1996	yes	after			51
Crash1	Lassen	154	EYPM	treated	thin	9/ /1996	no				119
Crash1	Lassen	155	EYPM	treated	thin	9/ /1996	no				45
Crash1	Lassen	156	EYPM	treated	thin	9/ /1996	no				10
Crash3	Lassen	309	EYPD	treated	thin	9/ /1996	yes	after			64
Crash3	Lassen	310	EYPD	treated	thin	9/ /1996	no				25
Crash3	Lassen	311	EYPD	treated	thin	8/ /1996	no				19
Crash4	Lassen	300	TEWF	treated	precom thin	10/ /1998	no				31
Crash4	Lassen	301	TEWF	treated	precom thin	10/ /1997	no				72
Crash4	Lassen	302	TEWF	treated	precom thin	10/ /1997	no				43
Crash4	Lassen	303	TEWF	treated	precom thin	10/ /1997	no				86
Crash4	Lassen	304	TEWF	treated	precom thin	10/ /1998	no				5
Crash4	Lassen	305	TEWF	treated	precom thin	10/ /1998	no				41
Crash4	Lassen	306	TEWF	treated	precom thin	10/ /1997	no				54
Crash4	Lassen	307	TEWF	treated	precom thin	10/ /1997	no				81
Crash4	Lassen	308	EYPD	treated	precom thin	10/ /1997	yes	after			38
Crocker	Plumas	147	EYPM	treated	precom thin	11/ /1998	no				50
Dixie	Plumas	28	EYPM	treated	thin	10/ /1998	no				40
Dixie	Plumas	29	EYPM	treated	thin	10/ /1998	no				69
Dixie	Plumas	30	EYPM	treated	thin	10/ /1998	yes	before			26
Dixie	Plumas	31	EYPM	treated	thin	10/ /1998	no		prescribed	/ /1986	28
Dixie	Plumas	32	EYPM	treated	thin	10/ /1998	no				31
Dotta	Plumas	55	EYPM	treated	thin	8/ /1999	no				27
Dotta	Plumas	57	EYPM	treated	thin	8/ /1999	no				20
Dotta	Plumas	59	EYPM	treated	thin	8/ /1999	no				40
Dotta	Plumas	61	EYPM	treated	thin	8/ /1999	no				18
Dotta	Plumas	62	EYPM	treated	thin	8/ /1999	no				39
Dotta	Plumas	63	EYPM	treated	thin	8/ /1999	no				149
Dotta	Plumas	68	EYPM	treated	thin	8/ /1999	no				149
Dotta	Plumas	70	EYPD	treated	thin	8/ /1999	no				151
Dotta	Plumas	71	EYPD	treated	thin	8/ /1999	no				72
Dotta	Plumas	74	EYPD	treated	thin	8/ /1999	no				108
Dotta	Plumas	77	EYPD	treated	thin	8/ /1999	no				142

Dotta	Plumas	78	EYPD	treated	thin	8/ /1999	no				137
Dotta	Plumas	79	EYPD	treated	thin	8/ /1999	no				37
Dotta	Plumas	80	EYPD	treated	thin	6/ /2000	no				25
Dotta	Plumas	81	EYPD	treated	thin	8/ /1999	yes	before			25
Dotta	Plumas	82	TEYP	treated	thin	8/ /1999	yes	before			103
Dotta	Plumas	83	EYPM	treated	thin	8/ /1999	no				88
Dotta	Plumas	85	EYPD	treated	thin	8/ /1999	no				97
Dotta	Plumas	86	TEYP	treated	thin	8/ /1999	no				29
Dry Flat	Plumas	10	TEYP	treated	precom thin	8/ /1997	no				73
Dry Flat	Plumas	18	TEYP	treated	precom thin	8/ /1997	no				117
Dry Flat	Plumas	21	TEYP	treated	precom thin	8/ /1997	no				15
Dry Flat	Plumas	26	EYPD	treated	precom thin	8/ /1997	no				12
Dry Flat	Plumas	40	EYPD	treated	precom thin	6/ /1997	yes	after			37
Dry Flat	Plumas	41	EYPM	treated	precom thin	6/ /1997	no				35
Dry Flat	Plumas	42	EYPM	treated	precom thin	6/ /1997	no				80
Dry Flat	Plumas	43	TEYP	treated	precom thin	6/ /1997	no				47
Dry Flat	Plumas	44	EYPD	treated	precom thin	6/ /1997	yes	after			41
Dry Flat	Plumas	45	TEYP	treated	precom thin	6/ /1997	no				23
Dry Flat	Plumas	46	EYPM	treated	precom thin	6/ /1997	no				7
Eagle	Plumas	1	WHMCD	treated	biomass	9/ /1997	no		machine piles	11/ /1996	12
Eagle	Plumas	6	WHMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	11
Eagle	Plumas	10	WHMCD	treated	biomass	9/ /1997	no		machine piles	11/ /1996	79
Eagle	Plumas	15	WHMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	78
Eagle	Plumas	19	WHMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	39
Eagle	Plumas	20	WMCD	treated	biomass	9/ /1997	no		machine piles	11/ /1996	22
Eagle	Plumas	21	WMCM	treated	biomass	9/ /1997	yes	after	machine piles	11/ /1996	15
Eagle	Plumas	22	WMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	21
Eagle	Plumas	23	WMCM	treated	biomass	9/ /1997	yes	after	machine piles	11/ /1996	24
Eagle	Plumas	24	WHMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	15
Eagle	Plumas	25	WHMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	41
Eagle	Plumas	26	WMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	43
Eagle	Plumas	28	WMCM	treated	biomass	9/ /1997	yes	after	machine piles	11/ /1996	69
Eagle	Plumas	30	WMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	25

Eagle	Plumas	32	WMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	28
Eagle	Plumas	34	WMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	37
Eagle	Plumas	39	WMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	19
Eagle	Plumas	43	WMCD	treated	biomass	9/ /1997	no		machine piles	11/ /1996	27
Eagle	Plumas	47	WMCM	treated	biomass	9/ /1997	no		machine piles	11/ /1996	22
Eagle	Plumas	49	WMCD	treated	biomass	9/ /1997	yes	after	machine piles	11/ /1996	12
East Dusty	Lassen	3	WHMCD	not treat	thin		no		roadside piles	10/ /1998	31
East Dusty	Lassen	8	WHMCD	treated	thin	/ /1998	no		roadside piles	10/ /1998	13
East Dusty	Lassen	9	TMCM	not treat	thin		yes	before	roadside piles	10/ /1998	21
East Dusty	Lassen	15	WHMCM	treated	thin	7/ /1997	yes	after	roadside piles	10/ /1998	23
East Dusty	Lassen	16	WHMCM	treated	thin	/ /2000	no		roadside piles	10/ /1998	21
East Dusty	Lassen	21	WHMCD	treated	thin	6/4/1997	no		roadside piles	10/ /1998	40
East Dusty	Lassen	24	WHMCD	treated	precom thin	6/4/1997	no		roadside piles	10/ /1998	28
East Dusty	Lassen	25	WHMCD	treated	precom thin	6/4/1997	no		roadside piles	10/ /1998	58
East Dusty	Lassen	26	WHMCD	treated	thin	6/4/1997	no		roadside piles	10/ /1998	28
East Dusty	Lassen	29	WHMCM	treated	thin	/ /1990	no		roadside piles	10/ /1998	89
East Dusty	Lassen	36	WHMCD	treated	sanitation	/ /1990	no		roadside piles	10/ /1998	23
East Dusty	Lassen	41	WHMCM	treated	thin	/ /1996	no		roadside piles	10/ /1998	25
East Dusty	Lassen	42	WHMCM	treated	sanitation	8/26/1997	no		roadside piles	10/ /1998	12
East Dusty	Lassen	45	WHMCM	treated	thin	/ /1999	yes	before	roadside piles	10/ /1998	65
East Dusty	Lassen	47	WHMCM	treated	thin	6/31/1997	no		roadside piles	10/ /1998	20
East Dusty	Lassen	52	WHMCM	treated	thin	6/31/1997	no		roadside piles	10/ /1998	8
East Dusty	Lassen	54	WHMCM	treated	thin	/ /1992	no		roadside piles	10/ /1998	10
East Dusty	Lassen	55	LP	treated	thin	9/ /1997	yes	after	roadside piles	10/ /1998	61
East Dusty	Lassen	57	WHMCM	treated	thin	/ /1990	no		roadside piles	10/ /1998	22
East Dusty	Lassen	64	WHMCM	not treat	thin		no		roadside piles	10/ /1998	17
East Dusty	Lassen	67	WHMCD	treated	thin	6/ /1997	no		roadside piles	10/ /1998	11
East Dusty	Lassen	74	WHMCD	treated	thin	/ /1997	no		roadside piles	10/ /1998	17
East Dusty	Lassen	79	WHMCD	treated	thin	/ /1997	no		roadside piles	10/ /1998	14
East Dusty	Lassen	86	WHMCD	treated	sanitation	11/19/199	no		roadside piles	10/ /1998	59
East Dusty	Lassen	89	WHMCD	treated	sanitation	11/19/199	no		roadside piles	10/ /1998	56
East Dusty	Lassen	93	LP	treated	thin	6/31/1997	no		machine piles	10/ /1998	55
East Dusty	Lassen	100	WHMCD	treated	thin	/ /1999	no		roadside piles	10/ /1998	27
East Dusty	Lassen	102	WHMCD	not treat	thin		no		roadside piles	10/ /1998	9

East Dusty	Lassen	103	WHMCD	not treat	precom thin		no		roadside piles	10/ /1998	19
East Dusty	Lassen	149		treated	thin	/ /1998	no				32
East Dusty	Lassen	150		treated	thin	/ /1997	no				10
East Dusty	Lassen	167		treated	thin	/ /1996	no				36
East Dusty	Lassen	173	WHMCD	treated	sanitation	6/ /1997	yes	after	roadside piles	10/ /1998	14
East Dusty	Lassen	184	WHMCD	treated	sanitation	6/ /1997	yes	after	roadside piles	10/ /1998	24
East Dusty	Lassen	203		treated	thin	/ /1992	no				31
East Dusty	Lassen	621	WHMCM	treated	thin	6/31/1997	no		roadside piles	10/ /1998	10
East Dusty	Lassen	622		treated	thin	6/31/1997	no				5
East Dusty	Lassen	1551		treated	thin	/ /1997	no				7
East Dusty	Lassen	1552		treated	thin	/ /1991	no				16
Fanani	Lassen	1		treated	thin	/ /1999	no		roadside piles	10/ /1999	39
Fanani	Lassen	14	WHMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	41
Fanani	Lassen	18	WHMCM	treated	thin	9/ /1998	no		roadside piles	10/ /1999	18
Fanani	Lassen	19	WHMCM	treated	sanitation	9/ /1998	no		roadside piles	10/ /1999	39
Fanani	Lassen	21	WHMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	46
Fanani	Lassen	23	RF	treated	sanitation	10/3/1997	no		roadside piles	10/ /1999	53
Fanani	Lassen	25	WHMCM	treated	thin	9/ /1998	no		roadside piles	10/ /1999	16
Fanani	Lassen	28		treated	sanitation	/ /1997	no		roadside piles	10/ /1999	27
Fanani	Lassen	32	WHMCD	treated	sanitation	/ /1998	no		roadside piles	10/ /1999	29
Fanani	Lassen	33	RF	treated	thin	10/ /1997	no		roadside piles	10/ /1999	37
Fanani	Lassen	40	WHMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	25
Fanani	Lassen	42		treated	thin	/ /1992	no		roadside piles	10/ /1999	34
Fanani	Lassen	43	WHMCM	treated	thin	9/ /1998	no		roadside piles	10/ /1999	47
Fanani	Lassen	48	WHMCD	treated	thin	/ /1997	no		roadside piles	10/ /1999	38
Fanani	Lassen	50	WHMCD	treated	thin	11/ /1997	yes	after	roadside piles	10/ /1999	12
Fanani	Lassen	52	WHMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	9
Fanani	Lassen	54	WHMCD	treated	precom thin	9/ /1998	no		roadside piles	10/ /1999	20
Fanani	Lassen	57	WMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	7
Fanani	Lassen	65	WHMCD	treated	sanitation	10/15/199	no		roadside piles	10/ /1999	49
Fanani	Lassen	69	WHMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	37
Fanani	Lassen	74	WHMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	19
Fanani	Lassen	86	WHMCM	treated	thin	9/ /1998	no		roadside piles	10/ /1999	44

Fanani	Lassen	93	WHMCD	treated	thin	10/ /1997	yes	after	roadside piles	10/ /1999	14
Fanani	Lassen	94	WHMCD	treated	thin	10/ /1997	no		roadside piles	10/ /1999	31
Fanani	Lassen	271		treated	thin	/ /1998	no		roadside piles	10/ /1999	5
Fanani	Lassen	272		treated	thin	/ /1998	no		roadside piles	10/ /1999	3
Fanani	Lassen	432		treated	thin	/ /1995	no		roadside piles	10/ /1999	6
Fanani	Lassen	681	WHMCD	treated	thin	/ /1999	no		roadside piles	10/ /1999	70
Fanani	Lassen	682		treated	thin	/ /1996	no		roadside piles	10/ /1999	48
Fanani	Lassen	1001	WHMCD	treated	precom thin	11/21/199	no		roadside piles	10/ /1999	8
Fanani	Lassen	1002		treated	thin	/ /1991	no		roadside piles	10/ /1999	12
Fanani	Lassen	1003		treated	thin	/ /1996	no		roadside piles	10/ /1999	6
Fanani	Lassen	1004		treated	thin	/ /1990	no		roadside piles	10/ /1999	3
Fawn	Plumas	83	EYPM	partial	biomass		no				18
Fawn	Plumas	84	EYPM	partial	biomass		no				37
Fawn	Plumas	85	EYPM	partial	biomass		no				40
Fawn	Plumas	86	EYPM	partial	biomass		no				15
Fawn	Plumas	87	EYPM	partial	biomass		no				57
Fawn	Plumas	88	EYPM	partial	biomass		no				32
Fawn	Plumas	89	EYPM	partial	biomass		no				18
Fawn	Plumas	90	EYPM	partial	biomass		no				14
Fawn	Plumas	91	EYPM	partial	biomass		no				27
Force Account	Tahoe	1	EYPD	partial	thin	11/ /1997	no		pile and burn	10/ /1998	34
Force Account	Tahoe	2	EYPD	partial	thin	11/ /1997	yes	after	pile and burn	10/ /1998	12
Force Account	Tahoe	3	EYPD	partial	thin	11/ /1997	no		pile and burn	10/ /1998	17
Force Account	Tahoe	4	EYPD	partial	thin	11/ /1997	yes	unknown	pile and burn	10/ /1998	9
Force Account	Tahoe	5	EYPD	partial	thin	10/ /1997	no		pile and burn	10/ /1998	16
Force Account	Tahoe	6	EYPD	partial	thin	10/ /1998	no		pile and burn	10/ /1998	6
Force Account	Tahoe	7	EYPD	partial	thin	10/ /1997	yes	after	pile and burn	10/ /1998	19
Force Account	Tahoe	8	EYPD	partial	thin	10/ /1997	no		pile and burn	10/ /1998	38
Force Account	Tahoe	9	EYPD	partial	thin	11/ /1997	no		pile and burn	10/ /1998	6
Ganser	Plumas	2	WMCM	partial	biomass	9/ /1998	yes	after			19
Ganser	Plumas	3	WMCD	partial	biomass	9/ /1998	yes	after			5
Ganser	Plumas	4	WHMCM	partial	biomass	10/ /1998	no				57
Ganser	Plumas	5	WHMCM	partial	biomass	10/ /1998	no		prescribed	6/ /1998	85
Ganser	Plumas	9	WHMCM	partial	biomass	10/ /1998	no		prescribed	6/ /1998	70

Ganser	Plumas	10	WMCD	partial	biomass	10/ /1998	no		prescribed	6/ /1998	24
Ganser	Plumas	11	WMCD	partial	biomass	10/ /1998	no				6
Glazer Point	Plumas	13	WHMCM	partial	thin	10/ /2000	no				17
Glazer Point	Plumas	16	WHMCM	partial	thin	9/ /2000	no				15
Glazer Point	Plumas	18	WHMCM	partial	thin	9/ /2000	yes	before			23
Glazer Point	Plumas	19	WHMCM	partial	thin	9/ /2000	yes	before			64
Glazer Point	Plumas	20	WHMCD	partial	thin	10/ /2000	no				14
Glazer Point	Plumas	952	WHMCD	partial	thin	9/ /2000	yes	before			17
Glazer Point	Plumas	953	WHMCD	partial	thin	9/ /2000	no				2
Glazer Point	Plumas	954	WHMCD	partial	thin	9/ /2000	no				12
Goathill	Plumas	2	WMCM	partial	biomass	9/ /1997	no		pile and burn	11/ /1998	3
Goathill	Plumas	3	WMCD	partial	biomass	9/ /1997	no		pile and burn	11/ /1998	8
Goathill	Plumas	4	WMCD	partial	biomass	9/ /1997	no		pile and burn	11/ /1998	8
Goathill	Plumas	5	WMCD	partial	biomass	9/ /1997	no		pile and burn	11/ /1998	34
Goathill	Plumas	6	WMCM	partial	biomass	9/ /1997	no		pile and burn	11/ /1998	24
Goathill	Plumas	7	WMCD	partial	biomass	9/ /1997	no		pile and burn	11/ /1998	16
Goathill	Plumas	51	WMCD	partial	biomass	9/ /1997	no		pile and burn	11/ /1998	10
Green Flat	Plumas	1	WHMCD	partial	thin	7/ /1997	no				1253
Green Flat	Plumas	2	WHMCD	partial	thin	7/ /1997	no				1337
Greenhorn	Plumas	1	WMCD	partial	prescribe burn	/ /1996	yes	after			235
Grigsby	Plumas	22	ASP	partial	thin		no				24
Grigsby	Plumas	23	EYPM	partial	thin		no				223
Grigsby	Plumas	24	EYPM	partial	thin		no				26
Grigsby	Plumas	25	EYPM	partial	thin		no				54
Grigsby	Plumas	26	EYPD	partial	thin		no				92
Grigsby	Plumas	27	EYPD	partial	thin		no				234
Grigsby	Plumas	57	EYPD	partial	thin		no				52
Grigsby	Plumas	58	ASP	partial	thin		no				31
Grigsby	Plumas	59	EYPM	partial	thin		no				18
Grigsby	Plumas	60	EYPD	partial	thin		no				87
Grigsby	Plumas	61	TEYP	partial	thin		no				42
Grigsby	Plumas	62	EYPD	partial	thin		no				13
Grigsby	Plumas	63	TEYP	partial	thin		no				188

Grigsby	Plumas	64	EYPD	partial	thin		no				48
Grigsby	Plumas	65	TEYP	partial	thin		no				10
Grigsby	Plumas	66	TEYP	partial	thin		no				32
Grigsby	Plumas	67	EYPD	partial	thin		no				34
Grigsby	Plumas	69	EYPM	partial	thin		no				66
Grigsby	Plumas	70	EYPM	partial	thin		no				55
Grigsby	Plumas	71	EYPM	partial	thin		no				46
Grigsby	Plumas	72	EYPM	partial	thin		no				33
Grigsby	Plumas	73	EYPM	partial	thin		no				138
Grigsby	Plumas	74	EYPM	partial	thin		no				10
Grigsby	Plumas	75	EYPM	partial	thin		no				117
Grigsby	Plumas	76	EYPM	partial	thin		no				20
Grigsby	Plumas	77	EYPM	partial	thin		no				46
Grigsby	Plumas	78	TEWF	partial	thin		yes	before			17
Hallet	Plumas	1	TMCD	partial	prescribe burn	1/ /1999	yes	before			285
Highway 44	Lassen	1	WMCD	partial	thin	11/ /1998	no				71
Highway 44	Lassen	2	WMCD	partial	thin	9/ /1998	no				96
Highway 44	Lassen	4	WMCD	partial	thin	9/ /1998	no				113
Highway 44	Lassen	5	WMCD	partial	thin	1/ /1999	no				11
Highway 44	Lassen	6	WMCM	partial	thin	12/ /1998	no				37
Highway 44	Lassen	7	WMCM	partial	thin	12/ /1998	no				78
Highway 44	Lassen	8	WMCM	partial	thin	10/ /1998	no				27
Highway 44	Lassen	9		partial	thin	12/ /1999	no				45
Highway 44	Lassen	13		partial	thin	12/ /1999	no				33
Highway 44	Lassen	14	WMCD	partial	thin	1/ /1998	yes	before			13
Highway 44	Lassen	15	WMCD	partial	thin	1/ /1998	no				229
Highway 44	Lassen	17	WMCD		thin	4/ /1998	no				97
Highway 44	Lassen	18	WMCD	partial	thin	5/ /1998	yes	after			24
Highway 44	Lassen	19	WMCD	partial	thin	4/ /1998	no				28
Highway 44	Lassen	20	WMCD	partial	thin	5/ /1998	no				80
Howland Flat	Plumas	2	WHMCM	partial	thin	7/ /1998	no				10
Howland Flat	Plumas	3	WHMCM	treated	thin	7/ /1998	yes	after			4
Howland Flat	Plumas	4	WHMCM	treated	sanitation	7/ /1998	no				5
Howland Flat	Plumas	5	WHMCM	treated	thin	7/ /1998	no				17

Howland Flat	Plumas	6	WHMCM	treated	thin	8/ /1998	no				37
Howland Flat	Plumas	7	WHMCM	treated	thin	8/ /1998	no				134
Howland Flat	Plumas	8	WHMCM	treated	thin	8/ /1998	no				7
Howland Flat	Plumas	10	WHMCM	treated	thin	11/ /1997	no				5
Howland Flat	Plumas	11	WHMCM	treated	thin	11/ /1997	no				15
Howland Flat	Plumas	13	WHMCM	treated	thin	11/ /1997	no				22
Howland Flat	Plumas	15	WHMCM	treated	thin	11/ /1997	no				2
Howland Flat	Plumas	16	WHMCM	treated	thin	11/ /1997	no				7
Huevos III	Plumas	1	WHMCD	treated	prescribe burn	5/ /1998	yes	after			214
Hungry	Plumas	1	TMCD	treated	thin	9/ /1999	no				92
Hungry	Plumas	2	TMCD	treated	thin	9/ /1999	no				144
Hungry	Plumas	3	TMCD	treated	thin	9/ /1999	no				990
Hungry	Plumas	4	TMCD	treated	thin	9/ /1999	no				8
Hungry	Plumas	5	TMCD	treated	thin	9/ /1999	no				33
Hungry	Plumas	6	TMCD	treated	thin	9/ /1999	no				143
Hungry	Plumas	11	TMCD	treated	thin	9/ /1999	no				9
Hungry	Plumas	12	TMCD	treated	thin	9/ /1999	no				23
Hungry	Plumas	13	TMCD	treated	thin	9/ /1999	no				75
Hungry	Plumas	14	TMCD	treated	thin	9/ /1999	yes	before			30
Hungry	Plumas	15	TMCD	treated	thin	9/ /1999	yes	before			195
Hungry	Plumas	16	TMCD	treated	thin	9/ /1999	no				97
Ingalls	Plumas	7	EYPM	treated	thin	8/ /2000	yes	before			173
Ingalls	Plumas	8	EYPM	treated	thin	8/ /2000	no				307
Ingalls	Plumas	10	EYPM	treated	thin	8/ /2000	no				280
Jackson	Plumas	6	WHMCM	treated	prescribe burn	5/ /1997	yes	after			136
Jade	Tahoe	1	EYPM	treated	thin	10/ /1998	no				19
Jade	Tahoe	2	EYPM	treated	thin	10/ /1998	no				7
Jade	Tahoe	3	EYPM	treated	thin	10/ /1998	no				32
Jade	Tahoe	4	TEWF	treated	thin	8/ /1998	no				25
Jade	Tahoe	5	TEWF	treated	thin	9/ /1998	yes	before			183
Jade	Tahoe	8	EYPM	treated	thin	11/ /1998	no				5
Jade	Tahoe	9	EYPM	treated	thin	11/ /1998	no				38
Jade	Tahoe	10	TEWF	treated	thin	11/ /1998	no				32

Jade	Tahoe	11	EYPM	treated	thin	11/ /1998	yes	before			23
Jade	Tahoe	12	TEWF	treated	thin	12/ /1999	no				51
Jade	Tahoe	13	TEWF	treated	thin	12/ /1999	yes	before			60
Jade	Tahoe	14	RF	treated	thin	12/ /1998	yes	before			81
Jade	Tahoe	15	RF	treated	thin	12/ /1998	no				30
Jade	Tahoe	16	TEWF	treated	thin	12/ /1998	no				42
Jade	Tahoe	17	TEWF	treated	thin	12/ /1998	yes	before			47
Jade	Tahoe	18	TEWF	treated	thin	11/ /1998	no				5
Jade	Tahoe	19	TEWF	treated	thin	10/ /1998	yes	before			12
Jade	Tahoe	20	RF	treated	thin	12/ /1998	no				13
Jade	Tahoe	21	RF	treated	thin	12/ /1998	no				10
Jade	Tahoe	22	RF	treated	thin	12/ /1998	no				49
Jade	Tahoe	23	RF	treated	thin	12/ /1998	no				12
Jade	Tahoe	24	EYPM	treated	thin	8/ /1998	no				65
Jade	Tahoe	25	EYPM	treated	thin	8/ /1998	no				37
Jade	Tahoe	26	TEWF	treated	thin	10/ /1998	no				23
Jade	Tahoe	27	TEWF	treated	thin	10/ /1998	no				12
Jade	Tahoe	28	TEWF	treated	thin	10/ /1998	no				25
Jade	Tahoe	29	EYPM	treated	thin	11/ /1998	no				11
Jade	Tahoe	30	EYPM	treated	thin	11/ /1998	no				12
Keddie	Plumas	1	WMCD	treated	biomass	10/ /1997	no				9
Keddie	Plumas	2	WMCD	treated	biomass	10/ /1997	no				31
Keddie	Plumas	3	WMCD	treated	biomass	10/ /1997	yes	before			25
Keddie	Plumas	4	WMCD	treated	biomass	10/ /1997	no				6
Keddie	Plumas	5	WMCD	treated	biomass	10/ /1997	no				25
Keddie	Plumas	6	WMCD	treated	biomass	10/ /1997	yes	after			24
Keddie	Plumas	7	WMCD	treated	biomass	10/ /1997	no				10
Keddie	Plumas	8	WMCD	treated	biomass	10/ /1997	no				3
Keddie	Plumas	9	WMCM	treated	biomass	10/ /1997	yes	after			9
Keddie	Plumas	10	WMCD	treated	biomass	10/ /1997	no				22
Keddie	Plumas	11	WMCD	treated	biomass	10/ /1997	no				8
Keddie	Plumas	12	WMCM	treated	biomass	10/ /1997	yes	after			28
Kelly Biomass	Lassen	1	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ / 199	67
Kelly Biomass	Lassen	12	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ / 199	44

Kelly Biomass	Lassen	25	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ / 199	57
Kelly Biomass	Lassen	30	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ / 199	40
Kelly Biomass	Lassen	86	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ / 199	43
Kelly Biomass	Lassen	87	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ / 199	135
Kelly Biomass	Lassen	96	WHMCD	treated	thin	/ /1995	no		machine piles	10/ /2000	207
Kelly Biomass	Lassen	141	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ / 199	125
Kelly Biomass	Lassen	143		treated	thin	/ /1999	no				19
Kelly Biomass	Lassen	153	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ /1998	47
Kelly Biomass	Lassen	166	WHMCD	treated	thin	/ /1995	no		roadside piles	10/ /1998	73
Kelly Biomass	Lassen	186		treated	thin	/ /2000	no				42
Kelly Biomass	Lassen	212		treated	thin	/ /1996	no				4
Kelly Fuelwood	Lassen	145		treated	thin	/ /2000	no				45
Kelly Fuelwood	Lassen	245	LP	treated	thin	/ /1999	yes	before			19
Kelly Fuelwood	Lassen	280	WHMCD	treated	thin	/ /1999	no				33
Kelly Fuelwood	Lassen	281		treated	thin	/ /1995	no				27
Kyburz	Tahoe	10	EYPM	treated	thin	10/ /1996	yes	after			67
Kyburz	Tahoe	12	EYPM	partial	thin		yes	before			108
Kyburz	Tahoe	31	TEWF	partial	thin	9/ /1998	no				18
Kyburz	Tahoe	32	EYPD	partial	thin	12/ /1998	no				8
Kyburz	Tahoe	33	EYPD	partial	thin	8/ /1999	yes	before			94
Kyburz	Tahoe	35	TEWF	partial	thin	10/ /1998	no				51
Kyburz	Tahoe	37	EYPD	partial	thin	8/ /2000	no				155
Kyburz	Tahoe	57	EYPD	partial	thin	11/ /1998	no				18
Kyburz	Tahoe	59	TEWF	partial	thin	12/ /1999	no				77
Kyburz	Tahoe	64	EYPM	partial	thin		no				46
Kyburz	Tahoe	77	EYPD	partial	thin		no				31
Kyburz	Tahoe	98	EYPD	partial	thin	8/ /1999	no				19
Kyburz	Tahoe	107	EYPM	partial	thin	8/ /2000	no				91
Kyburz	Tahoe	126	TEWF	partial	thin	9/ /1996	no				22
Kyburz	Tahoe	131	EYPM	partial	thin		no				63
Kyburz	Tahoe	153	EYPM	partial	thin	9/ /1996	no				100
Kyburz	Tahoe	191	EYPD	partial	thin		no				117
Kyburz Flat I	Tahoe	1	EYPD	partial	prescribe burn	11/ /1996	no				279

Kyburz Flat II	Tahoe	1	EYPD	partial	prescribe burn	6/ /1997	no				116
Lewis Wemple	Plumas	121	TEYP	partial	precom thin	10/ /1997	no				25
Lewis Wemple	Plumas	122	TEYP	partial	precom thin	10/ /1997	yes	after			31
Lewis Wemple	Plumas	123	TEYP	partial	precom thin	10/ /1997	no				94
Lewis Wemple	Plumas	124	TEYP	partial	precom thin	8/ /1997	yes	after			95
Lewis Wemple	Plumas	127	TEYP	partial	precom thin	8/ /1997	no				11
Lewis Wemple	Plumas	128	TEYP	partial	precom thin	8/ /1997	no				36
Lewis Wemple	Plumas	130	TEYP	partial	precom thin	8/ /1997	no				61
Lewis Wemple	Plumas	132	EYPD	partial	precom thin	8/ /1997	no				26
Lewis Wemple	Plumas	134	EYPM	partial	precom thin	8/ /1997	no				75
Long Valley	Plumas	55	TEWF	partial	precom thin		no				148
Long Valley	Plumas	68	TEWF	partial	precom thin		no				110
Long Valley	Plumas	69	TEWF	partial	precom thin	9/ /2000	no				180
Lookout	Lassen	20	WHMCM	partial	thin	/ /1996	no				70
Lookout	Lassen	21	WHMCM	partial	thin	/ /1999	no				35
Lookout	Lassen	24	WHMCM	partial	thin	/ /1998	no				45
Lookout	Lassen	35	WHMCM	partial	thin	/ /2000	no				20
Lookout	Lassen	41	RF	partial	thin		no				24
Lookout	Lassen	43	WHMCM	partial	thin	/ /2000	no				15
Lookout	Lassen	45	WHMCM	partial	thin		no				15
Lookout	Lassen	46	WHMCM	partial	thin	/ /2000	no				19
Lookout	Lassen	51	WHMCM	partial	thin	/ /2000	no				41
Lookout	Lassen	64	WHMCM	partial	thin		no				39
Lookout	Lassen	80	WHMCM	partial	thin	/ /2000	no				78
Lookout	Lassen	87	WHMCM	partial	thin	11/ /2000	yes	before			26
Lookout	Lassen	92	WHMCM	partial	thin	/ /2000	no				23
Lost Lake	Lassen	7	WHMCD	partial	precom thin	6/ /2000	yes	before			15
Lost Lake	Lassen	8	WHMCD	partial	precom thin	/ /2000	no				97
Lost Lake	Lassen	10		partial	thin	/ /1997	no				18
Lost Lake	Lassen	11	WHMCD		sanitation		no				16
Lost Lake	Lassen	12	WHMCD	partial	thin		no				98
Lost Lake	Lassen	14	WHMCD	partial	thin		no				157
Lost Lake	Lassen	31		partial	sanitation	/ /2001	no				28
Lost Lake	Lassen	33		partial	thin	/ /1999	no				18

Lost Lake	Lassen	35		treated	sanitation	/ /1997	no				29
Lost Lake	Lassen	51	WHMCD	treated	sanitation	/ /1996	no				29
Lost Lake	Lassen	64		treated	sanitation	/ /2001	no				65
Lost Lake	Lassen	65	WHMCM	treated	thin	/ /2000	no				17
Lost Lake	Lassen	67	RF	treated	sanitation	10/ /1999	yes	before			27
Lost Lake	Lassen	85		treated	thin	/ /1999	no				21
Lost Lake	Lassen	93		treated	sanitation	/ /2000	no				9
Lost Lake	Lassen	109	RF	treated	thin	/ /1999	no				12
Lost Lake	Lassen	111	TEWF	treated	precom thin	7/ /1999	yes	before			36
Lost Lake	Lassen	126	RF	treated	sanitation	/ /1998	no				27
Lost Lake	Lassen	153	WHMCD	treated	sanitation	/ /1996	no				27
Lost Lake	Lassen	206		treated	thin	/ /1998	no				27
Lost Lake	Lassen	208	WHMCD	treated	thin	/ /1998	no				49
Lost Lake	Lassen	214	RF	treated	thin	/ /1998	no				43
Lost Lake	Lassen	215	RF	treated	sanitation	/ /2000	no				37
Lost Lake	Lassen	217	WHMCD	treated	thin	/ /1999	no				13
Lost Lake	Lassen	220	RF	treated	sanitation	/ /1999	no				21
Lost Lake	Lassen	222	WHMCD	treated	thin	/ /1998	no			8/ /2000	4
Lost Lake	Lassen	223	RF	treated	thin	8/ /1999	yes	before		8/ /2000	15
Lost Lake	Lassen	224	WHMCM	treated	thin	/ /1992	no			8/ /2000	24
Lost Lake	Lassen	232	RF	treated	sanitation	7/ /1999	yes	before			25
Lost Lake	Lassen	254		treated	thin	/ /1995	no				17
Lost Lake	Lassen	267		treated	thin	/ /1996	no				43
Lost Lake	Lassen	272		treated	thin	/ /1997	no				26
Loyalton Pines	Tahoe	1	EYPM	treated	thin	11/ /1998	yes	before			72
Loyalton Pines	Tahoe	2	EYPM	treated	thin	11/ /1997	yes	after	pile and burn	11/ /98	79
Loyalton Pines	Tahoe	3	EYPM	treated	thin	11/ /1997	yes	after	pile and burn	11/ /98	7
Loyalton Pines	Tahoe	5	EYPM	not treat	prescribe burn		yes	before			23
Mahogany Red Clover	Plumas	80	EYPM	treated	precom thin	12/ /1999	no				10
Mahogany Red Clover	Plumas	81	EYPM	treated	precom thin	7/ /1999	yes	before			77
Mahogany Red Clover	Plumas	803	EYPM	treated	prescribe burn	8/ /1997	yes	after			44
Mahogany Red Clover	Plumas	804	EYPM	treated	precom thin	9/ /1996	yes	after			51
Manzanita Chute	Lassen	1	TEWF	treated	biomass	7/29/1997	no				19

Manzanita Chute	Lassen	2	TEWF	treated	biomass	7/29/1997	no				68
Manzanita Chute	Lassen	3	TEWF	treated	biomass	7/29/1997	no				27
Manzanita Chute	Lassen	4	TEWF	treated	biomass	7/29/1997	no				245
Mapes	Plumas	1	WHMCD	treated	prescribe burn	5/ /1996	yes	after			73
Mapes	Plumas	2	WHMCD	treated	prescribe burn	5/ /1997	yes	after			524
Mapes II	Plumas	1	TMCD	treated	prescribe burn	5/ /1999	yes	before			303
Marack	Plumas	1	WHMCM	treated	biomass	9/ /1996	no				5
Marack	Plumas	2	WHMCM	treated	biomass	9/ /1996	no				10
Marack	Plumas	4	WHMCM	treated	biomass	9/ /1996	yes	after	pile and burn	11/ /1996	6
Marack	Plumas	6	WHMCD	treated	biomass	9/ /1996	no		pile and burn	11/ /1996	18
Marack	Plumas	21	WHMCD	treated	biomass	9/ /1996	no				10
Marack	Plumas	23	WHMCD	treated	biomass	9/ /1996	no				5
Massack	Plumas	1	WMCD	treated	prescribe burn	/ /1999	yes	before			348
McClellan	Plumas	67	EYPM	treated	precom thin	9/ /1996	no				97
McClellan	Plumas	68	EYPM	treated	precom thin	9/ /1996	no				37
McClellan	Plumas	69	EYPM	treated	thin	9/ /1999	no				14
McClellan	Plumas	70	EYPM	treated	thin	9/ /1999	no				21
McClellan	Plumas	71	EYPM	treated	thin	9/ /1999	no				27
McClellan	Plumas	72	EYPM	treated	thin	9/ /1999	no				14
McClellan	Plumas	73	EYPM	treated	thin	9/ /1999	no				101
McClellan	Plumas	74	EYPM	treated	thin	9/ /1999	no				27
McFarland	Plumas	1	WHMCD	treated	precom thin	9/ /2000	no				105
McFarland	Plumas	2	WHMCD	treated	precom thin	9/ /2000	no				12
McFarland	Plumas	3	WHMCD	treated	precom thin	10/ /1999	no				24
McFarland	Plumas	4	WHMCD	treated	precom thin	10/ /1999	yes	before			60
McFarland	Plumas	5	WHMCD	treated	precom thin	11/ /1999	no				17
McFarland	Plumas	6	WHMCD	treated	precom thin	10/ /1999	no				22
McFarland	Plumas	7	WHMCD	treated	precom thin	10/ /1999	no				59
McFarland	Plumas	8	WHMCD	treated	precom thin	11/ /2000	no				26
McFarland	Plumas	9	WHMCD	treated	precom thin	9/ /1998	no				80
McFarland	Plumas	10	WHMCD	treated	precom thin	10/ /1998	no				10
McFarland	Plumas	11	WHMCD	treated	precom thin	10/ /1998	no				26
McFarland	Plumas	12	WHMCD	treated	precom thin	2/ /1999	yes	before			51
McFarland	Plumas	13	WHMCD	treated	precom thin	11/ /1999	no				25

McFarland	Plumas	14	WHMCD	treated	precom thin	11/ /1999	no				40
McFarland	Plumas	15	WHMCD	treated	precom thin	11/ /1999	no				82
Mudhole	Lassen	10		treated	thin	/ /1997	no		roadside piles	10/ /1999	79
Mudhole	Lassen	17		treated	thin	/ /1998	no		roadside piles	10/ /1999	52
Mudhole	Lassen	26	WHMCD	treated	thin	10/15/199	no		roadside piles	10/ /1999	115
Mudhole	Lassen	28		treated	thin	/ /1997	no		roadside piles	10/ /1999	145
Mudhole	Lassen	31	WHMCD	treated	thin	10/ /1997	yes	after	roadside piles	10/ /1999	40
Mudhole	Lassen	41	WHMCD	treated	thin	4/ /1997	yes	after	roadside piles	10/ /1999	18
Mudhole	Lassen	44	WHMCD	treated	thin	/ /1997	no		roadside piles	10/ /1999	22
Mudhole	Lassen	45	WHMCD	treated	thin	10/9/1997	no		roadside piles	10/ /1999	27
Mudhole	Lassen	53	WHMCM	treated	thin	/ /1999	no		roadside piles	10/ /1999	69
Mudhole	Lassen	56	WHMCM	treated	thin	/ /2001	no		roadside piles	10/ /1999	76
Mudhole	Lassen	57	WHMCM	treated	thin	/ /1990	no		roadside piles	10/ /1999	16
Mudhole	Lassen	59	WHMCM	treated	thin	7/ /1999	yes	before	roadside piles	10/ /1999	57
Mudhole	Lassen	63	WHMCM	treated	thin	/ /1990	no		roadside piles	10/ /1999	67
Mudhole	Lassen	65	WHMCD	treated	thin	10/15/199	no		roadside piles	10/ /1999	28
Mudhole	Lassen	66		treated	thin	/ /2001	no				24
Mudhole	Lassen	68	WHMCD	treated	thin	10/7/1997	no		roadside piles	10/ /1999	11
Mudhole	Lassen	98	WHMCM	treated	sanitation	/ /1998	no		roadside piles	10/ /1999	44
Mudhole	Lassen	109	WHMCM	treated	thin	7/ /1997	yes	after	roadside piles	10/ /1999	43
Mudhole	Lassen	113	WHMCM	treated	thin	9/11/1997	no		roadside piles	10/ /1999	69
Mudhole	Lassen	114	WHMCD	treated	precom thin	9/11/1997	no		roadside piles	10/ /1999	20
Mudhole	Lassen	115	WHMCD	treated	thin	9/19/1997	no		roadside piles	10/ /1999	33
Mudhole	Lassen	117	WHMCD	treated	thin	9/17/1997	no			8/ /2000	54
Mudhole	Lassen	129		treated	thin	/ /1990	no				67
Mudhole	Lassen	141	WHMCD	treated	thin	/ /1990	no		roadside piles	10/ /1999	23
Mudhole	Lassen	146	WHMCM	treated	sanitation	/ /1990	no		roadside piles	10/ /1999	51
Mudhole	Lassen	282		treated	thin	/ /1997	no				3
Mudhole	Lassen	711	WHMCD	treated	thin	7/ /1997	yes	after	roadside piles	10/ /1999	47
Mudhole	Lassen	712		treated	thin	7/ /1997	no				6
North Antelope	Plumas	1	TEYP	treated	thin	10/ /1997	yes	after			123
North Antelope	Plumas	2	TEYP	treated	thin	10/ /1997	yes	after			689
North Dusty	Lassen	20	WHMCM	not treat	thin		no				19

North Dusty	Lassen	26	WHMCM	not treat	thin		no				5
North Dusty	Lassen	27	WHMCM	not treat	sanitation		no				21
North Dusty	Lassen	30	WHMCM	not treat	thin		no				30
North Dusty	Lassen	31	WHMCD	treated	thin	6/ /2000	yes	before			28
North Dusty	Lassen	43	WHMCM	not treat	thin		yes	before			113
North Dusty	Lassen	45	LP	treated	thin	/ /2000	no				23
North Dusty	Lassen	50	WHMCM	not treat	sanitation		no				9
North Dusty	Lassen	53	WHMCD	treated	thin	/ /2000	no				47
North Dusty	Lassen	55	WHMCM	not treat	sanitation		yes	before			94
North Dusty	Lassen	57	WHMCD	treated	thin	/ /2000	no				106
North Dusty	Lassen	61	WHMCD	treated	thin	/ /2000	no				21
North Dusty	Lassen	64	WHMCM	not treat	sanitation		no				23
North Dusty	Lassen	67	WHMCD	treated	thin	/ /1999	no				16
North Dusty	Lassen	74	LP	not treat	precom thin		yes	before			14
North Dusty	Lassen	80	WHMCD	treated	thin	/ /1999	no				148
North Dusty	Lassen	81		treated	thin	/ /2000	no				13
North Dusty	Lassen	83	WHMCD	not treat	thin		no				34
North Dusty	Lassen	100	WHMCD	treated	thin	/ /2000	no				26
North Dusty	Lassen	155	RF	not treat	sanitation		no				31
North Dusty	Lassen	159		treated	sanitation	/ /2000	no				19
North Dusty	Lassen	164	WHMCD	treated	thin	/ /2000	no				9
North Dusty	Lassen	167	WHMCD	treated	thin	/ /2000	no				32
North Dusty	Lassen	187	WHMCD	treated	thin	/ /2000	no				15
North Dusty	Lassen	188		treated	thin	/ /1999	no				9
North Dusty	Lassen	200		treated	thin	/ /1999	no				16
North Dusty	Lassen	266		treated	thin	/ /1999	no				62
North Dusty	Lassen	286		treated	thin	/ /2000	no				24
North Dusty	Lassen	296		treated	thin	/ /2000	no				10
North Dusty	Lassen	312		treated	thin	/ /2000	no				73
North Dusty	Lassen	386		treated	thin	/ /2000	no				6
North Dusty	Lassen	611		treated	thin	/ /2000	no				14
North Dusty	Lassen	811		treated	thin	/ /2000	no				24
Pearl	Tahoe	1	TMCM	partial	thin		no				20
Pearl	Tahoe	2	TMCM	partial	thin		no				185

Pearl	Tahoe	3	TMCM	partial	thin		no				147
Pearl	Tahoe	5	TMCD	partial	thin		no				12
Pearl	Tahoe	6	RF	treated	thin	10/ /2000	yes	before			43
Pearl	Tahoe	7	TEWF	partial	thin		yes	before			63
Pearl	Tahoe	8	TMCM	partial	thin		no				117
Pearl	Tahoe	9	TMCM	partial	thin		yes	before			78
Pearl	Tahoe	10	TMCM	not treat	thin		yes	before			10
Pearl	Tahoe	11	TEWF	treated	thin	10/ /2000	no				8
Pearl	Tahoe	12	TEWF	partial	thin		yes	before			5
Pearl	Tahoe	13	TEWF	partial	thin		no				13
Pearl	Tahoe	14	TEWF	partial	thin		no				16
Pearl	Tahoe	15	TEWF	partial	thin		no				30
Pearl	Tahoe	16	TEWF	treated	thin	10/ /2000	no				6
Pearl	Tahoe	17	TEWF	treated	thin	10/ /2000	no				21
Pearl	Tahoe	18	TMCM	partial	thin		no				109
Pearl	Tahoe	19	RF	partial	thin	10/ /2000	no				11
Pearl	Tahoe	20	RF	partial	thin	10/ /2000	no				3
Pearl	Tahoe	21	TEWF	partial	thin	10/ /2000	no				17
Pearl	Tahoe	22	TEWF	partial	thin	10/ /2000	no				16
Pearl	Tahoe	23	TEWF	partial	thin	10/ /2000	yes	before			16
Pearl	Tahoe	24	TEWF	partial	thin	10/ /2000	yes	before			33
Pinnacle	Lassen	6	WHMCD	partial	thin	/ /1997	no		roadside piles	10/ /1999	49
Pinnacle	Lassen	8	WHMCD	partial	thin	7/ /1997	yes	after	roadside piles	10/ /1999	22
Pinnacle	Lassen	12	WHMCD	partial	thin	/ /1997	no		roadside piles	10/ /1999	8
Pinnacle	Lassen	16	WHMCM	partial	thin	/ /1997	no		roadside piles	10/ /1999	20
Pinnacle	Lassen	23	WHMCM	partial	sanitation	/ /1997	no		roadside piles	10/ /1999	9
Pinnacle	Lassen	25	WHMCD	partial	thin	/ /1997	no		roadside piles	10/ /1999	17
Pinnacle	Lassen	26	WHMCD	partial	thin	/ /1997	no		roadside piles	10/ /1999	17
Pinnacle	Lassen	33	WHMCM	partial	thin	/ /1997	no		roadside piles	10/ /1999	120
Pinnacle	Lassen	35	WHMCM	partial	thin	/ /1997	no		roadside piles	10/ /1999	1
Pinnacle	Lassen	37	WHMCM	partial	sanitation	/ /1997	no		roadside piles	10/ /1999	40
Pinnacle	Lassen	38	WHMCM	partial	sanitation	/ /1997	no		roadside piles	10/ /1999	23
Pinnacle	Lassen	40	WHMCM	partial	thin	/ /1997	no		roadside piles	10/ /1999	7

Pinnacle	Lassen	43	WHMCM	partial	thin	/ /1997	no		roadside piles	10/ /1999	30
Pinnacle	Lassen	45	WHMCM	partial	thin	/ /1997	no		roadside piles	10/ /1999	4
Red Mountain	Plumas	17	WHMCM	partial	thin		no				100
Red Mountain	Plumas	18	WHMCM	partial	thin		no				21
Red Mountain	Plumas	21	WHMCM	partial	thin	10/ /2000	no				31
Red Mountain	Plumas	23	WHMCM	partial	thin		no				8
Red Mountain	Plumas	26	WHMCM	partial	thin		yes	before			83
Red Mountain	Plumas	75	RF	partial	thin		no				11
Red Mountain	Plumas	76	RF	partial	thin		no				19
Red Mountain	Plumas	77	RF	partial	thin	10/ /1999	no				49
Red Mountain	Plumas	79	RF	partial	thin		no				37
Red Mountain	Plumas	80	WHMCM	partial	thin	10/ /2000	no				39
Red Mountain	Plumas	81	WHMCM	partial	thin		no				10
Red Mountain	Plumas	83	WHMCM	partial	thin		no				12
Red Mountain	Plumas	84	RF	partial	thin		no				13
Red Mountain	Plumas	89	RF	treated	thin	10/ /2000	no				6
Red Mountain	Plumas	91	WHMCM	treated	thin	10/ /2000	yes	before			7
Red Mountain	Plumas	300	WHMCD	treated	thin	10/ /1999	no				8
Red Mountain	Plumas	303	WHMCM	partial	thin		no				52
Red Mountain	Plumas	307	WHMCD	partial	thin		no				4
Red Mountain	Plumas	331	WHMCM	partial	thin		no				5
Red Mountain	Plumas	334	RF	partial	thin		yes	before			36
Red Mountain	Plumas	446	WHMCD	treated	thin	11/ /1999	no				14
Red Mountain	Plumas	478	WHMCD	treated	thin	10/ /1999	no				30
Red Mountain	Plumas	3891	RF	partial	thin		no				5
Reference 1		12	WHMCD	not treat	reference		yes	before			
Reference 1		27	WMCM	not treat	reference		yes	before			
Reference 2		9	TEWF	not treat	reference		yes	before			
Reference 2		11	TEWF	not treat	reference		yes	before			
Reference 2		13	TEWF	not treat	reference		yes	before			
Reference 2		15	TMCD	not treat	reference		yes	before			
Reference 2		16	EYPM	not treat	reference		yes	before			
Reference 2		18	TMCM	not treat	reference		yes	before			
Reference 2		21	TEYP	not treat	reference		yes	before			

Reference 3		1	TEWF	not treat	reference		yes	before			
Reference 3		2	TEYP	not treat	reference		yes	before			
Reference 3		3	TEWF	not treat	reference		yes	before			
Reference 3		20	EYPD	not treat	reference		yes	before			
Reference 3		31	TEWF	not treat	reference		yes	before			
Reference 3		32	EYPM	not treat	reference		yes	before			
Reference 3		33	EYPM	not treat	reference		yes	before			
Reference 4		1	WMCD	not treat	reference		yes	before			
Reference 4		2	TMCD	not treat	reference		yes	before			
Reference 4		3	TMCD	not treat	reference		yes	before			
Reference 4		4	TMCM	not treat	reference		yes	before			
Reference 4		5	WMCM	not treat	reference		yes	before			
Reference 4		6	WMCM	not treat	reference		yes	before			
Reference 4		8	WMCD	not treat	reference		yes	before			
Reference 4		9	WHMCM	not treat	reference		yes	before			
Reference 4		10	WHMCM	not treat	reference		yes	before			
Reference 4		11	TMCM	not treat	reference		yes	before			
Reference 5		1	EYPM	not treat	reference		yes	before			
Reference 5		2	EYPM	not treat	reference		yes	before			
Reference 5		3	EYPD	not treat	reference		yes	before			
Reference 5		4	EYPM	not treat	reference		yes	before			
Reference 5		5	WMCM	not treat	reference		yes	before			
Reference 5		6	TEWF	not treat	reference		yes	before			
Reference 5		7	RF	not treat	reference		yes	before			
Reference 5		8	LP	not treat	reference		yes	before			
Reference 5		9	TEYP	not treat	reference		yes	before			
Reference 5		10	TEYP	not treat	reference		yes	before			
Reference 5		11	TMCD	not treat	reference		yes	before			
Reference 5		12	TEYP	not treat	reference		yes	before			
Reference 5		13	TEYP	not treat	reference		yes	before			
Reference 5		14	WMCD	not treat	reference		yes	before			
Reference 5		15	TEWF	not treat	reference		yes	before			
Reference 5		16	WMCM	not treat	reference		yes	before			

Reference 5		17	LP	not treat	reference		yes	before			
Reference 5		18	LP	not treat	reference		yes	before			
Reference 5		19	WHMCD	not treat	reference		yes	before			
Reference 5		21	WHMCD	not treat	reference		yes	before			
Reference 5		22	WMCM	not treat	reference		yes	before			
Reference 5		23	WMCM	not treat	reference		yes	before			
Reference 5		24	WHMCM	not treat	reference		yes	before			
Reference 5		25	WMCD	not treat	reference		yes	before			
Reference 5		26	WHMCD	not treat	reference		yes	before			
Reference 5		27	TMCD	not treat	reference		yes	before			
Reference 5		28	WHMCM	not treat	reference		yes	before			
Reference 5		29	TMCM	not treat	reference		yes	before			
Reference 5		30	WMCM	not treat	reference		yes	before			
Robinson	Plumas	110	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	59
Robinson	Plumas	111	RF	treated	thin	9/ /1999	no		pile and burn	10/ /1999	9
Robinson	Plumas	112	RF	treated	thin	9/ /1999	no		pile and burn	10/ /1999	7
Robinson	Plumas	113	WHMCM	treated	thin	9/ /1999	no		pile and burn	10/ /1999	7
Robinson	Plumas	114	RF	treated	thin	9/ /1999	no		pile and burn	10/ /1999	13
Robinson	Plumas	115	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	25
Robinson	Plumas	116	WHMCM	treated	thin	8/ /1999	no		pile and burn	10/ /1999	28
Robinson	Plumas	117	WHMCM	treated	thin	7/ /1999	no		pile and burn	10/ /1999	35
Robinson	Plumas	118	WHMCM	treated	thin	7/ /1999	no		pile and burn	10/ /1999	16
Robinson	Plumas	120	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	29
Robinson	Plumas	121	RF	treated	thin	6/ /1999	no		pile and burn	10/ /1999	12
Robinson	Plumas	122	WHMCM	treated	thin	9/ /1999	no		pile and burn	10/ /1999	25
Robinson	Plumas	200	WHMCM	treated	thin	6/ /1999	yes	before	pile and burn	10/ /1999	22
Robinson	Plumas	201	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	19
Robinson	Plumas	202	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	28
Robinson	Plumas	1131	WHMCM	treated	thin	9/ /1999	no		pile and burn	10/ /1999	10
Robinson	Plumas	1141	RF	treated	thin	9/ /1999	no		pile and burn	10/ /1999	16
Robinson	Plumas	1151	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	5
Robinson	Plumas	1152	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	7
Robinson	Plumas	1161	WHMCM	treated	thin	8/ /1999	no		pile and burn	10/ /1999	3
Robinson	Plumas	1162	WHMCM	treated	thin	8/ /1999	no		pile and burn	10/ /1999	14

Robinson	Plumas	1181	WHMCM	treated	thin	7/ /1999	no		pile and burn	10/ /1999	2
Robinson	Plumas	1182	WHMCM	treated	thin	7/ /1999	no		pile and burn	10/ /1999	4
Robinson	Plumas	2001	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	5
Robinson	Plumas	2021	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	8
Robinson	Plumas	2022	WHMCM	treated	thin	6/ /1999	no		pile and burn	10/ /1999	5
Rock Island	Plumas	35	WMCD	partial	thin		no				9
Rock Island	Plumas	36	WHMCM	partial	thin		no				9
Rock Island	Plumas	49	WHMCM	treated	thin	7/ /1999	no				8
Rock Island	Plumas	51	WHMCM	treated	thin	10/ /1999	no				10
Rock Island	Plumas	56	WHMCM	treated	thin	12/ /2000	no				31
Rock Island	Plumas	60	WHMCM	treated	thin	8/ /1999	no				23
Rock Island	Plumas	62	WHMCM	partial	thin		no				53
Rock Island	Plumas	65	WHMCM	treated	thin	8/ /1999	no				25
Rock Island	Plumas	66	WHMCM	treated	thin	8/ /1999	no				31
Rock Island	Plumas	68	WHMCM	treated	thin	8/ /1999	no				6
Rock Island	Plumas	69	WHMCM	treated	thin	8/ /1999	no				11
Rock Island	Plumas	71	WHMCM	partial	thin	1/ /2001	yes	before			25
Rock Island	Plumas	72	WHMCM	partial	thin	1/ /2001	no				35
Rock Island	Plumas	73	WHMCM	treated	thin	9/ /1999	no				9
Rock Island	Plumas	74	WHMCM	treated	thin	8/ /1999	no				30
Rock Island	Plumas	75	WHMCM	treated	thin	8/ /1999	yes	after			59
Rock Island	Plumas	76	WHMCM	partial	thin	1/ /2001	no				18
Rock Island	Plumas	77	WHMCM	treated	thin	7/ /1999	no				43
Rock Island	Plumas	79	WHMCM	treated	thin	8/ /1999	no				16
Rock Island	Plumas	80	WHMCM	partial	thin	1/ /2001	no				33
Rock Island	Plumas	81	WHMCM	partial	thin	1/ /2001	no				22
Rock Island	Plumas	82	WHMCM	partial	thin	1/ /2001	no				25
Rock Island	Plumas	83	WHMCD	partial	thin	1/ /2001	no				21
RT Thinning	Plumas	68	EYPD	treated	precom thin	10/ /1999	no				10
RT Thinning	Plumas	69	EYPM	treated	precom thin	10/ /1999	no				7
RT Thinning	Plumas	70	EYPM	treated	precom thin	10/ /1999	no				22
RT Thinning	Plumas	71	EYPM	treated	precom thin	10/ /1999	yes	before			20
RT Thinning	Plumas	73	EYPM	treated	precom thin	10/ /1999	no				27

RT Thinning	Plumas	74	EYPM	treated	precom thin	10/ /1999	no				53
RT Thinning	Plumas	75	EYPM	treated	precom thin	10/ /1999	yes	before			36
RT Thinning	Plumas	76	EYPM	treated	precom thin	10/ /1999	yes	before			14
Ruffa	Lassen	18		treated	thin	/ /1992	no				4
Ruffa	Lassen	28	WHMCM	treated	sanitation	7/ /1998	yes	after			13
Ruffa	Lassen	30	WHMCM	treated	sanitation	8/24/1998	yes	after			15
Ruffa	Lassen	33		treated	sanitation	/ /1998	no				21
Ruffa	Lassen	41	WHMCM	treated	sanitation	8/24/1998	no				6
Ruffa	Lassen	57		treated	sanitation	/ /1998	no				8
Ruffa	Lassen	84	WHMCD	treated	sanitation	7/ /1998	yes	after			111
Ruffa	Lassen	85		treated	sanitation	/ /1992	no				4
Ruffa	Lassen	109	WHMCM	treated	thin	/ /1999	no				5
Ruffa	Lassen	111	WHMCM	treated	precom thin	/ /1999	yes	before			23
Ruffa	Lassen	119	WHMCM	treated	thin	/ /1995	no				34
Ruffa	Lassen	123	WHMCD	treated	thin	/ /1996	yes	after			58
Ruffa	Lassen	124	WHMCM	treated	precom thin	11/19/199	no				31
Ruffa	Lassen	127	WHMCD	treated	sanitation	8/26/1998	no				125
Ruffa	Lassen	129	WHMCM	treated	sanitation	8/26/1998	no				15
Ruffa	Lassen	130	WHMCM	treated	thin	8/26/1998	no				27
Ruffa	Lassen	132	WHMCM	treated	precom thin	9/23/1998	no				25
Ruffa	Lassen	134	WHMCM	treated	sanitation	8/24/1998	no				23
Ruffa	Lassen	153	RF	treated	sanitation	8/ /1998	yes	after			49
Ruffa	Lassen	164	WHMCM	treated	thin	/ /1998	no				26
Ruffa	Lassen	187		treated	thin	/ /1998	no				19
Ruffa	Lassen	227		treated	sanitation	/ /1999	no				29
Ruffa	Lassen	264		treated	thin	/ /1998	no				4
Ruffa	Lassen	831	WHMCM	treated	sanitation	/ /1998	no				4
Ruffa	Lassen	832		treated	sanitation	/ /1998	no				10
Ruffa	Lassen	871	WHMCM	treated	thin	/ /1999	no				5
Ruffa	Lassen	872		treated	thin	/ /1998	no				28
Sardine Valley	Tahoe	1	EYPD	treated	prescribe burn	10/ /1996	yes	after			72
Sardine Valley	Tahoe	2	EYPD	treated	prescribe burn	/ /1996	no				104
Sardine Valley	Tahoe	3	EYPD	treated	prescribe burn	/ /1996	no				90
Sardine Valley	Tahoe	4	EYPD	treated	prescribe burn	/ /1996	no				81

Scenic	Lassen	1	WMCD	treated	thin	10/7/1998	no		roadside piles	10/ /1999	51
Scenic	Lassen	6		treated	thin	/ /1998	no				4
Scenic	Lassen	8		treated	thin	/ /1998	no				3
Scenic	Lassen	9	WMCM	treated	thin	36097	no		roadside piles	10/ /1999	5
Scenic	Lassen	10	WHMCM	treated	thin	7/ /1998	yes	after	roadside piles	10/ /1999	6
Scenic	Lassen	11	WMCD	treated	thin	11/4/1998	no		roadside piles	10/ /1999	28
Scenic	Lassen	12	WMCD	treated	thin	11/4/1998	no		roadside piles	10/ /1999	23
Scenic	Lassen	13	WMCD	treated	thin	11/4/1998	no		roadside piles	10/ /1999	53
Scenic	Lassen	16	WMCD	treated	thin	10/22/199	no		roadside piles	10/ /1999	34
Scenic	Lassen	23		treated	thin	/ /1998	no				7
Scenic	Lassen	25	WHMCM	treated	thin	10/20/199	no		roadside piles	10/ /1999	20
Scenic	Lassen	33	WHMCM	treated	thin	10/20/199	no		roadside piles	10/ /1999	19
Scenic	Lassen	37	WHMCM	treated	thin	10/20/199	no		roadside piles	10/ /1999	17
Scenic	Lassen	38	WHMCM	treated	thin	10/20/199	no		roadside piles	10/ /1999	13
Scenic	Lassen	46	WMCD	treated	thin	8/12/1998	no		roadside piles	10/ /1999	3
Scenic	Lassen	61	TMCM	treated	thin	6/ /1998	yes	after	roadside piles	10/ /1999	22
Scenic	Lassen	63	TMCM	treated	thin	8/14/1998	no		roadside piles	10/ /1999	38
Scenic	Lassen	67	TMCM	treated	sanitation	8/14/1998	no		roadside piles	10/ /1999	84
Scenic	Lassen	74		treated	thin	/ /1998	no				15
Scenic	Lassen	77		treated	thin	/ /1998	no				6
Scenic	Lassen	81	TMCM	treated	thin	8/14/1998	no		roadside piles	10/ /1999	32
Scenic	Lassen	82	TMCM	treated	thin	8/14/1998	no		roadside piles	10/ /1999	7
Scenic	Lassen	94	TMCM	treated	thin	8/14/1998	no		roadside piles	10/ /1999	28
Scenic	Lassen	96	TMCM	treated	thin	11/1/1998	no		roadside piles	10/ /1999	11
Scenic	Lassen	101		treated	sanitation	/ /1987	no				4
Scenic	Lassen	117	WMCM	treated	thin	8/14/1998	no		roadside piles	10/ /1999	12
Scenic	Lassen	121	TMCM	treated	thin	9/ /1998	yes	after	roadside piles	10/ /1999	16
Scenic	Lassen	122	TMCM	treated	thin	10/20/199	no		roadside piles	10/ /1999	30
Scenic	Lassen	123	TMCM	treated	thin	7/ /1998	yes	after	roadside piles	10/ /1999	8
Shanghai	Lassen	7	RF	treated	sanitation	10/11/1990	no		roadside piles	10/ /1999	24
Shanghai	Lassen	27		treated	thin	/ /1987	no		roadside piles	10/ /1999	10
Shanghai	Lassen	28	WHMCD	treated	sanitation	/ /1998	no		roadside piles	10/ /1999	31
Shanghai	Lassen	29	RF	treated	thin	10/31/1990	no		roadside piles	10/ /1999	27

Shanghai	Lassen	33	WHMCD	treated	thin	10/15/1990	no		roadside piles	10/ /1999	31
Shanghai	Lassen	59	RF	treated	thin	9/ /1998	no		roadside piles	10/ /1999	4
Shanghai	Lassen	60		treated	sanitation	/ /1987	no		roadside piles	10/ /1999	56
Shanghai	Lassen	69		treated	sanitation	/ /1995	no		roadside piles	10/ /1999	55
Shanghai	Lassen	112	RF	treated	sanitation	10/17/1990	no		roadside piles	10/ /1999	45
Shanghai	Lassen	321	RF	treated	thin	10/15/1990	no		roadside piles	10/ /1999	16
Shanghai	Lassen	322		treated	thin	/ /1995	no		roadside piles	10/ /1999	3
Shanghai	Lassen	471	WHMCD	treated	thin	10/11/1990	no		roadside piles	10/ /1999	1
Shanghai	Lassen	472		treated	sanitation	/ /1999	no		roadside piles	10/ /1999	1
Shanghai	Lassen	721	WHMCD	treated	thin	9/ /1998	no		roadside piles	10/ /1999	20
Shanghai	Lassen	722		treated	thin	/ /1995	no		roadside piles	10/ /1999	12
Sherman	Plumas	1	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	17
Sherman	Plumas	2	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	8
Sherman	Plumas	3	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	14
Sherman	Plumas	4	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	5
Sherman	Plumas	7	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	25
Sherman	Plumas	8	WMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	4
Sherman	Plumas	9	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	8
Sherman	Plumas	10	WHMCM	treated	biomass	10/ /1997	no		machine piles	11/ /1996	14
Sherman	Plumas	12	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	21
Sherman	Plumas	13	WHMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	7
Sherman	Plumas	14	WHMCM	treated	biomass	10/ /1997	no		machine piles	11/ /1996	17
Sherman	Plumas	15	WHMCM	treated	biomass	10/ /1997	no		machine piles	11/ /1996	29
Sherman	Plumas	16	WHMCM	treated	biomass	10/ /1997	no		machine piles	11/ /1996	13
Sherman	Plumas	17	WHMCM	treated	biomass	10/ /1997	no		machine piles	11/ /1996	18
Sherman	Plumas	18	WMCD	treated	biomass	10/ /1997	no		machine piles	11/ /1996	9
Sherman	Plumas	19	WMCD	treated	biomass	10/ /1997	yes	after	machine piles	11/ /1996	12
Sherman	Plumas	20	WMCD	treated	biomass	10/ /1997	yes	after	machine piles	11/ /1996	9
Sherman	Plumas	21	WHMCD	treated	biomass	10/ /1997	yes	after	machine piles	11/ /1996	17
Spanish	Plumas	1		treated	precom thin	7/ /1998	no				171
Spike	Plumas	9	TEYP	treated	thin	9/ /1999	yes	before			64
Spike	Plumas	10	EYPD	treated	thin	9/ /1999	no				25
Spike	Plumas	11	EYPD	treated	thin	9/ /1999	no				33
Spike	Plumas	12	EYPD	treated	thin	9/ /1999	no				7

Spike	Plumas	22	EYPD	treated	thin	9/ /1999	no				84
Spike	Plumas	31	TEYP	treated	thin	9/ /1999	no		prescribed	1986	156
Spike	Plumas	32	EYPD	treated	thin	9/ /1999	no				59
Spike	Plumas	33	TEYP	treated	thin	9/ /1999	yes	before			176
Spike	Plumas	34	TEYP	treated	thin	9/ /1999	no				76
Spike	Plumas	35	TEYP	treated	thin	9/ /1999	no				52
Spike	Plumas	36	TEYP	treated	thin	9/ /1999	no				24
Spike	Plumas	37	EYPD	treated	thin	9/ /1999	no				63
Spike	Plumas	38	EYPD	treated	thin	9/ /1999	no				142
Spike	Plumas	39	EYPD	treated	thin	9/ /1999	no				25
Spike	Plumas	40	TEYP	treated	thin	9/ /1999	no				61
Summit	Tahoe	1	EYPM	partial	thin		no				68
Summit	Tahoe	2	EYPM	treated	thin	12/ /1999	no				62
Summit	Tahoe	3	EYPD	treated	thin	12/ /2000	no				101
Summit	Tahoe	4	EYPD	treated	thin	12/ /2000	no				39
Summit	Tahoe	6	EYPD	treated	thin	12/ /1999	yes	before			43
Summit	Tahoe	7	EYPM	treated	thin	7/ /2000	no				32
Summit	Tahoe	8	EYPD	treated	thin	12/ /2000	no				60
Summit	Tahoe	9	EYPD	treated	thin	3/ /1999	no				13
Summit	Tahoe	10	EYPD	treated	thin	12/ /2000	no				34
Summit	Tahoe	11	EYPD	treated	thin	12/ /2000	no				10
Summit	Tahoe	12	EYPD	partial	thin		no				15
Summit	Tahoe	13	EYPD	treated	thin	8/ /1999	no				20
Summit	Tahoe	14	EYPD	treated	thin	2/ /1998	no				21
Summit	Tahoe	15	EYPM	treated	thin	3/ /1998	no				41
Summit	Tahoe	16	EYPD	treated	thin	1/ /2000	yes	before			40
Summit	Tahoe	17	EYPM	treated	thin	7/ /2000	no				50
Summit	Tahoe	18	TEWF	treated	thin	12/ /2000	no				85
Summit	Tahoe	19	TEWF	treated	thin	9/ /1999	no				27
Summit	Tahoe	20	EYPM	treated	thin	9/ /1999	no				36
Summit	Tahoe	21	EYPM	treated	thin	7/ /2000	no			10/ /2000	39
Tamarack	Lassen	1	EYPM	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	265
Tamarack	Lassen	2	EYPM	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	70

Tamarack	Lassen	7	EYPM	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	206
Tamarack	Lassen	10	EYPM	treated	precom thin	9/ /1996	no		prescribed	10/ /1998	230
Tamarack	Lassen	17	EYPM	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	127
Tamarack	Lassen	18	EYPM	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	43
Tamarack	Lassen	19	EYPM	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	264
Tamarack	Lassen	27		treated	precom thin	8/ /1996	no				10
Tamarack	Lassen	261	TEWF	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	9
Tamarack	Lassen	263	TEWF	treated	precom thin	8/ /1986	no		roadside piles	10/ /1998	29
Tamarack	Lassen	264	TEWF	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	14
Tamarack	Lassen	265	TEWF	treated	precom thin	9/ /1996	no		roadside piles	10/ /1998	17
Vision	Lassen	17	TMCD	treated	thin	7/ /1994	yes	after	roadside piles	10/ /1996	23
Vision	Lassen	39	WMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	8
Vision	Lassen	44	WMCD	treated	thin	7/ /1994	yes	after	roadside piles	10/ /1996	23
Vision	Lassen	56	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	19
Vision	Lassen	57	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	27
Vision	Lassen	59	TMCD	treated	thin	/ /1994	no				17
Vision	Lassen	60	TMCD	treated	sanitation	/ /1994	no		roadside piles	10/ /1996	15
Vision	Lassen	64	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	35
Vision	Lassen	66	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	45
Vision	Lassen	68	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	25
Vision	Lassen	71	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	5
Vision	Lassen	72	TMCD	treated	sanitation	4/ /1994	yes	after	roadside piles	10/ /1996	25
Vision	Lassen	73	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	21
Vision	Lassen	80	TMCD	treated	thin	10/ /1994	yes	after	roadside piles	10/ /1996	17
Vision	Lassen	86	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	55
Vision	Lassen	87	TMCD	treated	thin	/ /1994	no				29
Vision	Lassen	88	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	15
Vision	Lassen	90	TMCD	treated	sanitation	7/ /1994	yes	after	roadside piles	10/ /1996	20
Vision	Lassen	91	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	6
Vision	Lassen	95	TMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	15
Vision	Lassen	114	WMCD	treated	thin	/ /1994	no		roadside piles	10/ /1996	19
Wadozzle	Plumas	73	EYPM	treated	biomass	7/ /1996	no				59
Wadozzle	Plumas	76	EYPM	treated	biomass	7/ /1996	no				76
Wadozzle	Plumas	77	EYPM	treated	biomass	7/ /1996	no				10

Wadozzle	Plumas	78	EYPM	treated	biomass	7/ /1996	no				21
Wadozzle	Plumas	79	EYPM	treated	biomass	7/ /1996	no				42
Wadozzle	Plumas	80	EYPM	treated	biomass	7/ /1996	no				68
Wadozzle	Plumas	81	EYPD	treated	biomass	7/ /1996	no				29
West Dusty	Lassen	3	WHMCD	treated	thin	/ /1999	no				34
West Dusty	Lassen	8	WHMCD	treated	thin	/ /1998	no				41
West Dusty	Lassen	9	WHMCD	treated	thin	/ /1998	no				16
West Dusty	Lassen	14	WHMCD	treated	thin	/ /1987	no				45
West Dusty	Lassen	15	WHMCD	treated	thin	/ /1994	no				34
West Dusty	Lassen	18	LP	treated	thin	/ /1999	no				33
West Dusty	Lassen	23	WHMCD	treated	thin	/ /2000	no				23
West Dusty	Lassen	24	WHMCD	treated	thin	/ /1999	no				20
West Dusty	Lassen	25	WHMCD	treated	thin	/ /1999	no				15
West Dusty	Lassen	26	WHMCD	treated	thin	/ /1999	no				29
West Dusty	Lassen	27	WHMCD	treated	sanitation	/ /1996	no				74
West Dusty	Lassen	32	LP	treated	thin	/ /1998	no				21
West Dusty	Lassen	38	WHMCM	treated	thin	/ /1994	no				37
West Dusty	Lassen	44	WHMCM	treated	thin	/ /1994	no				55
West Dusty	Lassen	49	WHMCD	treated	thin	/ /1997	no				12
West Dusty	Lassen	50	WHMCD	treated	thin	/ /1994	no				7
West Dusty	Lassen	51	WHMCD	treated	sanitation	/ /1997	no				46
West Dusty	Lassen	52	WHMCM	treated	thin	/ /1998	no				24
West Dusty	Lassen	53	WHMCD	treated	thin	/ /1998	no				65
West Dusty	Lassen	55	LP	treated	thin	10/ /1999	yes	before			9
West Dusty	Lassen	59	WHMCD	treated	thin	7/ /2000	yes	before			34
West Dusty	Lassen	60	WHMCM	not treat	thin		no				33
West Dusty	Lassen	62	WHMCD	treated	thin	/ /1999	no				36
West Dusty	Lassen	63	WHMCD	treated	thin	/ /1999	no				42
West Dusty	Lassen	64	WHMCD	not treat	thin		no				72
West Dusty	Lassen	67	WHMCM	treated	thin	/ /2001	no				36
West Dusty	Lassen	70	WHMCD	not treat	sanitation		no				4
West Dusty	Lassen	73	WHMCD	treated	thin	/ /2000	no				43
West Dusty	Lassen	74	WHMCD	treated	thin	/ /1997	no				8

West Dusty	Lassen	75	WHMCM	treated	thin	/ /1999	no				49
West Dusty	Lassen	76	WHMCD	treated	thin	/ /1997	no				31
West Dusty	Lassen	77	WHMCD	treated	thin	/ /1998	no				10
West Dusty	Lassen	78	WHMCM	treated	thin	/ /1996	no				58
West Dusty	Lassen	79	WHMCM	not treat	thin		no				16
West Dusty	Lassen	80		not treat	thin		no				33
West Dusty	Lassen	81	WHMCD	not treat	thin		yes	before			47
West Dusty	Lassen	82	WHMCM	not treat	thin		no				15
West Dusty	Lassen	91	WHMCD	not treat	thin		no				56
West Dusty	Lassen	92	WHMCD	treated	thin	5/ /2001	yes	before			19
West Dusty	Lassen	95	WHMCD	treated	thin	/ /1994	no				25
West Dusty	Lassen	112	WHMCM	not treat	thin		no				8
West Dusty	Lassen	113		treated	sanitation	/ /1996	no				8
West Dusty	Lassen	146		treated	sanitation	/ /1997	no				64
West Dusty	Lassen	147		treated	sanitation	/ /1996	no				20
West Dusty	Lassen	152		not treat	thin		no				23
West Dusty	Lassen	153		treated	thin	/ /1998	no				16
West Dusty	Lassen	157		treated	thin	/ /1998	no				11
West Dusty	Lassen	160		treated	sanitation	/ /1997	no				6
West Dusty	Lassen	222	WHMCM	not treat	thin		no				37
West Dusty	Lassen	239	WHMCM	treated	thin	/ /1996	no				23
West Dusty	Lassen	242	WHMCM	treated	thin	/ /1997	no				42
West Dusty	Lassen	253	WHMCD	not treat	sanitation		no				21
West Dusty	Lassen	257	WHMCD	not treat	sanitation		no				9
West Dusty	Lassen	265	WHMCM	treated	thin	/ /2000	no				28
West Dusty	Lassen	267	WHMCD	not treat	sanitation	/ /1996	no				44
West Dusty	Lassen	270		treated	thin	/ /1996	no				72
West Dusty	Lassen	272		treated	thin	/ /1994	no				7
West Dusty	Lassen	275		treated	thin	/ /1994	no				56
West Dusty	Lassen	282		treated	thin	/ /1998	no				8
West Dusty	Lassen	502		treated	thin	/ /1998	no				14
West Dusty	Lassen	731		treated	thin	/ /1994	no				3
West Dusty	Lassen	732		treated	thin	/ /1996	no				12
West Dusty	Lassen	2461	WHMCD	treated	thin	7/ /2000	no				25

West Dusty	Lassen	2462	WHMCD	treated	thin	7/ /2000	yes	before			32
West Dusty	Lassen	2463	WHMCD	treated	thin	7/ /2000	no				7
Westside	Plumas	110	EYPM	treated	biomass	5/ /1997	no				5
Westside	Plumas	111	EYPM	treated	biomass	5/ /1997	no				135
Westside	Plumas	112	EYPM	treated	biomass	5/ /1997	no				22
Westside Bio #9	Plumas	9301	WMCD	treated	precom thin	6/ /1997	no		pile and burn	1998	12
Westside Bio #9	Plumas	9302	WMCD	treated	precom thin	6/ /1997	no		pile and burn	1998	14
Westside Bio #9	Plumas	9303	WMCD	treated	precom thin	7/ /1997	no		pile and burn	1998	6
Westside Bio #9	Plumas	9304	WMCD	treated	precom thin	8/ /1997	no		pile and burn	1998	11
Westside Bio #9	Plumas	9305	WMCD	treated	precom thin	7/ /1997	no		pile and burn	1998	7
Westside Bio #9	Plumas	9306	WMCD	treated	precom thin	7/ /1997	no		pile and burn	1998	7
Westside Bio #9	Plumas	9308	WMCD	treated	precom thin	7/ /1998	no		pile and burn	1998	38
Westside Bio #9	Plumas	9309	WMCD	treated	precom thin	9/ /1997	no		pile and burn	1998	9
Westside Bio #9	Plumas	9310	WMCD	treated	precom thin	10/ /1997	no		pile and burn	1998	12
Westside Bio #9	Plumas	9311	WMCD	treated	precom thin	9/ /1998	no		pile and burn	1998	11
Wheel	Lassen	10	WHMCM	treated	thin	12/ /1997	yes	after			120
Wheel	Lassen	11		treated	thin	12/ /1999	no				82
Wheel	Lassen	12	WHMCM	partial	thin		no				96
Wheel	Lassen	22	WHMCD	partial	thin		no				56
Wheel	Lassen	24	LP	partial	thin		no				111
Wheel	Lassen	25	WHMCM	partial	thin		no				82
Wheel	Lassen	26	WHMCM	treated	thin	11/ /1998	no				97
Willow	Lassen	1	WHMCD	treated	thin	/ /1996	no				102
Willow	Lassen	2	WHMCD	treated	thin	/ /1993	yes	after			100
Willow	Plumas	1	TEYP	treated	prescribe burn	5/ /1995	yes	after			66

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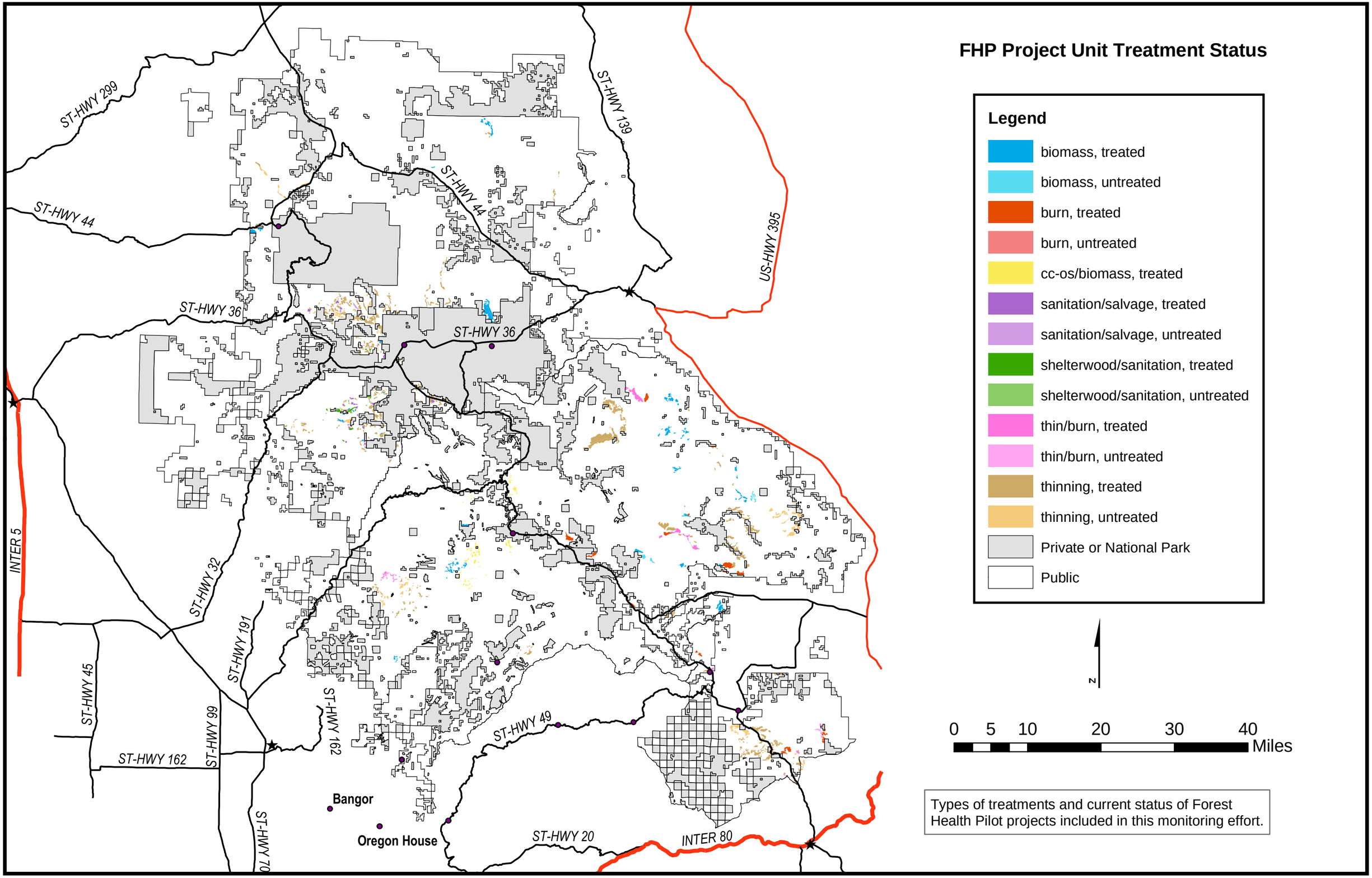
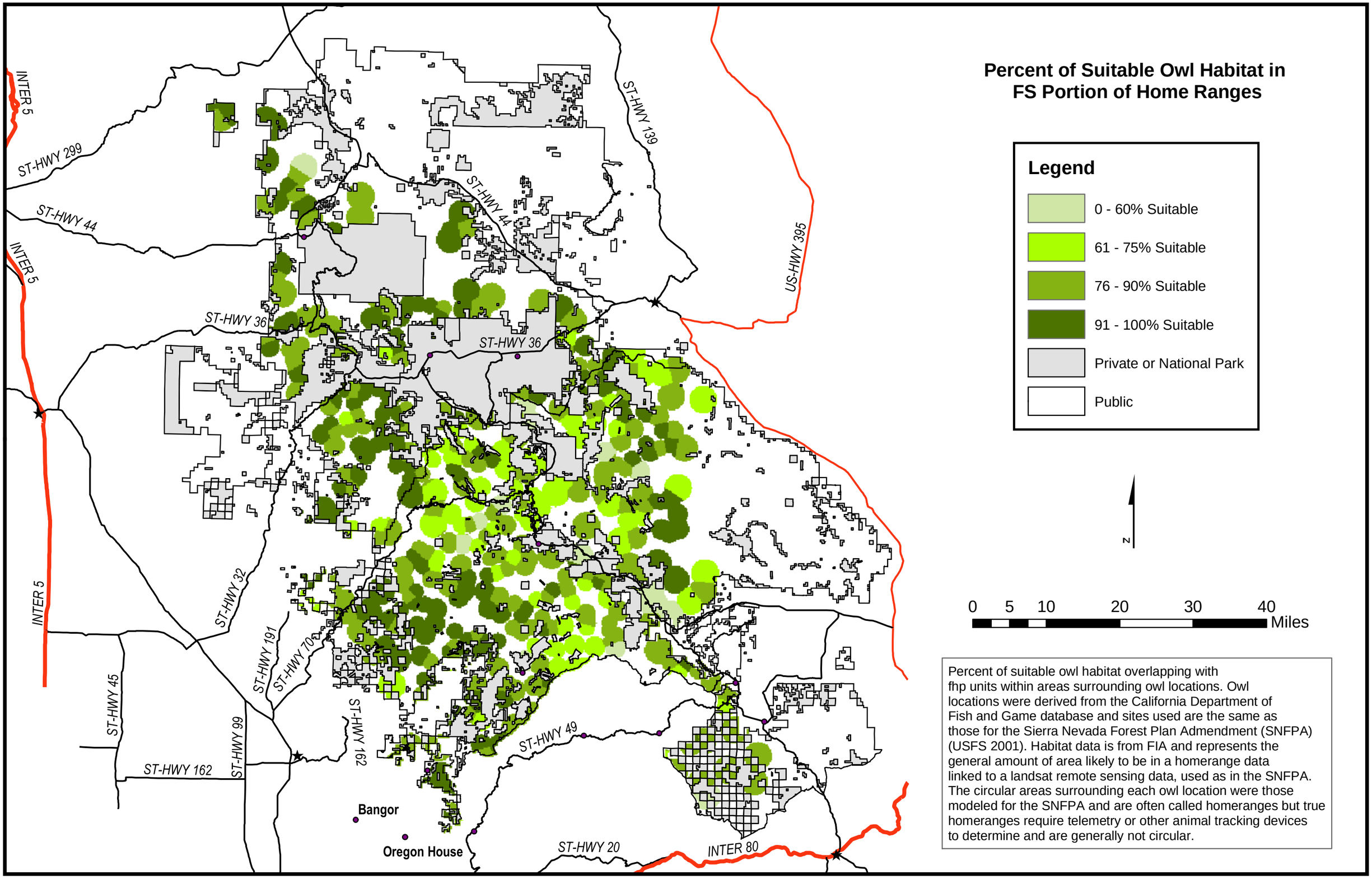
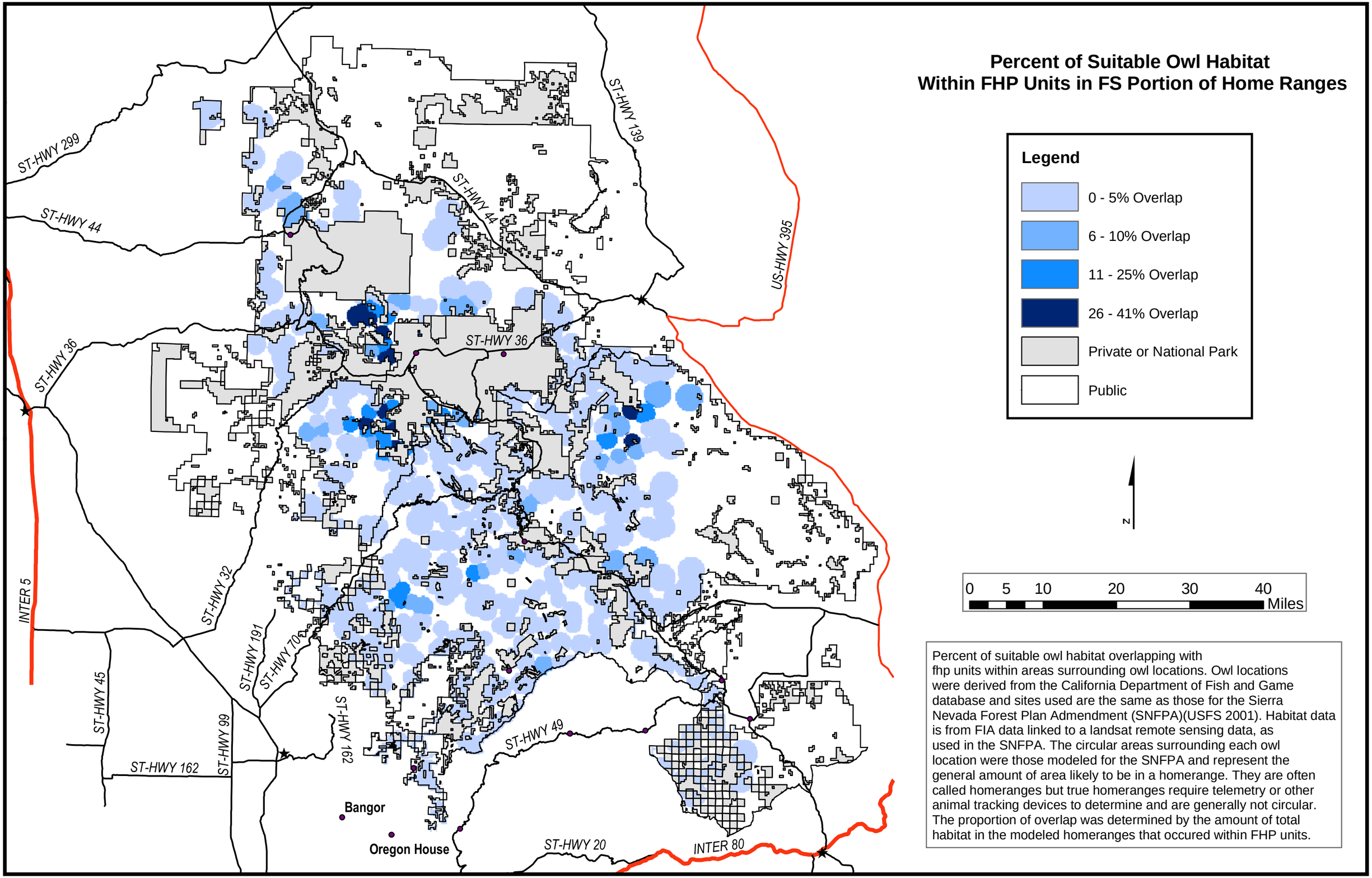
Appendix C. Maps

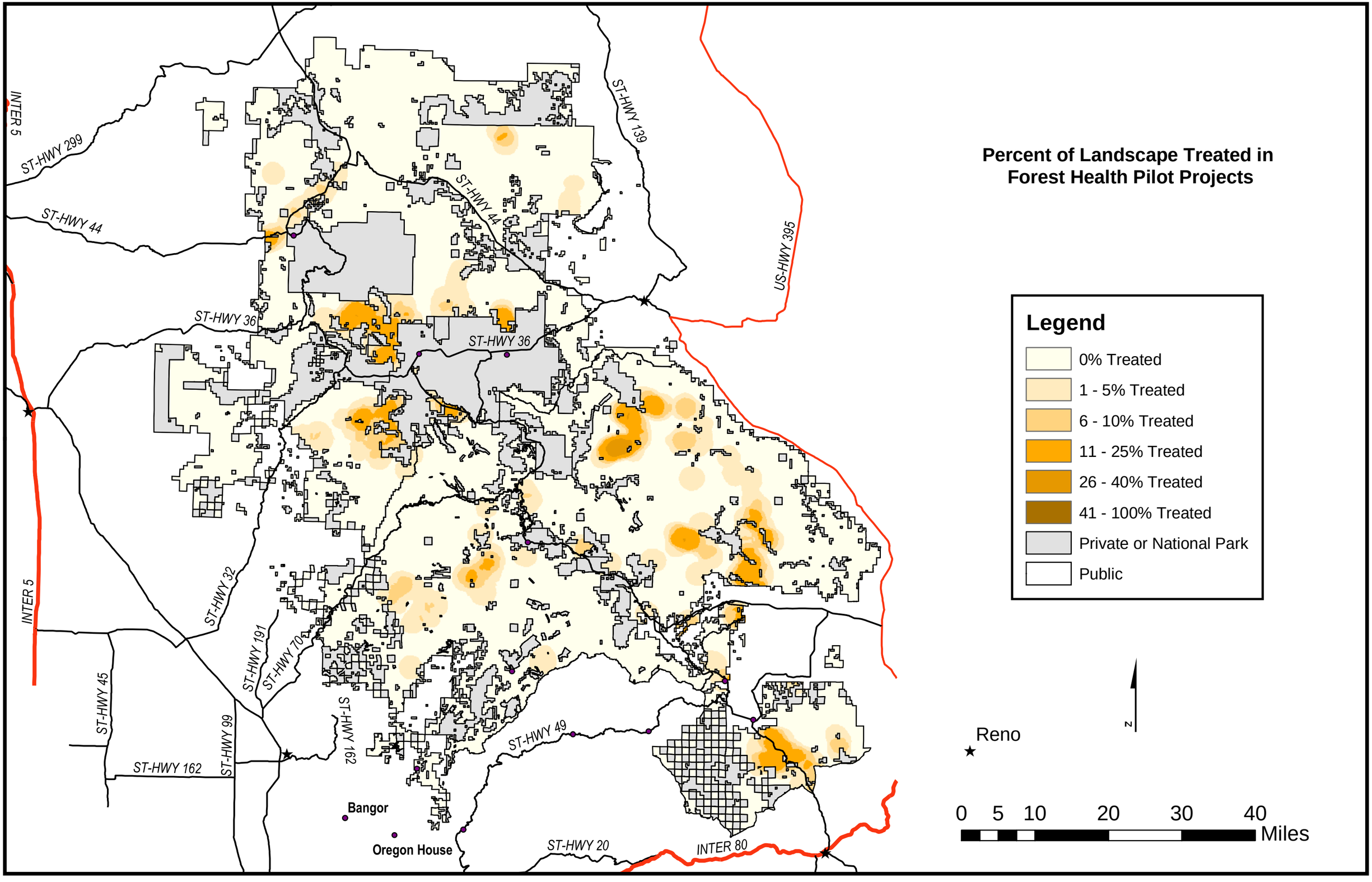

FHP Project Unit Treatment Status
Legend
biomass, treated
biomass, untreated
burn, treated
burn, untreated
cc-os/biomass, treated
sanitation/salvage, treated
sanitation/salvage, untreated
shelterwood/sanitation, treated
shelterwood/sanitation, untreated
thin/burn, treated
thin/burn, untreated
thinning, treated
thinning, untreated
Private or National Park
Public
N
0 5 10 20 30 40
Miles
Types of treatments and current status of Forest Health Pilot projects included in this monitoring effort.
ST-HWY 299
ST-HWY 44
ST-HWY 139
US-HWY 395
ST-HWY 36
INTER 5
ST-HWY 32
ST-HWY 191
ST-HWY 45
ST-HWY 99
ST-HWY 162
ST-HWY 70
Bangor
Oregon House
ST-HWY 49
ST-HWY 20
INTER 80



Percent of suitable owl habitat overlapping with fhp units within areas surrounding owl locations. Owl locations were derived from the California Department of Fish and Game database and sites used are the same as those for the Sierra Nevada Forest Plan Admendment (SNFPA) (USFS 2001). Habitat data is from FIA and represents the general amount of area likely to be in a homerange data linked to a landsat remote sensing data, used as in the SNFPA. The circular areas surrounding each owl location were those modeled for the SNFPA and are often called homeranges but true homeranges require telemetry or other animal tracking devices to determine and are generally not circular.



Percent of suitable owl habitat overlapping with fhp units within areas surrounding owl locations. Owl locations were derived from the California Department of Fish and Game database and sites used are the same as those for the Sierra Nevada Forest Plan Admendment (SNFPA)(USFS 2001). Habitat data is from FIA data linked to a landsat remote sensing data, as used in the SNFPA. The circular areas surrounding each owl location were those modeled for the SNFPA and represent the general amount of area likely to be in a homerange. They are often called homeranges but true homeranges require telemetry or other animal tracking devices to determine and are generally not circular. The proportion of overlap was determined by the amount of total habitat in the modeled homeranges that occured within FHP units.


Percent of Landscape Treated in
Forest Health Pilot Projects
Legend
0% Treated
1 - 5% Treated
6 - 10% Treated
11 - 25% Treated
26 - 40% Treated
41 - 100% Treated
Private or National Park
Public
INTER 5
ST-HWY 299
ST-HWY 44
ST-HWY 139
US-HWY 395
ST-HWY 36
ST-HWY 32
ST-HWY 191
ST-HWY 70
ST-HWY 45
ST-HWY 99
ST-HWY 162
ST-HWY 49
ST-HWY 20
INTER 80
Bangor
Oregon House
Reno
N
0 5 10 20 30 40
Miles

Eastside Prescribed Burn

p17u803a.jpg

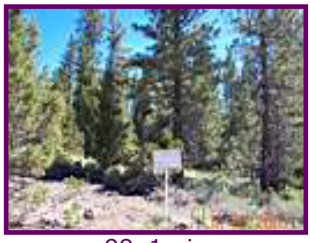
p17u803b.jpg

p17u803c.jpg

p74u1a.jpg

p74u1b.jpg

p74u1c.jpg


p99u1a.jpg

p99u1b.jpg

p99u1c.jpg

17-803
FHP 6-16-01
6. 16. 2001

17-803
FHP 6-16-01
6. 16. 2001

17-803
FHP 6-16-01
6. 16. 2001

FHP 74-2
06-27-03
SOUTH

FHP 74-1
06-17-01
WEST

FHP 74-2
06-27-03
NORTH

99-1
FHP 6 16 01
6. 16. 2001

99-1
FHP 6 16 01
6. 16. 2001

99-1
FHP 6160
6. 16. 2001

Eastside Thin

p1u153a.jpg

p1u153b.jpg

p1u153c.jpg

p61u55a.jpg

p61u55b.jpg

p61u55c.jpg

p63u33a.jpg

p63u33b.jpg

p63u9a.jpg

p63u9b.jpg

p66u11a.jpg

p66u11b.jpg

p66u11c.jpg

p72u1a.jpg

p72u1b.jpg

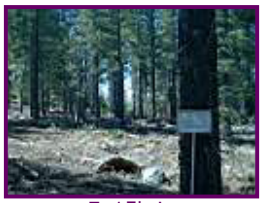
p72u1c.jpg

p72u3a.jpg

p72u3b.jpg

p72u3c.jpg

p7u15a.jpg


p7u15b.jpg

p7u15c.jpg

p7u6a.jpg

p7u6b.jpg

p7u6c.jpg

6. 17. 2001

F153
FHP6A-U
6. 17. 2001

6. 17. 2001

61-55
FHP 6-15-01
6. 15. 2001

61-55
FHP 6-15-01
6. 15. 2001

61-55
FHP 6-15-01
6. 15. 2001

63-33
FHP 6160
6. 16. 2001

63-33
FHP 6/16/01
6. 16. 2001

63-1
6. 16. 2001

63-9
6. 16. 2001

FHP 66-11
6/8/01
Looking South

SOUTH

FNP 72-2
EAST

WEST

FMP 72-3
6-17-02
WEST

FHP 72-3
6-17-02
SOUTH

FHP 72-3
6-17-02
EAST

FHP 7-15

FHP 7-15
6/6/01

F-P 7-15

FHP 7-6
6/16/01

FHP 7-6
6/16/01

EHP 7-6
6/12/01

Eastside Treated Thin & Burn

p62u34a.jpg

p62u34b.jpg

p65u10a.jpg

p65u10b.jpg

62-34
FHP 6-16-01
6. 16. 2001

62-34
FHP 6-16-01
6. 16. 2001

FHP 65-10
06-17-01
NORTH

FHP 65-10
06-17-01
WEST

Eastside Thin & Burn (Partially Treated)

p65u12a.jpg

p65u12b.jpg

p65u12c.jpg

FHP 65-12
08-17-01
EAST

FHP 65-12
06-17-01
NORTH

FHP 65-22
06-17-01
WEST

Eastside Biomass/Precommercial Thin

p4u308a.jpg

p4u308b.jpg

p4u308c.jpg

p83u1a.jpg

p83u1b.jpg

4-308
FHP6FFQ
6. 17. 2001

4-308
FHP6A-a
6. 17. 2001

4-308
6. 17. 2001

6. 17. 2001

83-1
6. 17. 2001

Eastside Reference

p902u21a.jpg

p902u21b.jpg

p902u21c.jpg

p903u2a.jpg

p903u2b.jpg

p903u2c.jpg

p999u1a.jpg

p999u1b.jpg

p999u1c.jpg

p999u2a.jpg

p999u2b.jpg

p999u2c.jpg

SOUTH

EAST

FHP 90221
06-17-01
NORTH

903-2
FHP 6/16/01
6. 16. 2001

903-2
FHP 6-16-01
6. 16. 2001

403-2
FHP 6/16/01
6. 16. 2001

999-1
FHP 6-16-01
6. 16. 2001

999-1
FHP 6-16-01
6. 16. 2001

999-1
FHP 8-16 01
6. 16. 2001

C99-2
6. 16. 2001

999-2
FHP 6 16 01
6. 16. 2001

999-2
6. 16. 2001

Lodgepole Biomass/Precommercial Thin

p55u74a.jpg

p55u74b.jpg

55-74
FHP 61701
6. 17. 2001

5574
FHP 6170
6.17.2001

Lodgepole Reference

p999u17a.jpg

p999u17b.jpg

p999u18a.jpg

p999u18b.jpg

p999u18c.jpg

6. 17. 2001

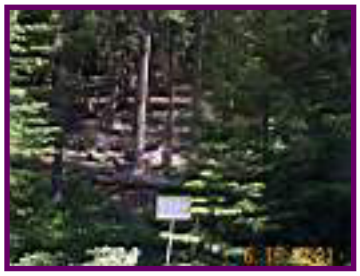
999-17
FHP 61701
6. 17. 2001

999-18
FHP 61701
6. 17. 2001

999-18
FHP 61701
6. 17. 2001

999-18
FHP 6-17-01
6. 17. 2001

Mixed Conifer Overstory Removal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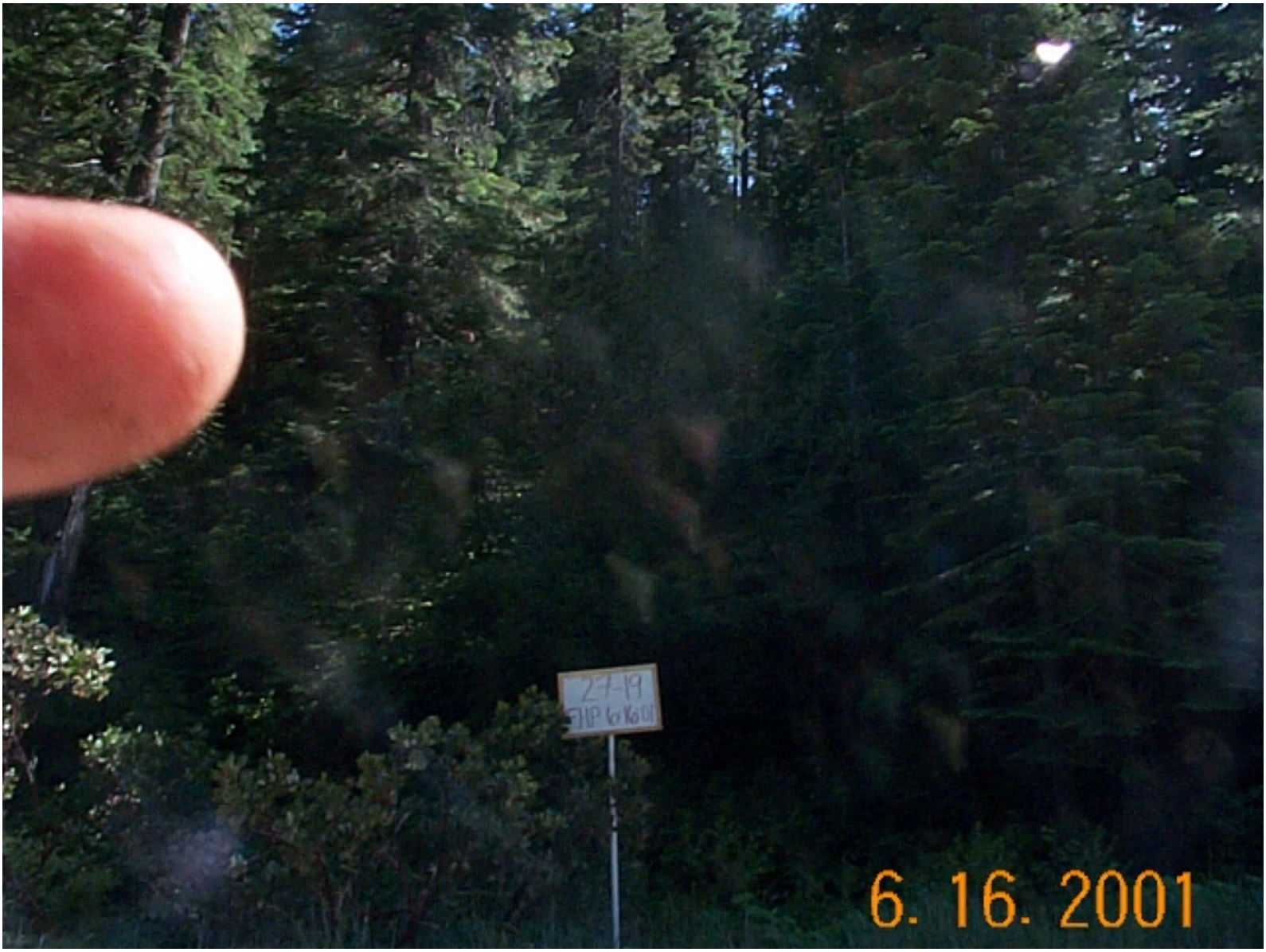
p27u19b.jpg

p27u20a.jpg

p27u20b.jpg

27-19
FHP 6-16-01
6. 16. 2001


27-19
6. 16. 2001

6. 16. 2001

6. 16. 2001

Mixed Conifer Reference (Untreated)

p902u11a.jpg

p902u11b.jpg

p902u11c.jpg

p904u10a.jpg

p904u10b.jpg

p904u10c.jpg

p904u3a.jpg

p904u3b.jpg

p999u15a.jpg

p999u15b.jpg

FHP #02-11
6-17-01
SOUTH

FHP 902-11
6-17-01
WEST

FHP 902-11
6-17-01
NORTH

904-10
FHP 6-16-01
6. 16. 2001

904-10
6. 16. 2001

904-10
FHP 6-16-01
6. 16. 2001

904-3
FHP 6/16/01
6. 16. 2001

6. 16. 2001

999-15
6. 17. 2001

999-15
FHP 61701
6. 17. 2001

Mixed Conifer Thin (Treated)

p48u59a.jpg

p48u59b.jpg

p48u59c.jpg

p48u92a.jpg

p48u92b.jpg

p48u92c.jpg

p50u5a.jpg

p50u5b.jpg

p53u4a.jpg

p53u4b.jpg

p53u5a.jpg

p53u5b.jpg

p53u6a.jpg

p53u6b.jpg

p62u16a.jpg

p62u16b.jpg

p62u16c.jpg

p66u13a.jpg

p66u13b.jpg

p66u13c.jpg

p66u19a.jpg

p66u19b.jpg

p66u19c.jpg

6. 17. 2001

6. 17. 2001

48-54
FHP 61701
6. 17. 2001

6. 17. 2001

48-92
FHP 6-17-01
6. 17. 2001

48-92
FHP 6/7/01
6.17.2001

6. 17. 2001

50-5
FHP617a
6. 17. 2001

53-4
FHP617a
6. 17. 2001

53-4
FHP 6-17-01
6. 17. 2001

53-5
FHP 61701
6. 17. 2001

FHP6170
6. 17. 2001

556
FHP6179
6. 17. 2001

53-6
FHP 61701
6. 17. 2001

62-16
FHP 6-16-01
6. 16. 2001

62-16
FHP 6-16-01
6. 16. 2001

62-16
FHP 6-16-01
6. 16. 2001

FHP66-13
6/15/01
Looking E.

FHP66-13
6/18/01
Looking NORTH

FHP66-13
6/16/01
Looking WEST

FHP66-19
6/16/01
Looking WEST

FHP66-19
6/8/01

Mixed Conifer Thin (Untreated)

p48u81a.jpg

p48u81b.jpg

p49u9a.jpg

p49u9b.jpg

p49u9c.jpg

48-81
FHP 6/17/01
6. 17. 2001

48-81
FHP 6.17.01
6. 17. 2001

49-9
FHP 61701
6. 17. 2001

49-9
FHP 6/17/01
6. 17. 2001

6. 17. 2001

Mixed Conifer Prescribed Burn

p97u1a.jpg

p97u1b.jpg

97-1
FHP 6-16-01
6. 16. 2001

97-1
FHP 6-16-01
6. 16. 2001