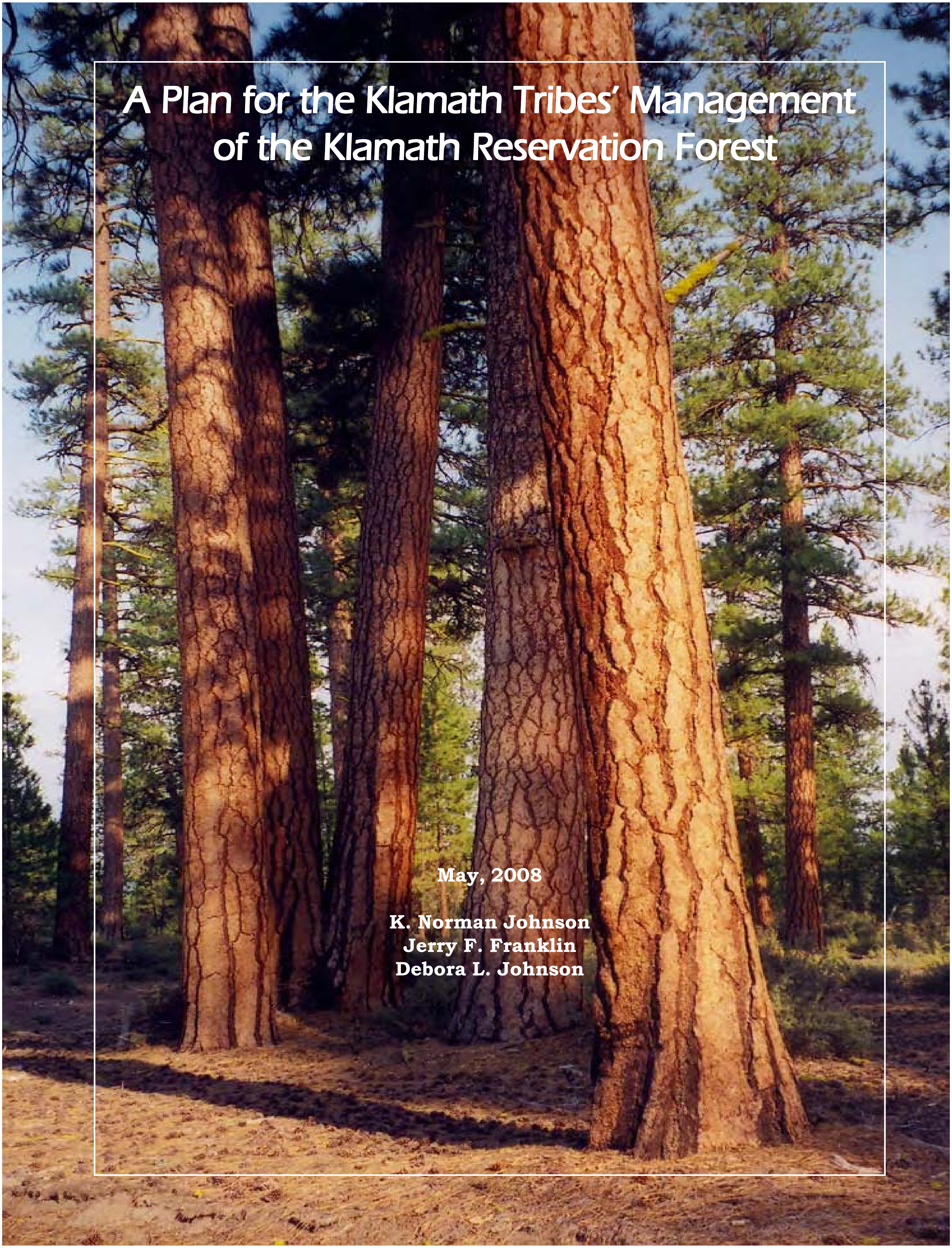
A Plan for the Klamath Tribes' Management of the Klamath Reservation Forest



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The cover picture was taken at the Bull Pasture stand southeast of Buckhorn Springs.All pictures without credits in the report were taken on the Reservation Forest during our field work.

Contents

Introduction

This document is a management plan for the forests of the former reservation lands that are now part of the Winema and Fremont National Forests. We call these lands the “Klamath Reservation Forest.” A draft of this plan was released in 2003. This is the final plan. It is divided into three parts and five appendices.

Part I describes historical conditions and desired future conditions for the forests of the former reservation lands that are now part of the Winema and Fremont National Forests. We call these lands the “Klamath Reservation Forest.”

Part II describes current conditions, needed activities to move the forest toward desired conditions, an adaptive management plan, and management reference sites representing the major forest conditions. The discussion of management reference is organized around prescriptions to move the sites to the desired conditions.

Part III covers the current forest inventory and growth, proposed treatments, costs and revenues from managing the Klamath Reservation Forest, and standards and guidelines for forest management.

The five appendices are: A) Maps of the Reservation Forest, B) a photo collage of the Forest, C) a quantitative description of the forest inventory, D) harvest simulations, and E) a peer review of the proposed forest plan.

In late summer 2002, before release of the draft plan, we received peer review on the scientific content of the plan from four people: 1) John Gordon, Interforest and former Dean of the School of Forestry and Environmental Studies, Yale, 2) John Beuter, Umpqua-Tualatin, Inc., 3) Norm Christensen, former Dean of the School of the Environment, Duke University, and 4) Hal Salwasser, Dean, College of Forestry, Oregon State University. Their report is in Appendix E.

In addition, we went on tours of the forest to explain our proposed forest plan with tribal members, representatives of the Supervisor’s Office of the Winema-Fremont, representatives of Chiloquin, Chemult, and Bly Districts of the Winema-Fremont, and members of local conservation groups.

In this work we owe a heavy debt to Will Hatcher, Tribal Forester. Will has been with us on many dusty roads and cross-country hikes through these forests. His ideas and knowledge have greatly improved our effort. In addition two other Klamath Tribal professionals have significantly assisted us: Rick Ward, Tribal Biologist, and Carl White, GIS Specialist. Finally, we wish to acknowledge the employees of the Winema-Fremont National Forest who have willingly provided their knowledge and data.

Part I:
The Desired Future Condition

Development of this vision has been guided by the Klamath Tribes' Economic Self-sufficiency Plan (Klamath Tribes 2000). In the Self-sufficiency Plan, the Tribes propose to manage the lands under the "Restoration Alternative" of "A Sustainability Strategy for the Klamath Forest in the Context of the Upper Klamath Basin," prepared for the Tribes by Interforest, LLC and dated September 6, 2000 (hereinafter "Sustainability Strategy"). The objectives for management of the lands set out in the Sustainability Strategy include:

- Restoration of forest (stand structure) complexity
- Reduction of average stand density to allow greater individual tree growth and shrub development
- Reduction of overall fuel levels and continuity to reduce the potential for uncharacteristic stand-replacement fires
- Restoration of more natural fire regimes
- Increased habitat and carrying capacity for deer and elk, and other wildlife and fish species
- Enhanced spiritual and cultural values
- Production of sustained monetary and subsistence income

The principle goal of such management under the Restoration Alternative would be "to move as much of the forest as possible toward a structurally complex ponderosa and mixed-conifer dominated forest as rapidly as possible ... Forest stand structure and complexity will be emphasized through a variety of restoration techniques including pre-commercial and commercial silvicultural treatments. Stand density, structure and wildlife management decisions will be made on a tree-by-tree, site-specific basis. Restoration to pre-1954 complexity and structure will guide all forest management activities as well as the management of wildlife habitat and populations, restoration of riparian habitats and the possible use of prescribed burning to restore a larger-than-current role for fire (Interforest 2000, p. 42)."

The purpose of this report is to further develop the restoration goal described in the Sustainability Strategy. To do this, we will develop the desired future condition for the three major forest types that were identified in the Interforest Report: 1) ponderosa pine, 2) mixed conifer, and 3) lodgepole pine. We will describe the desired condition of these types in terms of species mix and structure of the tree overstory and (to the degree possible) the abundance and vitality of the shrub understory. In addition, we will describe the desired condition of associated resources including meadows, riparian areas, draws, and hardwood patches.

Goals for Restorative Management of the Klamath Reservation

The basic principles guiding restoration of the Klamath Tribal Forest can be summarized as:

- Restoration of diverse, structurally complex forest ecosystems; and
- Enhancement and protection of the forest, wildlife, water, and soil resources of the reservation.

The Interforest Report defines structurally complex forests as follows: “These are forests which retain much of the pre-management forest structure, including: 1) a large-diameter tree component (including ponderosa pine when appropriate to the site); 2) a spatially-complex pattern of stand structural units (e.g., large tree groves and open areas of dense regeneration); 3) coarse wood habitats (snags and logs); 4) well-developed understory communities of herbs and shrubs; and 5) moderate tree stocking levels (Interforest Report 2000, p. 21).” The goal of “restoration of healthy, diverse, structurally complex forest ecosystems” calls for the return of ponderosa pine and mixed-conifer forests of the Reservation to this structurally complex condition across the landscape.

A complex ponderosa pine forest is illustrated in Figure 1 (from the Interforest Report). Individual patches can be relatively simple, i.e., all trees of similar size, but the mosaic of different sizes and ages creates the complexity. Thus, the structural complexity is achieved though a fine-scale mosaic of relatively simple patches along with scattered large trees, snags, and down logs.

Restoration of a complex forest ecosystem also must address the suite of vegetation types and landforms that complement the complex forests described above. They include the interspersed riparian areas, meadows, draws, and hardwood patches.

Finally, restoration of a complex forest ecosystem must address the many features of the forest of interest to the Klamath Tribes including the enhancement of mule deer populations and of other fish and wildlife species.

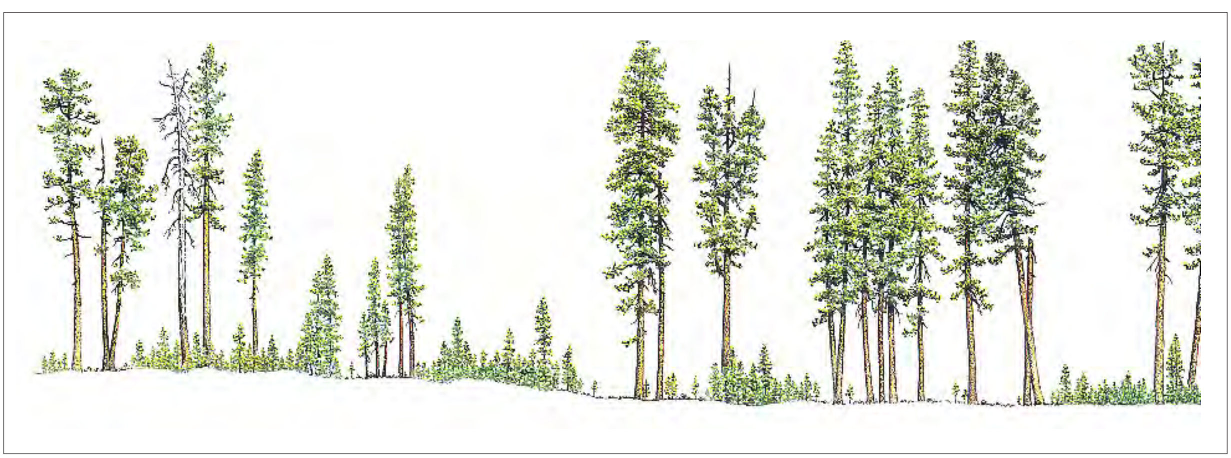


Figure 1. Canopy profile (150m x 20m) that shows the structural cross-section of a ponderosa pine forest at Bluejay Springs, Klamath Reservation Forest. Source: Interforest Report (2000).

We consider these objectives (restoring a complex forest ecosystem and protection of forest, water, wildlife, soil resources) as providing the focus for tribal management, rather than precise re-creation of hypothesized 19th century or early 20th century conditions. We will, though, utilize historical information to increase our understanding of the historical conditions of forests, meadows, and riparian areas that provide a diversity of benefits to sustain the Klamath Tribes.
We attempt below to further specify these objectives through the creation of a set of desired future conditions for the sites or habitat types found on the reservation. Of course, these desired future conditions should reflect the best current understanding of these sites and the constituent species, and should be modified, as needed, in the future as more is learned.

We believe that the desired future conditions should reflect the complex, pine-dominated forest landscape described in the 1921 (USDI Geologic Survey) and 1936 (USDA Forest Service) type maps of the Klamath Reservation Forest and other descriptions from the period. A copy of the aggregated version of the 1936 type map is included with this report (Appendix A, Map 1). The 1921 maps are available in the National Archives. This landscape showed a mix of ponderosa pine dominated forest, wet meadows, dry meadows, "grassy glades," lodgepole pine in flats (often with occasional ponderosa pine) and along streams, and hardwood patches in the uplands and along streams. These maps should guide the macro-architecture of restoration—the pattern of conifer forest, hardwood patch, meadow, and marsh that once typified the Klamath Reservation.

Ponderosa pine stand ca. 1930.

Harold Weaver

19th and Early 20th Century Forest Conditions on Klamath Reservation Forest

Photographs, written accounts, and survey records provide a historical picture of forest conditions on the Klamath Reservation Forest. These numerous sources are identified in the references section at the end of the report. They range from reports of early explorers, to the 1921 and 1936 type maps described above, to the work of early scientists and foresters that visited the Klamath country and measured its contents, to the Klamath Agency reports on early forestry and grazing activities on the Reservation.

Conditions on the Klamath Reservation Forest included:

- A complex mixture of forest, wet meadows, dry meadows, "grassy glades", lodgepole in flats (often with occasional ponderosa pine) and along streams, hardwood patches in the uplands and along streams;
- Lower elevation forests that were much more open (at significantly lower densities) than current stands, primarily as a result of much higher fire frequencies;
- Forest landscapes that were dominated by ponderosa pine, with most of the basal area in large, old pine trees, and those trees often seeming to represent a single story;
- Ponderosa pine trees 21-32 inches in diameter breast height (dbh) as the most common sizes in the overstory, with relatively few trees over 40";
- A scattering of small, old pine trees;

Harold Weaver

An example of an attempt north of Klamath Agency, to restore historical conditions through prescribed fire by Harold Weaver in1958.

- Generally uneven-aged stands, with trees showing an age range of hundreds of years;
- Large snags created through lightening, wildfire, and insect attack;
- Volume/acre averaging 5-25 MBF per acre (in trees over 18") with a gradient of increasing volume from dry to wet sites;
- Occasional even-aged stands from stand replacing fires;
- A generally open understory with patches of small trees and shrubs filling in gaps created by the death of individual mature trees or small groups of these trees;
- Bitterbrush that was much more patchily distributed than at present, primarily because of its sensitivity to fire;
- Mountain mahogany in scab flats and rocky outcrops along the Sprague River and elsewhere;
- At higher elevations, denser stocking, more big trees, more understory trees, a higher density of shrubs (especially snowbrush and manzanita), but still heavily dominated by ponderosa pine except for some north slopes and very wet areas where white fir predominate;
- Lodgepole pine forests of much lower densities and existing in the form of stand mosaics of different ages and densities, rather than forming extensive areas of dense, contiguous forest as have been recently seen. Wildlife and insects were key forces in organizing the age and distribution of lodgepole pine cohorts and stands. Patches of bitterbrush present across much of the lodgepole areas;
- Greater diversity and extent of hardwoods (e.g., aspen, upland willows, and cottonwood) as groves and small stands; and
- Greater extent and diversity of non-forested meadows without the exotic plants and tree invasion that are characteristic of those areas today (see Youngblood et al. 2004, Hessburg et al. 2005, Spies et al. 2006, and Fitzgerald 2005 for added description of the historical forest).

Key disturbance processes

Lightening, wildfire, and insects attacks were the three disturbance processes most responsible for the historical conditions described above.

Lightning has been a source of mortality in the large pine trees on the reservation. One survey over hundreds of acres, found about one tree per every two acres recently killed by lightning (Klamath Agency 1915a). In addition, these lightning strikes were undoubtedly a major source of fires on the reservation, although Indian burning may also have played an important role.

Wildfire was a dominant force in shaping the forests of the Klamath Reservation. Frequent low intensity fires kept ponderosa pine forests generally open, usually doing little damage to the thick, barked old pine trees. Fires that kill individual pine trees or clumps were more common

than large crown fires (Agee 1991). Wildfire swept through mixed conifer forests somewhat less frequently than pine forests, and with more effect. Thus, the name of "mixed severity fires" can be applied to the fire in these forests, with fire often staying in the understory, but also occasionally jumping up into the crowns. Less is known about wildfire in lodgepole pine forests, but these fires also might be called "mixed severity." Drought and strong winds were key factors in increasing fire severity. Undoubtedly, burning by the Tribes contributed to these fire regimes, but the exact extent is unknown.

Insect outbreaks helped to keep overall stand densities down and provided snags in patches and as individual trees. Western pine beetle and mountain pine beetle attacks occasionally rose to epidemic levels, such as from 1915-1935 on the Reservation Forest. In that case, tree mortality associated with these two beetles in the ponderosa pine stands rose from background levels to annual mortality levels of .5-2.5% of the trees. Some patches were hit much harder. Drought, defoliation by the Pandora moth, and many very old and weakened trees were all given as reasons for the attacks. Over the 20-25 years of the epidemic, perhaps 20-30% of the big pines succumbed to beetle attack across the reservation. These attacks led, in part, to the Keen Classification for marking trees for harvest that focused on those most susceptible to insect attack. (Jaenicke 1926, Keen 1927, and numerous letters between the Klamath Agency and the BIA and the BIA and the Secretary of Interior between 1913 and 1933). These outbreaks were often keyed to drought; the western pine beetle outbreak in the 1920s and 1930s was associated with a multi-decade drought across the interior West.

Change from historical conditions

Overall, in the 20th century, the Klamath Reservation Forest has been converted to a much more homogenized, denser, less healthy forest landscape with more shade-tolerant species, particularly white fir; many fewer large, old ponderosa pines; and dense stands of lodgepole pine. Also, Douglas-fir and sugar pine are more prevalent. As stated in the Interforest Report (2000, p. 20), "comparing the current forest to the pre Euro-American settlement forests:

- Stand densities of small trees are much higher;
- Proportion of ponderosa pine is much lower;
- Density of large, old trees (especially ponderosa pine) is much lower;
- Fuel loadings and continuity (ground to crown and crown to crown) are much higher;
- Fire regimes have shifted from frequent low-intensity burns to infrequent stand-replacing fires; and
- Overall condition of understory browse used by deer and elk has deteriorated.

These conditions are the consequence of many factors including fire suppression and tree removal—including both harvest of large old trees, and active efforts to regenerate dense ("fully stocked") even-aged stands. In addition, meadows have been degraded through fire suppression, grazing, and channelization. (See Hessburg et al. 2005, and Spies et al. 2006 for additional descriptions of current conditions.)

To gain a better quantitative comparison of historical conditions to current conditions on the reservation, we can utilize an estimate of 1910 conditions from the 1954 Wilcox/Mezger management plan and an estimate of current conditions from our work (Table 1). The Wilcox/Mezger management plan was the last plan written under the BIA. In that plan they used historical documents and analysis to reconstruct the 1910 inventory. Our estimate for 2006 is based on a Forest Service inventory from 1993-1995 projected to 2006.

Table 1. Comparison of historical conditions to current conditions by species.

Year	Acres	Total	PP	SP	WF	DF/IC	OS*
			--------------------millions of board feet--------------------				
Total							
1910	647,000	9,295	8,849	95	288	72	50
%			95	1	3	1	1
2006	522,000	6,260	4,355	230	1,044	180	465
%			69	4	17	3	7
			--------------------thousands of board feet--------------------				
Per acre							
1910		14.4	13.7	.14	.45	.11	.07
2006		11.9	8.3	.44	2.0	.38	.84

* Mainly lodgepole pine

This comparison shows fewer acres in the ponderosa pine/mixed-conifer types now as compared to 1910 (Table 1). At least two reasons account for this difference: 1) a portion of the old reservation (the northwest corner) went to a private company at termination; current figures include only the portion of the old reservation under the Forest Service. 2) Some of the acres classified as pine/mixed conifer in 1910 would be classified as lodgepole pine today due the harvest of the big pines in pine/lodegepole stands and the invasion of lodgepole into these stands due to fire suppression.

In terms of the volumes on the ponderosa pine/mixed-conifer types, this comparison reveals a number of differences:

- A somewhat lower overall level of board foot volume (11.9 compared to 14.4).
- A significantly lower proportion of ponderosa pine (69% vs. 95%).
- Much higher levels and proportions of white fir and lodgepole pine along with somewhat higher levels of sugar pine and Douglas-fir/incense cedar.

Desired Future Conditions for the Habitat Types of the Klamath Reservation Forest

We feel that "habitat types" provide the best ecological basis for stratifying the Klamath Reservation Forest into areas with different potentials, and, consequently, different responses to management regimes. The habitat types are named after the plant associations that identify and characterize these sites: USDA Forest Service area ecology plant association guides are the primary source of this information (Hopkins 1979a, Hopkins 1979b, Volland 1985). The understory shrubs, herbs, and grasses are especially important in identifying these types. These plant associations integrate soil, microclimate and other conditions making them useful guides to productivity, selection of species that are likely to be successful on the site, and potential regeneration problems.

We have organized the habitat types on the Reservation Forest into groups for discussion and presentation (Table 2a). While this table and the associated map (see Appendix A, Map 2)) gives a useful overview of the habitat types of the Klamath Forest Reservation, their abundance, and

Ponderosa pine stand at Irving Creek

Table 2a. Habitat types (plant association groups) of the Klamath Reservation Forest

		Acres	Code
Ponderosa pine/sagebrush			
Ponderosa pine/bitterbrush-sagebrush/fescue		14,844	CPS111
Ponderosa pine/mountain mahogany-bitterbrush-big sagebrush/fescue		1,672	CPC211
	Total	16,515	
Ponderosa pine/bitterbrush			
Ponderosa pine/bitterbrush/fescue		51,022	CPS211
Ponderosa pine/bitterbrush/needlegrass		281,767	CPS212
Ponderosa pine/bitterbrush-manzanita/needlegrass		7,646	CPS213
Ponderosa pine/bitterbrush-snowbrush/needlegrass		6,941	CPS311
Ponderosa pine/bitterbrush/sedge		3,098	CPS215
Ponderosa pine/wooly wyethia		730	CPF111
Ponderosa pine/bitterbrush-manzanita/fescue		9,158	CPS217
	Total	360,362	
Mixed conifer/snowbrush			
Mixed conifer/snowbrush		7,764	CWS114
Mixed conifer/snowbrush-manzanita		51,075	CWS112
Mixed conifer/snowbrush-chinquapin		211	CWH111
Mixed conifer/snowbrush-bearberry		239	CWC215
Mixed conifer/snowbrush-squawcarpet/strawberry		29,987	CWS116
	Total	89,277	
Moist mixed conifer			
White fir/snowberry/strawberry		26,567	CWS312
White fir/chinquapin-boxwood-prince's pine		105	CWH112
White fir-ponderosa pine-sugar pine/manzanita		744	CWC412
White fir-ponderosa pine-incense cedar/serviceberry		8,010	CWC111
White fir-ponderosa pine-aspen/sedge		5,054	CWH211
	Total	40,375	
Red fir and mountain hemlock			
Shasta red fir-white fir/chinquapin-prince's pine/long-stolon sedge		37	CRS311
Shasta red fir/long-stolon sedge		0	CRG111
Shasta red fir-mountain hemlock/pinemat manzanita/long-stolon sedge		89	CRS112
Mountain hemlock/grouse huckleberry		28	CMS111
	Total	154	
Lodgepole pine/bitterbrush			
Lodgepole pine/bitterbrush/needlegrass		69,589	CLS211
Lodgepole pine/bitterbrush/sedge		5,011	CLS212
Lodgepole pine/bitterbrush/forb		830	CLS213
Lodgepole pine/bitterbrush/fescue		288	CLS214
Lodgepole pine/current-bitterbrush/needlegrass		1,041	CLS215
	Total	76,759	
Marginal site and high elevation lodgepole pine			
Lodgepole pine/needlegrass basins		8,349	CLG311
Lodgepole pine/sedge-needlegrass basins		492	CLS413
Lodgepole pine/grouse huckleberry/long-stolon sedge		27	CLS414
Lodgepole pine/grouse huckleberry		6	CLS412
Lodgepole pine/sagebrush/fescue		68	CLS111
Lodgepole pine/forb		1,422	CLF111
Lodgepole pine/manzanita		5,517	CLS311
	Total	15,881	
Moist and wet lodgepole pine			
Lodgepole pine/blueberry/forb wetland		3,908	CLM311
Lodgepole pine/bearberry		19,007	CLM211
	Total	22,915	
	Total Forested Acres		**622,238**

Table 2b. Non-forested HabitatTypes

	Acres
Dry meadow	6,980
Wet meadow	4,392
Dry shrubland	2,934
Moist shrubland	1,013
Juniper	9,834
Sagebrush	12,151
No vegetation	8,614
Water	171
Total Non-forested Acres	46,089

Total Forested and Non-forested Acres = 668,327*

*21,500 acres are not classified. (Total acres of national forest land within the reservation = 689,827.)

their general location, they are approximate. Identification of the actual location and extent of the different habitat types will require fieldwork using the plant identification keys included in the plant association guides.

Our purpose here is to discuss the desired future condition of the different habitat types on the Klamath Reservation Forest based on the Tribal vision for the forest and expressed through the Sustainability Strategy. The coniferous habitat types are organized into groups (Table 2) that will be discussed in turn. Habitat types historically dominated by ponderosa pine are discussed first, followed by those of red fir, and finally those of lodgepole pine. We also discuss the desired future condition of hardwood patches, meadows, shrublands and riparian areas.

Habitat Types Historically Dominated by Ponderosa Pine

Ponderosa pine originally dominated the Klamath forest landscape—from sites where it is the climax species through most of the mixed-conifer habitat types where it was maintained by periodic fires. This spectrum of habitat types where the ponderosa pine was a dominant (or significant) stand component can be viewed as gradient from very dry to moist sites (Figure 2). Four broad groups of habitat types can be recognized (Table 2 and Appendix A, Map 2):

1) Ponderosa pine/sagebrush habitat types found on the very dry sites that typically occur at the transition between forest and sagebrush-grassland communities. Productivity is low and tree regeneration tends to be highly episodic. Western juniper is the only significant tree associate. Mountain mahogany is usually a significant shrub associate. Wildfire was frequent but generally not intense nor essential for maintaining the pine component;

2) Ponderosa pine/bitterbrush habitat types, which vary substantially in productivity and basal area carrying capacity. These are free of competition from shade-tolerant species (e.g., white fir) but may have an aggressive lodgepole pine component (in the habitat types characterized by long-stoloned sedge). Wildfire was frequent and generally of moderate intensity due to low fuel loadings; fire was not essential for maintaining the pine component but, along with bark beetles, acted to keep stand densities down;

3) Mixed-conifer/snowbrush habitat types, which were historically dominated by ponderosa pine; this includes all of the habitat types characterized by a snowbrush understory, which is often abundant in the understory. There are a variety of associated tree species including white fir (the most common), lodgepole pine, sugar pine, incense cedar, and Douglas-fir (southern part of reservation). Wildfire was somewhat less frequent than in the ponderosa pine habitat types and of generally higher intensity, with the intensity depending upon fuel loadings. Fire was the major factor maintaining pine against encroachment of white fir and other shade-tolerant species as well as in keeping fuel loadings low. Some portions of these habitat types, especially north slopes, almost certainly did escape fire for long enough periods to develop a significant shade-tolerant component, high fuel loadings, and the potential for stand-replacement fire.

4) Moist mixed-conifer habitat types. These habitat types are confined to the area south of Sprague River including the higher portions of the Swan Lake Mountain area. The types were also generally dominated by ponderosa pine, but often with a significant component of other conifers, especially on north slopes. These habitat types had the highest densities of forest of any of the types where ponderosa pine was a significant component.

These groups of habitat types, that were dominated by ponderosa pine, can be viewed as a gradient in moisture and temperature conditions (Figure 2). In general, site productivity, basal areas, and large tree densities tended to increase from dry to moist habitat types and natural wildfire frequency tended to decrease. It is important to note that bitterbrush is primarily important in the climax ponderosa pine sites but not on the mixed-conifer habitat types.
Current stand conditions are very similar throughout most of this group of habitat types (see Part III for quantitative details):

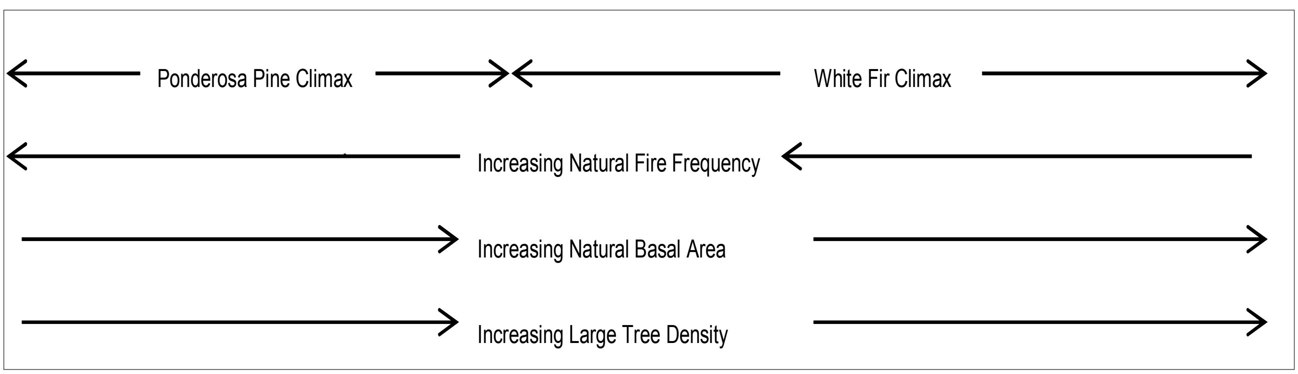
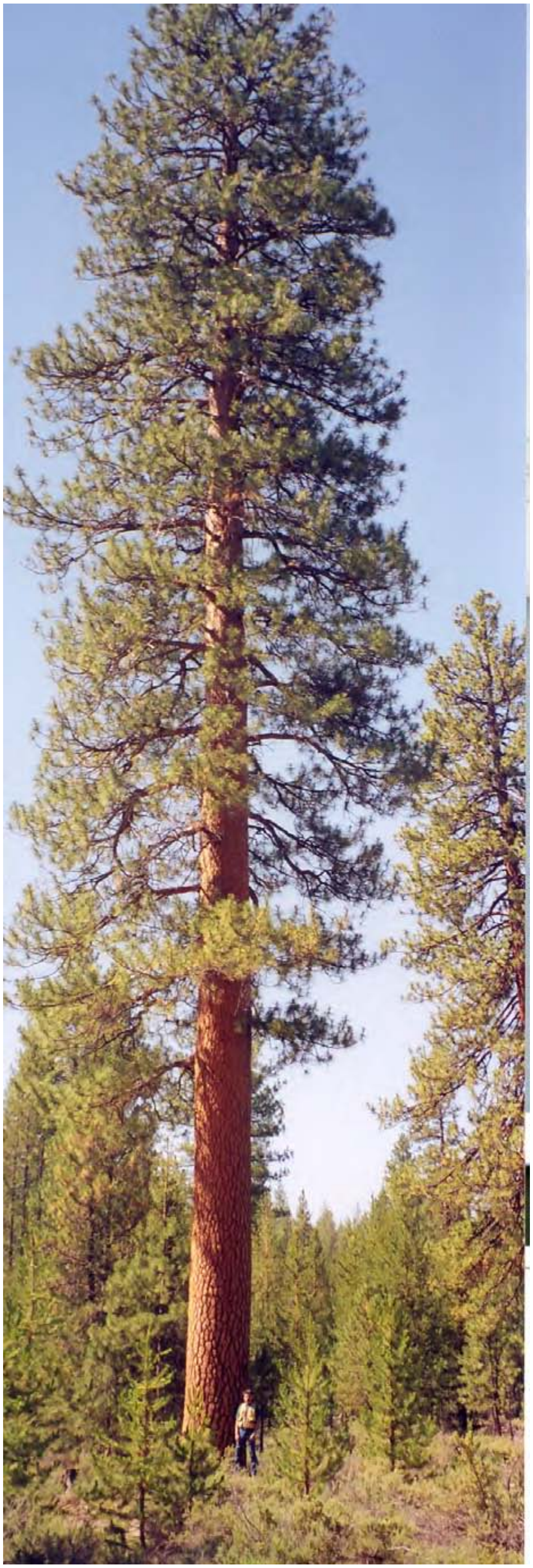


Figure 2. Habitat types where ponderosa pine is a significant component.

- Dramatically increased stand densities throughout the gradient. This stocking is entirely of ponderosa pine and (on some sites) lodgepole pine on the ponderosa pine/bitterbrush habitat types and, typically, shade tolerant tree species, such as white fir, on the mixed-conifer/snowbrush habitat types;

- Grossly simplified and homogenized stand structures, because of systematic removal of larger ponderosa pine, active measures to regenerate “fully stocked” stands and fire suppression; and

- Consistent with the above, greatly increased fuel loadings.



Desired future stand conditions—i.e., the long-term management goal—should call for restoring and maintaining structurally complex stands dominated by ponderosa pine—including a permanent population of large, old pine trees—throughout the gradient. This can be accomplished by carefully designed silvicultural treatments using tree removal and prescribed fire along with mowing to revitalize the shrub understory. All harvests would be in the form of partial cuts with the objective of reducing overall stand densities *as well as restoring spatial heterogeneity within the stand* (i.e., variable density prescriptions).

Also, as stated in the Interforest Report (2000, p. 22): "Currently much of the structurally-simplified forest offers low to moderate potential as wildlife habitat because of its uniformity and relatively high tree canopy cover which has reduced amounts and quality of understory browse. The potential for restoration is very high. Maintaining protective cover and limited sighting distances is an important consideration if significant commercial thinning is done; variable density prescriptions which maintain some denser patches will probably be needed to maintain desirable levels of hiding cover."

Desired basal area levels and densities will vary across the gradient of habitat types. Target stand basal area levels for the drier end of the range would be 50-70 sq ft/acre in contrast with 120-140 sq ft/acre on the moistest and most productive habitat types. Large diameter trees (trees>21" dbh) will generally dominate the stands, often comprising more than 75% of the basal area. We describe these targets in more detail below.

Representative stands to use as a guide to desired future conditions

We have provided data from some representative stands that can guide the development of the desired stand structure (Tables 3 and 4). Three stands come from historical studies and four come from recent surveys.

Table 3. Stand structures from selected stands in the vicinity of the Klamath Reservation (all information per acre).

Stand #1
Lake County (Munger 1917)

Dia. Class	# trees	Basal Area	
	PP	PP	%
4-10	23.2	6	6
10-21	16.9	24	24
21-32	11.7	45	45
32-40	2.7	19	19
40+	0.7	7	7
Total	55.2	101	

Stand #2
Klamath Lake (Munger 1917)

Dia. Class	# of trees			Basal Area		
	PP	Oth	All	PP	Oth	All
4-10	12	14	26	2.86	3	5.8
10-21	10	5.4	15.4	15	7.6	22.6
21-32	11.2	3.2	14.2	44.7	12.5	57.2
32-40	2.8	0.9	3.7	20	6.5	26.5
40+	0.8	0.3	1.1	7.6	3.5	11.1
Total	36.8	23.8	60.6	90	33.1	123.1

Stand #3
Mt. Scott (Bedford 1915)

Dia. Class	# of trees				Basal Area				
	PP	WF	SP	All	PP	WF	SP	All	%
6-18	7.2	0.4	0.1	7.7	3.9	0.2	0.1	4.2	5
18-21	2.1	0.2	0.1	2.4	4.6	0.5	0.2	5.3	7
21-32	8.1	0.7	0.3	9.1	32.5	3	1.1	36.6	47
32-40	2.5	0.2	0.1	2.8	18.3	1.1	0.9	20.3	26
40+	0.8	0	0.2	1	8.8	0.5	2.6	11.9	15
Total	20.7	1.5	0.8	23	68.1	5.3	4.9	78.3	

Stand #4
Blue Jay Springs (Johnson 2001)

Dia. Class	# trees	Basal Area	
	PP	PP	%
4-10	45	7.5	7
10-21	30	30	28
21-32	12	43	41
32-40	3.2	22	20
40+	.3	2	2
Total	90.5	104.5	100

Stand #5
Wildhorse (Johnson 2003)

Dia. Class	# trees	Basal Area	
	PP	PP	%
4-10	61	10.4	11
10-21	28	28.4	31
21-32	10.7	38.9	42
32-40	1.9	12.5	14
40+	.2	1.8	2
Total	101.8	92.0	100

Stand #6
Metolius (Youngblood et al. 2003)

Dia. Class	# trees	Basal Area	
	PP	PP	%
<21	301	46	42
21-32	9.8	38	34
32+	3.4	26	24
Total		110	100

Stand #7
Pringle Falls (Youngblood et al. 2003)

Dia. Class	# trees	Basal Area	
	PP	PP	%
<21	138.8	37	38
21-32	10.8	40	40
32+	3.2	22	23
Total		99	100

Table 4a. The number of trees per acre (TPA) and basal area (BA) over 21” in selected historical and current stands.

Location	Ponderosa Pine		Other Species		Total	
	TPA	BA	TPA	BA	TPA	BA
Lake County	15.1	71				
Klamath Lake	14.8	72	4.4	23	19.2	95
Mt. Scott	11.4	60	1.5	9	12.9	69
Bluejay Springs	15.5	67				
Wildhorse	12.8	53				
Metolius	13.2	64				
Pringle Falls	14.0	62				

Table 4b. The number of trees per acre (TPA) and basal area (BA) over 32” in selected historical and current stands.

Location	Ponderosa Pine		Other Species		Total	
	TPA	BA	TPA	BA	TPA	BA
Lake County	3.4	26				
Klamath Lake	3.6	28	1.2	10	4.8	38
Mt. Scott	3.3	27	.5	5	3.8	32
Bluejay Springs	3.5	24				
Wildhorse	2.1	14				
Metolius	3.4	26				
Pringle Falls	3.2	22				

Munger (1917) provides the information for the first two stands in Tables 3 and 4. The first stand table is from Lake County and shows a significant portion of the stand (70% of the basal area) greater than 21 inches dbh and few trees over 40 inches dbh. The second stand table is from an area near Klamath Lake (probably from the mixed conifer area south of Chiloquin) and shows the same structure as the first one (a significant basal area between 21 and 32 inches dbh), but a somewhat higher number of trees over 21 inches and a significant number of trees of “other species” over 21 inches.

The third stand in Tables 3 and 4 is from the cruise for the Mt. Scott timber sale (Klamath Agency 1915b)—a 5% strip cruise of 35,000 acres north of Agency Lake and west of the Williamson River for one of the first commercial timber sales prepared by the BIA. This cruise shows an “average” stand which is dominated by ponderosa pine, but with some other species (sugar pine and white fir). This stand has a structure similar to Munger’s, but with a lower overall density (basal area), and much lower densities of trees less than 21”.

The fourth stand (Bluejay Springs) in Tables 3 and 4 was selected because we believe that it illustrates the structures that the ponderosa pine type could achieve. Our cruise revealed few signs of past harvest. This stand averages 15.5 trees over 21 inches dbh with a basal area of 67 sq ft/acre in a stand with a total basal area of a little over 100 sq ft/acre. The stand component over 21 inches dbh is nearly the same as stand #1 but it has more small trees. Some of the area had been recently burned with prescribed fire, which reduced the density of small trees, but there are still more small trees than the historical stands, especially in the unburned area. We found an average of slightly less than 2 snags per acre.

Wildhorse Ridge is the location of the fifth stand in Tables 3 and 4; this area currently contains the largest extent of contiguous complex forest on the Reservation. Our cruise suggests that it contains slightly less basal area (92 vs. 106 sq feet) than does Bluejay and also slightly fewer trees over 21” dbh (12.8 vs. 15.5). It also shows slightly more signs of harvest.

The trees in the surveyed stands are not uniformly distributed across the acres but rather have a clumpy, patchy distribution as suggested in the drawing of the forest at Bluejay Springs (Figure 1). Numerous accounts discuss the clumpy distribution of ponderosa pine in this area (Munger 1917, Klamath Agency 1915b, and others), especially the small trees, reflecting both the way the trees are born and die. Scattered clumps of regeneration and young trees were noted among stands that had a generally open appearance.

Both Bluejay and Wildhorse stands display the clumpy nature in the distribution of regeneration and young trees. For example, 30% of the plots on Wildhorse and 35% of the plots on Bluejay had no trees under 21” dbh while less than 5% of the plots in the two areas lacked trees over 21” dbh. Excluding the few plots that landed in clumps lowers the Wildhorse basal area from 92 to 84 square feet and the percentage of basal area in trees under 21 inches from 43% to 35%.

In addition, we have the work of Youngblood, et al. (2004) (Table 3, Stand 6 and 7). The purpose of their study was to quantify horizontal and vertical structural attributes in eastside old-growth ponderosa pine forest to guide restoration prescriptions. The Metolius study area is about 300 ha within the 581 ha Metolius Research Natural Area, which was designated as a reserve for non-manipulative research in 1931. The Pringle Butte study area is about 200 ha and lies within the 470 ha Pringle Falls RNA established in 1936. These areas were originally chosen for Research Natural Areas because they were old-growth ponderosa pine stands little affected by human intervention or activity. The stands are currently multi-aged with as many as 16 cohorts at Metolius and 22 at Pringle Butte and they are surrounded by large areas of young ponderosa pine stands.

Dense, young patch

Twelve 100m x 100m plots were systematically placed in the Metolius area and five 1 ha plots were placed at Pringle Butte. All trees >= 15 cm were measured. Total ages of 215 trees were measured at Metolius and 170 at Pringle Butte. Trees that were alive and in the “upper canopy” (>36 cm) at both study areas were present in 1900 and represent “old-growth” trees in this analysis. All other lower canopy trees were not present in 1900 and represent growth since then. Youngblood, et al. found numbers of trees over 21" and 32" similar to the other studies (Tables 4 and 5), and slightly more than two standing dead trees per acre. Also, they found some trees under 21" that were over 200 years of age—what might be called “small old growth” trees. In terms of basal area, they found higher levels than the other studies in trees under 21" but they noted that these higher densities were not an unexpected result of fire suppression.

Structural goals

We can use the characteristics of these five sample stands, and related information, to estimate the structure of complex forests of the different ponderosa pine/mixed-conifer types. We would expect that:

Large trees

- Complex ponderosa pine/bitterbrush habitat types would have a number and density of big trees per acre shown by these stands (12-15 trees and at least 60 sq ft of basal area per acre over 21"; 2-4 trees and at least 25 sq ft of trees over > 32").

- Mixed-conifer habitat types would have the higher density and larger number of big trees shown by the Klamath Lake stand, as they grow on more moist sites. We would expect mixed-conifer types to have at least 15 trees and 70 sq ft of basal area over 21” dbh/acre and moist mixed-conifer types to have even more. Further we would expect these habitat types to have at least 30 sq ft of basal area greater than 32”. Some of those large trees in the mixed-conifer stands would be sugar pine, white fir, and (south of the Sprague River and west of HY 97) Douglas-fir.

- A relatively small number of large snags (less than two per acre on average) would occur except in the moister, productive mixed-conifer types where the number of large snags would be higher.

- Complex ponderosa pine/sagebrush forests would have fewer big trees (perhaps 6-8 trees over 21” per acre) than the stands shown here as they grow on very dry sites.

Small trees

- We also use these five stands to help define the desired number and distribution of smaller trees (trees < 21”). We see a considerable variation in the density of small trees among the different stands: the basal area in trees from 4- 21” varies from (approximately) 10 sq ft (Mt. Scott) to 39 sq ft (Wildhorse). It might be argued that the Mt. Scott stands represent more of average conditions since this was a much larger, unbiased sample as compared to the Munger stands (Lake County and Klamath Lake) which were small and may have been specially selected.

John Libby, at left, with Forest Supervisor Fred Moffat inspecting burned beetle infested trees in 1931. Harold Weaver

- We would expect that trees less than 21", especially seedlings, saplings, and poles, would not be uniformly distributed across the acres but would have a clumpy, patchy distribution (see the Bluejay Springs drawing in Figure 1). We believe three sources of information suggest this approach: 1) the historical observations of clumps of small trees, 2) the clumpy distribution of small trees found at Bluejay Springs and Wildhorse, 3) the consistency of this pattern with the disturbance pattern that predominated in ponderosa pine stands (death of individual trees and small groups). In addition, the Interforest Report (2000), reflecting the Klamath Tribes' interest in mule deer states (p. 22): "Maintaining protective cover and limited sighting distances will be an important consideration when commercial thinning is done; variable density prescriptions which maintain some denser patches will probably be needed to maintain desirable levels of hiding cover."

- The Wilcox/Mezger inventory in 1954 found a density of trees 10-21 inches of approximately 15 square feet of basal area in the 80% of the Reservation that had been harvested. Including the likely density of trees 4-10 inches suggests a total basal area, at that time, of 20-25 square feet in trees 4-21 inches.

- Considering this inventory, we believe that the patchy distribution of small trees should average 20-30 sq ft/acre in trees 4-21 inches dbh in ponderosa/bitterbrush and slightly higher than that in mixed conifer. We would expect the mixed-conifer types to average a

Heavy bitterbrush ground cover east of Klamath Agency, 1958 Harold Weaver

higher number of small trees due to increased moisture and a more infrequent fire return interval.

Given this information and our judgment, we propose the following desired future conditions for complex forests in the pine/mixed-conifer types (BA = basal area):

Table 5. Desired basal area (BA) by habitat type

Habitat Types	Total BA (sq ft/acre)	BA <21" (sq ft/acre)	BA > 21" (sq ft/acre)	BA >32" (sq ft/acre)	Acres (thousands)
P. pine/sagebrush	30-50	10-20	20-30	0	15
P. pine/bitterbrush	75-95	20-30	55-65	25-30	376
Mixed conifer	100-120	30-40	70-80	30-35	91
Moist mixed conifer	120-140	30-40	90-100	35-40	39

Note: much of the basal area <21" should be in clumps

Susceptibility to insect attack

We believe that stand densities proposed in this report will not create significant potential for major beetle outbreaks, especially given the characteristics and vigor of the trees for the foreseeable future on the Reservation Forest. Trees considered particularly vulnerable to insect attack (such as large, very old, ponderosa pine Keen Class 4) were targeted for harvest long ago and largely eliminated from the Reservation. It will take decades, and in some cases hundreds of years, for the pine trees currently in the Reservation Forest to grow into these classes. Furthermore, endemic levels of mortality are important in maintaining the complex forest structure by providing snags and creating gaps for regeneration. Still, we recommend monitoring beetle infestation levels as a regular part of the overall monitoring plan.

Shrubs

In the desired future condition, we expect that bitterbrush will be common in the ponderosa pine/ sagebrush and ponderosa pine/bitterbrush habitat types, but will be patchily distributed as a result of periodic prescribed fire. While bitterbrush was likely less abundant in the 1800s than it is now, it was common and often quite abundant on the Reservation Forest by 1930. Both the opening of the stands due to tree removal and insect outbreak and the suppression of fire contributed to the development of denser bitterbrush. Prescribed burn intervals and patterns selected for the ponderosa pine/bitterbrush habitat types must consider the sensitivity of bitterbrush to fire. In fact, we believe that the frequency of prescribed burning should be 15-20 years -- somewhat less than it was historically on ponderosa pine/bitterbrush habitat types.

Snowbrush and manzanita have always been common in the mixed-conifer types, especially in wetter areas. We would expect these conditions to continue.

The frequency of prescribed burning in the mixed-conifer/snowbrush habitat types will need to be timed to cope with rapid accumulations of fuels (i.e., the greater productivity) and tendencies toward regeneration of dense stands, especially of white fir on the mixed-conifer habitats. A burn interval of 20-30 years may be ideal. This burning would often be combined with tree removal to reduce the potential for crown fire.

Red Fir and Mountain Hemlock Habitat Types

In addition to the above habitat types where ponderosa pine was generally dominant, there is an additional set of habitat types (called “Red fir and mountain hemlock”) where the pine may be a component of many stands but is rarely (if ever) dominant.

Four of these habitat types can occur on the Klamath Reservation Forest, but none are extensive there (Table 2). They range from those found on productive sites at moderate elevations, dominated by white fir, Douglas-fir, and Shasta red fir, to true, high-elevation, subalpine forests of mountain hemlock, lodgepole pine, and Shasta red fir. The forests of these habitat types typically have high densities, dense canopies, and moderate-to-low fire frequencies because of their moist conditions.

Desired future conditions for these habitat types would be to maintain mixed stands. Forest management could utilize a variety of silvicultural approaches, including group selection and variable retention prescriptions for regeneration harvests. Prescribed fire would not be a part of the management regime although slash burning may be. On the higher elevation types, management should *never include clearcutting* because of the severe conditions it creates for regeneration.

Lodgepole pine stand at Head of the River

Lodgepole Pine Habitat Types

Lodgepole pine types are divided into three habitat groups for discussions of desired future condition: 1) lodgepole pine/bitterbrush, 2) lodgepole pine on moist and wet sites, and 3) lodgepole pine on marginal and high elevation sites (Table 2 and Appendix A, Map 2).

Lodgepole Pine/Bitterbrush

Lodgepole pine/bitterbrush is an extensive type on the Klamath Reservation Forest (KRF) and one that provides a variety of important resource values, including habitat for mule deer, great gray owls, and other wildlife and commercial timber products. Lodgepole pine is a relatively short-lived species in this region with a generational cycle of 75 to 150 years. Stand-regenerating disturbances include wildfire and mountain pine beetle epidemics. Lodgepole pine here typically regenerates well following such natural disturbances, assuming that a seed source remains.

Extensive, dense stands of lodgepole pine with well-developed bitterbrush understories characterized most of this habitat type during much of the 20th century. It is likely that some of these dense lodgepole pine forests are the result of fire-control programs in the 20th century. In recent decades, these stands have incurred heavy mortality from mountain pine beetle followed by salvage harvest and natural regeneration of the resulting openings.

We believe that much of the area characterized by the lodgepole pine/bitterbrush habitat type historically were occupied by mosaics of stands of different ages and, sometimes, low densities, due to natural wildfire and occasional insect outbreaks. Pictures taken by Munger in 1908 confirm this description, and early inventories found very low commercial wood volumes on most of this type. In addition, bitterbrush has long been a component of these stands: Coville's 1902 visit to the Klamath Marsh mentioned the presence of bitterbrush throughout lodgepole pine surrounding the marsh (Coville 1902). However, we have less historical knowledge about the lodgepole pine types than for the ponderosa pine/mixed conifer types. Until recently lodgepole pine was not considered to be a commercial species; therefore, lodgepole pine forests have been less studied than pine/mixed conifer forests, and fewer timber sale cruises were done in them. Lodgepole pine/bitterbrush forests exist in large contiguous areas and also interspersed with wet lodgepole and dry and wet meadows. These spatially complex areas, such as the forest/meadow mosaic west of Rocky Ford, are important for many wildlife species.

Proposed management strategy

Management options for lodgepole pine/bitterbrush habitat are limited. Allowing stand replacement fires to burn uncontrolled throughout the type is not socially acceptable in the current landscape. Similarly, while the "boom and bust" pattern of lodgepole pine stand development experienced in the 20th century probably was part of the historical experience, it would be hard to argue that such a pattern provides desired resource values.

Among tribal values associated with the lodgepole pine/bitterbrush forests are provision of important habitat for mule deer and potential economic benefits from harvesting lodgepole pine timber, which currently has significant commercial value. Hence, a program for systematic management of lodgepole pine/bitterbrush forests should reflect these values.

We suggest that lodgepole pine/bitterbrush forests on the Klamath Reservation Forest be managed on a variable 75-150 year rotation reflecting the historical disturbance cycles of this type. Variable retention harvest prescriptions should be used in the regeneration harvests, with approximately 25% retention of green trees in both aggregated and dispersed patterns.

We also suggest retaining a portion of the types in reserves, perhaps 10% of the entire acreage, and buffering the forest around natural openings and meadows. In some cases, these two recommendations can be combined, such as creating a reserve out of the forest/meadow complex west of Rocky Ford.

Thus, we would suggest an approach that includes variable rotation lengths (averaging a little over 100 years), variable retention at regeneration harvest in individual trees and clumps, (averaging 25% of the stands), a portion of the forest in reserves, and forest buffers around natural openings and meadows. This should provide for spatial and temporal heterogeneity at stand, watershed and landscape scales.

Regeneration will generally be accomplished by natural seeding. Some use of prescribed fire is expected during the management cycle to achieve multiple objectives including reduction of fuels, stimulation of fire-related processes and organisms, and to assist in natural regeneration of lodgepole pine; techniques will include pile-and-burn and broadcast slash burning. A specific objective in managing these stands will be to perpetuate a healthy understory of bitterbrush; this consideration will be addressed in both logging and burning activities.

General standards and guides for lodgepole pine/bitterbrush include:

1. Use of variable rotation age of 75-150 averaging a little over 100 years;
2. Retention of 25 +/- % green tree retention;

3. Minimum of 50% of retention to be in the form of aggregates of 1-5 acres;
4. Retention of snags and trees to meet 60% potential population level of cavity nesters
5. Natural regeneration of lodgepole pine;
6. Consideration of bitterbrush populations in design and implementation of logging and burning programs (see below);
7. Retention of all ponderosa pine;
8. An adaptive management program aimed at understanding the effect of management on the structure of lodgepole pine/bitterbrush forests and on the habitats for key species.

This proposed management strategy for lodgepole pine forests reflects an effort to create a landscape that can be sustained by anticipating and emulating natural disturbance processes, and providing cultural and economic values.

Maintaining/enhancing bitterbrush

We still have much to learn about how to develop a healthy, palatable bitterbrush component in this forest type, while providing other values including a commercial timber harvest. The bitterbrush found under mature stands is often old, rank, and largely unpalatable as forage for deer. Bitterbrush sometimes develops in openings created by harvest, insects, or fire but not always. Prescribed fire under lodgepole to revitalize bitterbrush is tricky due to the susceptibility of bitterbrush to fire. Still, bitterbrush forage remains an important tribal objective.

Our initial observations and recommendations are as follows: 1) Openings created by regeneration harvest and other disturbances will stimulate bitterbrush regeneration as well as rejuvenate growth of existing plants. Such events should provide bitterbrush forage for significant periods following the disturbance. Studies are needed to determine levels and causes of variability in bitterbrush response however; 2) Prescribed fire experiments should be carried out in lodgepole

pine to determine its potential in increasing heterogeneity in stand density, including small openings where bitterbrush can thrive; and 3) Monitoring and adaptive management, including collaborations with other researchers in the region, are recommended to better understand how various management activities influence bitterbrush.

Lodgepole Pine on Ponderosa Pine Sites

There is significant evidence to support the hypothesis that some forest sites currently labeled as lodgepole pine/bitterbrush are potentially ponderosa pine/bitterbrush sites. The typing call between the two types was based on the presence of the two species on the vegetation plots. Examination of the inventory plots revealed that over 20% of the CFI plots in areas called lodgepole pine/bitterbrush had sufficient ponderosa pine basal area to be typed as ponderosa pine/bitterbrush. In additional areas, stumps reveal that numerous large ponderosa pine have been removed. In yet other areas, fire suppression has allowed lodgepole pine to migrate up the slopes from the frosty flats and replace the ponderosa pine that were there historically.

We feel that a high management priority should be shifting the forest composition on these sites currently occupied by lodgepole pine back to dominance of ponderosa pine. After these areas are identified, the lodgepole pine should be removed while retaining all existing ponderosa pine. Prescribed fire should be judiciously used to maintain and encourage a further compositional shift toward ponderosa pine.

Wet Lodgepole Pine

The wet lodgepole pine type represents a diverse array of moist and wet forested riparian areas dominated by lodgepole pine and a variety of hardwoods, including quaking aspen and willow. These are important habitats for a variety of organisms and ecosystem processes. For example, these areas have high plant and animal diversity, provide critical deer habitat (for food, cover, and fawning), buffer and "feed" aquatic ecosystems, and play a major role in hydrologic regimes.

Much of the wet lodgepole pine is believed to be in a degraded condition, due to increased lodgepole pine densities that have resulted from reduced fire frequencies. This has had adverse impacts on other important ecosystem components, such as aspen and willow, which are important to deer and many other elements of biological diversity.

The management goal for the wet lodgepole pine and related areas is restoration of the hardwood component of these areas by reducing pine dominance using mechanical means and fire. Since wildlife values are high in these areas, restoration prescriptions will be largely guided and results assessed by wildlife staff. Since there is relatively little experience in restoring such areas, restoration also will need to be highly adaptive in aggressively assessing and modifying prescriptions and techniques.

Initial restoration work in wet lodgepole pine will take place in more constricted riparian areas found in upland drainages, such as the narrow wetland zones found along intermittent streams in the Wildhorse Ridge area. The prescriptions will include felling and removal of green lodgepole pine, retention of snags (as possible given safety issues) and other coarse wood, and experimentation with prescribed burning.

Lodgepole pine on marginal and high elevation sites

Lodgepole pine often occupies severe, low productivity sites. Lodgepole pine may occur as an early successional species in subalpine areas such as the high elevation slopes of Yamsay Mountain. With fire on these slopes, lodgepole pine will maintain itself; without fire Shasta red fir, white fir, mountain hemlock or white pine will gradually take over. On the flatter, high elevation areas, lodgepole pine will remain dominant with or without fire. Pinemat manzanita is the most common understory shrub species.

Lodgepole pine habitat types also occupy intense frost pockets—generally flat basins where cold air accumulates in the winter, and which may be seasonally flooded. These areas have very low site productivity, regeneration is difficult to establish except under shrubs or trees, and the stand reverts to shrub-grass dominance for a number of years after burning. Bitterbrush is generally present and aggregated into patches. These areas can be important as mule deer habitat.

Finally, lodgepole pine occupies transitional areas between juniper and mixed-conifer forest south of Chiloquin. These areas vary in site quality and microclimate with a mixture of productive and marginal sites. Regeneration problems are common.

Lodgepole pine forests found on marginal sites and at high elevations probably are generally similar to those encountered historically and should generally be allowed to develop under natural disturbance regimes. Logging such sensitive habitats can often result in extended periods of deforestation.

Aspen, Willow, and Other Hardwoods

There is historical evidence that aspen, willows and other hardwood trees were more abundant in the Klamath forest in both upland and riparian areas (Coville 1902, USDI Geologic Survey 1921). The frequency and extent of aspen and cottonwood groves are one specific example; groves have disappeared entirely from some historical locations. Upland and riparian willow groves were numerous with, as an example, a willow complex of over 1000 acres reported on the Klamath Marsh by Coville.

Hardwoods provide an important resource for foraging animals such as deer. They also sustain many other elements of biological diversity and are the source of a variety of traditional goods. Hence, a comprehensive desired future condition for the Klamath Forest needs to include restoration and maintenance of aspen and other hardwood trees. This may be a challenging task because of the expanding elk populations within the Forest.

The 1921 USDI Geologic Survey forest type maps should be used to help identify the historical location and abundance of hardwoods of different species. These amounts and patterns of hardwoods would then guide restoration.

Meadows

Meadows are of critical importance in sustaining native biological diversity and plants, such as camas, that were historically important sources of foods and medicines. Hence, maintaining existing meadows and restoring conditions within these and other meadowlands that have been lost to trees is an important objective. Review of historical and current information suggests that significant meadowlands have been invaded by trees in the 20th century due to a variety of factors such as drainage of wet areas, grazing, drought, and fire control. The species composition of almost all meadows has been modified by introduction of exotics, often abetted by grazing, resulting in reduction or loss of the native plant component.

An active program to restore meadow conditions should begin with an assessment of the changes in meadow areas and conditions in the last 100 years. The 1921 USDI Geologic Survey and 1936 USDA Forest Service type maps should be utilized to identify the historical location and size of meadow complexes on the Reservation. In addition, we believe that habitat type information on wet, moist, and dry meadows (Hopkins 1979a, Hopkins 1979b, Volland 1985) can help develop an understanding of the plant composition of the different meadow types. Tribal knowledge on important plants to feature would be crucial to successful restoration. Field reconnaissance will be needed. All of this knowledge and work would then guide restoration.

Shrub lands, sagebrush, and juniper habitat types

As with the meadows described above, shrub and sagebrush habitat types make important contributions to biodiversity, food sources, and wildlife habitat. We would suggest a goal of restoring and maintaining a mixture of native grasses and various shrubs, including sagebrush, with a major emphasis on improving overall range quality for wildlife and the recovery of plants that historically have been important to the Tribes. Control of exotics is especially important.

Across eastern Oregon, the density of juniper on rangeland has greatly increased over the last 100 years, with the advent of fire protection and extensive grazing. Often, sagebrush has been crowded out by this expansion. Restoration may involve management with prescribed or natural fire and mechanical removal of juniper in some places, depending on the goals established for those areas.

Riparian Areas

As discussed in the Interforest Report, these areas include all of the critical areas with respect to ground and surface waters including seeps and springs. Riparian areas can be identified using a variety of overlays, including soil maps, plant associations, additional plant indicators, and landforms. Also, the Winema National Forest has used high elevation photography to estimate the forest characteristics of their riparian areas. Still field reconnaissance will be vital in understanding the condition of riparian areas and their potential.

On an acre-by-acre basis, there are probably few areas of higher value than the riparian areas of the Klamath Reservation Forest. Their scarcity in this arid environment only increases their value. We believe they should be managed to achieve and maintain their characteristic (historical) structure and function. As with much of the rest of the Forest this will involve restoring the large tree component and the hardwood patches along steams, marshes, springs, and seeps. As discussed earlier, historical records and type maps should be useful here in setting landscape goals.

Roads

For a very long time, trails have crossed the Klamath Reservation Forest. Many were turned into roads or tracks with the coming of the car and railroad. In the first few decades of the 20th century, a transportation system was established that facilitated movement across the reservation (Bowden 2003; Klamath Agency 1913; USDI Geologic Survey 1921). That system, though, had only a fraction of the mileage that now exists.

The Klamath Reservation Forest is now crisscrossed by many, many roads, most built to provide access for logging. The relatively gentle terrain makes it easy to build roads and difficult to close them.

To accommodate the needs for managing the forest, to improve conditions for deer, and to provide for solitude, among other reasons, the Tribes need to rethink the transportation system for the Klamath Reservation Forest. The Tribes should begin designing a transportation system that complements the Tribal vision for the future forest described here. In many places that will mean a lower, perhaps much reduced, road density.

Relationship of Proposed Approach to Climate Change

Climatic fluctuations, including global warming, are an important consideration in developing long-term forest plans. Such plans need to consider potential impacts of climate fluctuations on appropriate forest composition and forest health, including type and intensity of disturbances, for example.

Global warming is a long-term directional change in climate that would potentially affect the Klamath Forest. This is associated with increased levels of carbon dioxide and other greenhouse gases in the atmosphere. There is a scientific consensus that such warming is underway, although the nature and intensity of the change in climate vary with the region.

The Pacific Northwest and its forests are highly susceptible to climate changes that are predicted for the region. This is primarily due to the Mediterranean climatic regime characteristic of the region, particularly the highly seasonal precipitation; rainfall is concentrated during the winter months (and much of this is in the form of snow in the Klamath region) and summers are characteristically very dry. Consequently, summer drought is an important variable directly affecting tree vigor and growth as well as influencing frequency and intensity of fire and insect attack. Any climatic change that increases either the length or intensity of the summer drought period will have negative consequences for forest health (Franklin et al. 1991; Westerling et al. 2006).

Climate warming within the region is projected to result in increased annual temperatures, including summer temperatures, and small increases in annual precipitation but, unfortunately, little or no increase in summer precipitation. The net effect is that projected climatic changes in the Pacific Northwest will produce, on average, longer and more intense (drier) summer droughts.

If the predictions from the climate models are correct, the projected changes will have both direct and indirect effects on the Klamath Forests. Direct effects of warming will include increased plant moisture stress during the summer, which will, in turn, decrease annual growth and increase the physiological stress of trees. Increased populations of stressed trees will increase the potential for insect attack. The primary indirect effect of projected climate changes—longer and drier summer drought periods—will be an increase in the frequency and intensity of wildfires (Westerling et al. 2006).

The Klamath Forest restoration plan is well designed to accommodate climate change by increasing the forest's ability to resist both the direct and indirect effects of climate warming. It does this by:

- Reducing competition and the potential for drought-induced stress by reducing overall densities;
- reducing the potential for intense wildfires by lowering overall fuel levels and maintaining them at low levels through prescribed burning programs;
- favoring the most drought-tolerant and fire resistent species—ponderosa pine—over Douglas-fir and, especially, grand fir; and
- conserving old-growth trees, which are most resistent to drought and to wildfire.

The strong emphasis in the restoration plan of conserving the old-growth trees from both fire and competition is precisely the strategy that is most appropriate for managing forests under a regime of increasing temperatures and summer moisture deficits. Ponderosa pine is the most drought tolerant tree species (excepting only western juniper) present in the Klamath Forests. Old-growth trees—freed of heavy competition from younger trees—are the most resistent to drought stress. They are also the ecological "backbone" of the Klamath Forest ecosystem in terms of structure, function, and aesthetics—including provision of critical habitat elements to maintain characteristic species composition.

In summary, the Klamath Forest Plan is an appropriate response to current predictions regarding climate change. Activities proposed will make the forest more resilient to both direct and indirect effects of a climate that is warmer, has a more intense summer drought, and has an increased frequency and intensity of wildfire.

Part II: Current Condition and Needed Activities

Describing the Current Condition: Adapting and Quantifying the Interforest Structural Classification

The Sustainability Strategy developed by Interforest for the Tribes (Interforest 2000) utilized four structural classes to describe the ponderosa pine and mixed-conifer forests of the Reservation: 1) recovering clearcuts, 2) open, 3) simplified, and 4) complex. While the Interforest Report covered recovering clearcuts and open forest only briefly, it went into some detail in describing complex forests and simplified forests as summarized below.

Complex Forests

The Interforest Report defines structurally complex forests as follows (Interforest 2000, p. 21): "These are forests which retain much of the pre-management forest structure, including:

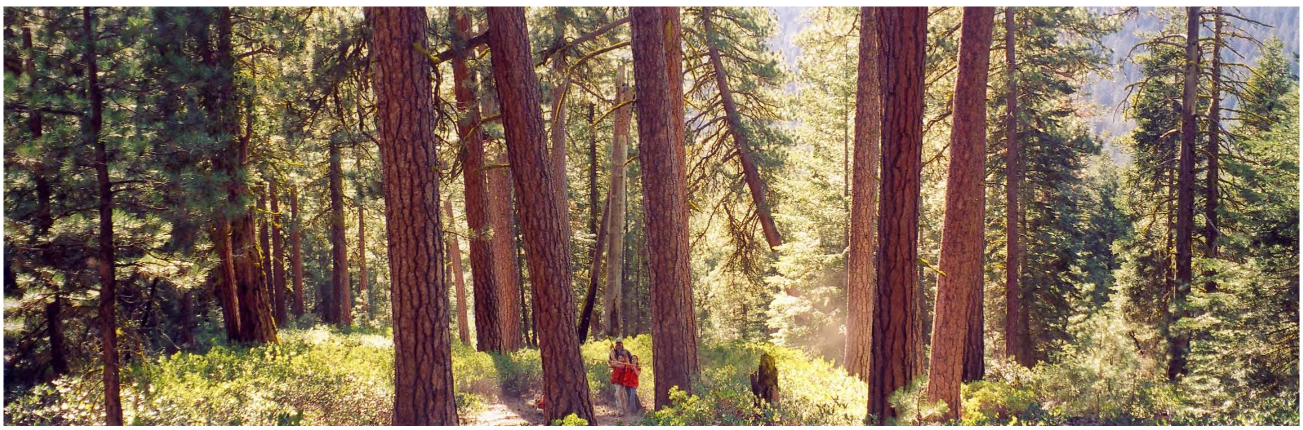
- A large-diameter tree component (including ponderosa pine when appropriate to the site);
- A spatially-complex pattern of stand structural units (e.g., large tree groves and open areas of dense regeneration);
- Coarse woody debris (snags and logs); well-developed understory communities of herbs and shrubs; and moderate tree stocking levels."

Figure 1 shows an example of a complex ponderosa pine forest. Individual patches can be relatively simple, i.e., trees all about the same size, but the mosaic of different sizes and ages creates the complexity. Thus, the structural complexity is achieved though a fine-scale mosaic of relatively simple patches along with scattered large trees, snags, and down logs (Franklin and Van Pelt 2004). Also, the pictures from the Klamath Reservation Forest in Appendix B show the elements of complex forests (big live and dead trees) and landscape pictures from Wildhorse Ridge/Bluejay Springs illustrate the spatial heterogeneity of complex forests.

Simplified Forests

As pointed out in the Interforest Report, much of the Klamath Reservation has been converted to a much more homogenized, denser, less healthy forest landscape with more shade-tolerant species, particularly white fir; many fewer large, old ponderosa pines; and dense stands of lodgepole pine. As stated in the Interforest Report (2000, p. 20), "comparing the current forest to the pre Euro-American settlement forests:

- Overall stand densities are much higher;
- Proportion of ponderosa pine is much lower;
- Density of large diameter trees (especially ponderosa pine) is much lower;
- Fuel loadings and continuity (ground to crown and crown to crown) are much higher;
- Fire regimes have shifted from frequent low-intensity burns to infrequent stand-replacing fires; and
- Overall condition of understory browse used by deer and elk has also deteriorated as a result of the changes in forest stand structure and fire regimes."



Complex forest on edge of Ya Whee escarpment

This shift from frequent low-intensity burns to infrequent stand-replacing fires is confirmed by Maps 3a and 3b in Appendix A from the Interior Columbia Basin Ecosystem Management Project (1996).

In addition, meadows have been degraded through fire suppression, grazing, conversion to exotic pasture grasses, and channelization. Also, meadows have been invaded by ponderosa pine and lodgepole pine.

As stated in the Interforest Report (2000, p. 22): "Currently much of the structurally-simplified forest offers low to moderate potential as wildlife habitat because of its uniformity and relatively high tree canopy cover which has reduced amounts and quality of understory browse. The potential for restoration is very high. Maintaining protective cover and limited sighting distances is an important consideration if significant commercial thinning is done; variable density prescriptions which maintain some denser patches will probably be needed to maintain desirable levels of hiding cover."

A Proposed Revised Classification

Our field work associated with this contract has caused us to suggest changes in the Interforest classification and to add quantitative standards to help judge where a stand fits in the classification:

Interforest Class	Revised Class	Number of live trees over 21”
Complex	Complex	at least 8-10
	Simplified with remnants	2 to 8-10
Simplified	Simplified	less than 2
Recovering clearcut		
Open		

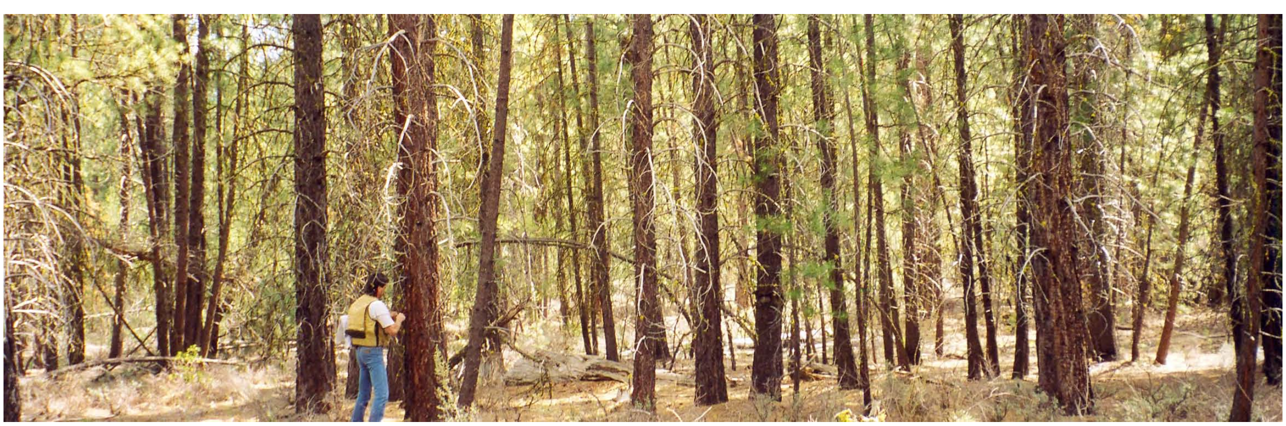
Our major change was to drop one class (open) and add one (simplified with remnants). We dropped the “open class,” which is largely confined to the ponderosa pine habitat types, for two reasons:

1) Small openings (1/8 to 1/2 acre) are a natural part of ponderosa pine forests.

2) A few of the openings are the result of regeneration failure following harvest. They are relatively uncommon on the forest (less than 500 acres), and do not seem to merit their own class. Larger (“unnatural”) open areas can be viewed as a subset of recovering clearcuts as they have been caused, by and large, by harvests that removed all of the overstory trees. They can vary from a few acres to 20-50 acres in size. Although there are few such areas, their recovery may take a very long time.

We merged “recovering clearcuts” with “simplified” because the seedling and sapling stands in the clearcuts are in the early stages of simplified forest. Actually, most of the acres previously called “simplified forest” are plantations established after wildfire and subsequent salvage and replanting.

We added a class called “simplified with remnants” to reflect a common condition on the Reservation forest, especially in the ponderosa pine types. Tribal harvest on the Reservation (from 1920 to 1955) generally left a remnant overstory of 2 or more residual trees. Many of these lands today contain 2-8 residual trees per acre over 21 inches. They do not have enough large remnant trees



Simplified forest at the base of Solomon Butte to be called “complex” but they have too many to be called “simple.” Therefore, we have created a new class, which is the most common class on the forest.

Locating the Remaining Complex Forest

As pointed out in Part 1, “habitat types” provide the best ecological basis for stratifying the Klamath Reservation Forest into areas with different potentials, and, consequently, different responses to management regimes (Map 2, Appendix A). The habitat types are named after the plant associations that identify and characterize these sites: USDA Forest Service area ecology plant association guides are the primary source of this information (Hopkins 1979a, Hopkins 1979b, Volland 1985). The understory shrubs, herbs, and grasses are especially important to the classification. These plant associations integrate soil, microclimate and other conditions and, as such, are useful guides to productivity, species that are likely to be successful on the site, and potential regeneration problems.

The Interforest Report estimated that approximately 100,000 acres of complex forest remained in 1988 on the ponderosa pine and mixed-conifer habitat types of the Reservation Forest. This estimate was based on an analysis of 1988 classified imagery. However, we found this imagery difficult to use for identifying old growth forest on the ground.

Remnant structure on the Ya Whee plateau

As an approximation of this remaining complex forest, we are fortunate to have an “old growth” map developed in the late 1980s-early 1990s for the Winema and Fremont National Forests through a cooperative effort of the Audubon Society and the Forest Service. A number of local people, especially Mark Gaffney, took the lead in this effort working with the Chiloquin Ranger District. They used stand exam and other information to identify candidate ponderosa pine and mixed-conifer stands and then went to the field to identify those stands that met the definition. The Forest Service checked the type calls, but did not change them as they seemed generally on target, given that judgment is always needed in these cases. According to the Forest Service, the mapping used a criterion of at least 10 trees/acre over 21 inches as a guide, but also identified as old growth, stands with fewer but larger trees, yellow bark stands that might fall short of 21 inches, and others that filled spatial gaps. The mapping keyed on the number of big trees under the assumption that the big trees could provide other components (such as large snags) through time as needed. District personnel then created a GIS coverage of the identified old growth areas. District personnel tried to use 10 acres as a minimum mapping unit but did include some areas below 10 acres that could be justified. Generally, the areas are amalgamations of stands delineated during stands exams, except where part of the stand had been cut. Most are multi-storied stands (Conversation with Chiloquin Ranger District silviculturist Steve Mooney, July, 2002).

Old growth was also mapped, using similar processes and criteria on the other Ranger Districts within the Reservation Forest: Chemult District of the Winema National Forest and the Bly and Silver Lake Districts of the Fremont National Forest. Our understanding of the details of this mapping on these other Districts is somewhat limited.

The Winema National Forest used the layer to identify areas to be reserved as old growth in addition to the areas reserved in their Forest Plan as part of meeting “Management Requirements.” A plan amendment was then written that selected some of the areas as reserves. These reserved areas are identified as Management Area 7 in Forest Plan allocations and include Wildhorse Ridge and Chiloquin Ridge (Conversation with Chiloquin Ranger District silviculturist Steve Mooney, July, 2002).

We have field checked the old growth map, with the help of Will Hatcher, after updating it for fires and harvests that occurred after it was made. In general, we found the map to accurately reflect the complex forest remaining on the Reservation. We have changed only a few of the polygons, with most of those changes in the areas north of Chiloquin that were harvested in the 1920s. We feel that those “old growth” areas are now dominated by simplified forest with an old growth remnant as is much of the area around them. After these adjustments, we have approximately 103,000 acres of complex ponderosa pine and mixed-conifer forest out of a total of 499,000 acres ponderosa pine and mixed-conifer habitat types on the Reservation Forest (Map 4 and Map 5 in Appendix A, Table 6).

The old growth map also identifies some old growth in the lodgepole pine habitat types, especially on the Fremont National Forest. We have not assessed the accuracy of this mapping.

Charlie Knight’s cabin

Table 6. Complex (old growth) acres by habitat type on the Klamath Reservation Forest

Habitat type	Complex Forest	Total Area	%of Habitat Type
	Thousands of acres		
Ponderosa pine/mixed conifer			
Ponderosa pine/bitterbrush	69.6	358.8	19
Mixed conifer/snowbrush	22.3	84.9	26
Moist mixed conifer	10.7	38.7	28
Ponderosa pine/sagebrush	.4	16.5	2
Total	103.0	499.0	21
Lodgepole pine			
Lodgepole pine/bitterbrush	5.1	76.3	7
High elevation/marginal lodgepole	.6	16.0	4
Wet lodgepole	3.0	22.8	13
Total	8.7	115.1	8
Overall Total	111.8	614.1	

Considering Watersheds and Rivers

Most of the Klamath Reservation is in the Sprague and Williamson watersheds (Map 6, Appendix A) which run into Upper Klamath Lake. Other major rivers include the Wood River on the western boundary of the Reservation and the Sycan River which runs into the Sprague. There are few other perennial streams within the Klamath Reservation Forest -- most run a month or two in the spring.

The major rivers are primarily on private land with the exception of the Sycan, which is a Wild and Scenic River. Species diversity in the Sycan River is very high. Fish species known to inhabit this segment include rainbow, brook, and brown trout; Pacific lamprey, Pit-Klamath brook lamprey, speckled dace, chubs, and sculpins. In addition, the Klamath large-scale sucker, the Oregon lakes tui chub, and the redband trout, all federal category 2 sensitive species, have been found in this river. Historically, the Sycan was also inhabited by the shortnose sucker and the Lost River sucker, both endangered species on the federal list. Bull trout, another federal category 2 sensitive species, was probably also present in the past.

Most of the Klamath Reservation Forest is under the aquatic guidance of the Inland Native Fish Strategy (INFISH). Management of the lands should meet or exceed the standards in INFISH. The standards in this strategy cover requirements on operations near streams, lakes, and wetlands along with the designation of buffer widths, and goals and requirements for management within buffers. The remainder of the forest falls under the standards in the Aquatic Conservation Strategy of the Northwest Forest Plan.

An Overall Strategy for Restoring the Klamath Reservation Forests

The long-term management goal (desired future stand conditions) should be to restore and maintain structurally complex stands dominated by ponderosa pine—including a permanent population of large, old pine trees—across the ponderosa pine and mixed-conifer habitat types. Old maps, such as the 1936 USDA Forest Service type map of the Klamath Reservation Forest confirm such a historical ponderosa pine dominance across the Reservation Forest (USDA Forest Service 1936) as do many of the early reports and surveys (Langille, et al. 1903; Leiberg 1900). Complex, ponderosa pine-dominated forest can be accomplished through carefully designed silvicultural treatments using tree removal and prescribed fire along with mowing to revitalize the shrub understory. All harvests would be in the form of partial cuts with the objective of reducing overall stand densities *as well as restoring spatial heterogeneity within the stand* (i.e., variable density prescriptions).

Desired basal area (the aggregate cross-section area of trees measured at 4.5') levels and densities will vary across the gradient of habitat types. Target stand basal area levels for the drier end of the range will be 30-50 sq ft/acre in contrast with 120-140 sq ft/ acre on the moistest and most productive habitat types. Large diameter trees (trees>21" dbh) will generally dominate the stands, often comprising more than two-thirds of the basal area.

In setting restoration priorities, we recommend that forest management on the Reservation Forest set the highest priority on conserving the areas of complex forest that now exist. A significant buildup in stand density has occurred on many complex areas that threatens their continued existence (see the pictures of Little Yamsay Butte, Fuego Mountain, and the plateau above the Sycan River). Old growth clumps and trees outside the complex forest areas are similarly threatened (see the picture of the forest on Spring Hill). They should also have a high priority for treatment. Ideally, projects will encompass complex areas in need of treatment as their core and then radiate out to include as much of the simplified with remnant areas and simplified areas as feasible. Thus, first, and foremost, management should be directed toward reducing the threat to these complex areas and old growth remnants. This should be done in a way that maintains and enhances the spatial complexity of these forests.

Second, management should be directed toward restoring the forage base for big game on the Reservation. The bitterbrush and other browse species have become decadent due to lack of fire and other disturbance and from competition from overstory trees. Action, such as patchy burning and mowing, needs to be taken to begin revitalizing bitterbrush and other brush species. In some places, especially draws and other relatively moist areas, forbs and hardwoods have been crowded out by invasive lodgepole pine due to lack of disturbance. Tree cutting and the reintroduction of fire should reverse these problems.

Third, special care must be given to riparian areas following guidelines in INFISH and related federal conservation strategies. While these areas occupy a relatively small part of the landscape, they make invaluable contributions to water quality, fish habitat, and wildlife habitat.

Fourth, roads now saturate much of the Reservation Forest. Management needs to begin reducing the road system to the system that existed in the days of the Reservation.

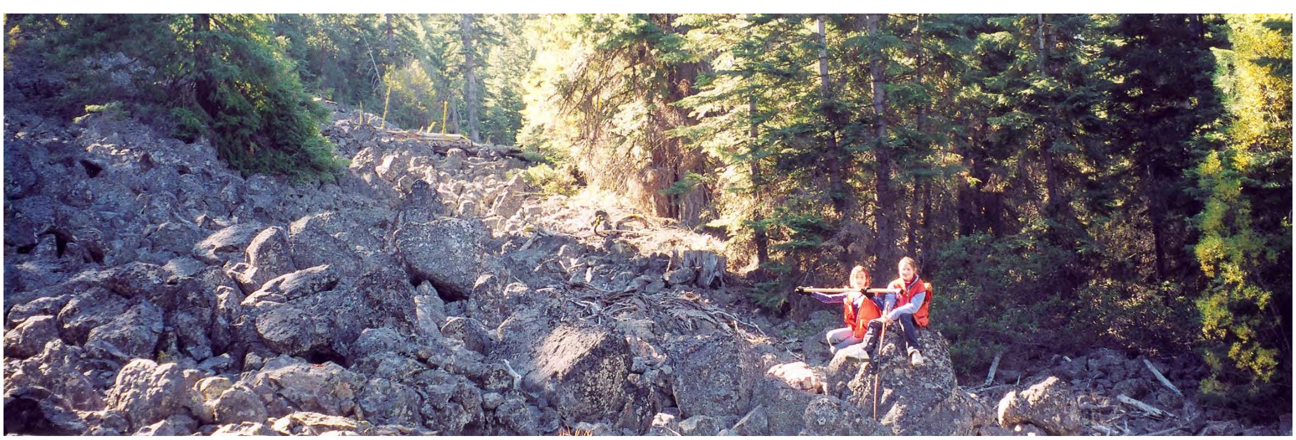
Some of the actions suggested here are well-proven; others will be experimental. We will propose an adaptive management plan to help accelerate learning about the effectiveness of the actions suggested here.

Recognizing Different Management Emphases on the Reservation Forest

To help guide the effort and increase understanding of our approach, we have constructed a map showing the location of proposed management emphases on the Reservation Forest (Map 7, Appendix A). These management emphases establish goals, standards and guidelines for each part of the Klamath Reservation Forest. In constructing this map, we were guided by the following principles: 1) recognize management emphases designated by federal law (Sycan Wild and Scenic River) or directly related to compliance with federal law (Bald Eagle Habitat); 2) recognize management emphases that will help accelerate learning though systematic study of forest ecosystems (Bluejay Springs Research Natural Area); and 3) recognize management emphases important to implementing the Tribe's sustainability strategy (remainder of the management emphases). The proposed management emphases are:

Bluejay Springs Research Natural Area—This area adjacent to Bluejay Springs has been administratively designated as a Research Natural Area by the USDA Forest Service as part of their region-wide system of natural areas. The Bluejay Springs Research Natural Area provides a research natural area for the ponderosa pine/bitterbrush type and can serve to assist in learning more about management of this type. This area would be managed primarily for research studies.

Riparian —Wet meadows and areas near streams are included here. These areas would be managed primarily to support the ecological functions of these systems. Any active management, such as tree planting, prescribed fire, and tree removal, would require great care in planning and monitoring to ensure that the desired ecological effects would result.



Sycan Wild and Scenic River—A portion of the Sycan River has been designated as a federal Wild and Scenic River. An area ¼ mile on each side of the designated portion of the Sycan River (see Map 7, Appendix A) must be managed to help conserve the outstandingly remarkable features of the river.

Ya Whee escarpment

Bald Eagle Habitat— A scattering of areas across the reservation are favored by the American bald eagle. These areas would be managed with the primary goal of supporting bald eagle habitat features.

Complex forest (old growth)—There are areas of ponderosa pine and mixed-conifer forest that currently have many of the characteristics of complex forest, especially the number of big, live trees. They would be managed to conserve and enhance the features of complex forests.

Restoration Forest—These are areas of ponderosa pine and mixed-conifer forest that currently are categorized as remnant forest or simplified forest. The focus of management in these areas would be to move them toward the characteristics of complex forest.

Lodgepole pine/bitterbrush—Lodgepole pine/bitterbrush types should be managed to emulate historical disturbance processes (see Part I for more details).

Marginal site and high elevation lodgepole—These are lodgepole pine habitat types that are difficult to actively manage due to the harshness of the site and the relatively low productivity and include much of Yamsay Mountain. In general, tree removal would not occur. Other management, such as prescribed fire, would require great care in planning and monitoring.

Wet lodgepole—These are lodgepole habitat types that are wet or moist in the spring and into the summer. They would be managed primarily to support aquatic and wildlife values. Active management, including removal of lodgepole pine, would be needed in many cases to reduce lodgepole dominance and encourage grasses, forbs, and hardwoods.

Big game winter range—These are areas that historically have been important to deer as winter range. While deer use of these areas in the winter has declined rapidly, and the portion of the range on private land in the Sprague Valley has been fragmented with development, the winter range will still be important as the herd recovers. We have shown this emphasis as an overlay on the emphases described above, as it will augment but not replace them.

Note: Dry meadows, shrublands, and scab flats are scattered throughout the management emphases recognized here. These areas would be managed to support a productive native flora using, as appropriate, prescribed fire and tree removal among other techniques.

Comparison to the Forest Service Plan

These proposed management emphases can be compared to the management emphases in the Forest Service long-term plans (Map 8, Appendix A). The Forest Service management emphases (allocations) have a significant acreage in “Timber Production,” while our proposed emphases have the majority of acreage in maintaining or restoring complex forest. Actually the Forest Service recognizes two emphases that have timber production as a goal (Map 8, Appendix A): 1) Timber Production in Matrix (Northwest Forest Plan) and 2) Timber Production in General Forest outside the Northwest Forest Plan (Winema and Fremont Forest Plans).

Much of the Reservation Forest west of Highway 97 and southeast of Chiloquin falls under the guidance of the Northwest Forest Plan (NWFP). That plan envisions fairly intensive timber production outside of Late-Successional Reserves which also were identified in the NWFP and are intermingled with timber production areas (Map 8, Appendix A). So far, the Forest Service has been unable to work through the requirements for tree removal in the Matrix. Full implementation of the NWFP in the Matrix, though, would allow significant harvest of the large, old trees there. Management of the late-successional reserves under the NWFP, on the other hand, could be similar to management under our proposal.

The long-term management of the Forest Service’s Timber Production allocation on the remainder of the Reservation Forest is unclear. While their management plans call for intensive timber production in this emphasis, a temporary addition to the plans in 1995 (the “east side screens”) call for management much closer to that envisioned in our proposal. Without the eastside screens, most of the remaining old ponderosa pine trees in the timber production areas would be harvested; with the eastside screens, most of the remaining old ponderosa pine trees would be retained. It is unclear which management strategy will prevail over time.

The Forest Service has significant acreage allocated to scenic management and a special upper Williamson Management Area. In these areas, bigger trees will be grown than in the timber production emphasis and tree removal will not be so visible. We do not recognize these allocations, as we feel our proposal will provide large trees and a pleasant view.

The Forest Service recognizes some but not all of the complex forest areas as “old growth.” Complex forest areas in other allocations would be managed to meet the goals of those allocations.

The Forest Service also recognizes a number of other allocations representing administrative decisions made through the planning process that we do not recognize. These include a special recreation area on Yamsay Mountain, special management areas on the eastern side of Saddle Mountain and in the Badlands. We feel those designations go beyond our assignment and should be left to the Tribes to determine.

Identifying Management Reference Sites and Generalized Prescriptions

We located, characterized, and photographed a series of Management Reference Sites representing the major forest conditions and their structural stages (Map 9, Appendix A). Also, we suggest silvicultural treatments for each reference site to move it from the current conditions to the desired future condition (see detailed prescriptions below).

The Interforest Report (2000) stated that there should be no commercial harvest within complex ponderosa pine or mixed conifer forest in the next decade, in part to ensure that large old trees in these areas would not be cut. In addition, the report calls for no harvest of trees over 21".

In the initial drafts of this plan for the Klamath Reservation Forest, we excluded timber harvest activities in the complex ponderosa pine and mixed-conifer forests, as originally proposed in the restoration vision developed by Interforest and adopted by the Klamath Tribes. There were several reasons for this proposed restriction, including the desire to focus restoration work on sites considered to have higher priority, and to clearly signal the intent to protect old forest and trees, as well as an erroneous impression that the complex forests were not at high risk. However, beginning early in the development of this plan, as much more extensive field work was undertaken, it became clear that some assumptions in the prescription for complex stands were not valid. We came to this conclusion for four reasons.

First, we quickly became aware that complex mixed-conifer forests—and the residual old-growth trees of ponderosa pine and other species that they contain—are at high risk of (1) uncharacteristic stand replacement fire eliminating the entire forest; and (2) severe competition from elevated stand density which will make the old-growth trees vulnerable to insects, especially during drought, even if the stands do not burn. On field inspection, it became clear that commercial-sized, young-growth ponderosa pine, lodgepole pine, Douglas-fir and white fir will need to be removed in mixed-conifer complex forest areas to complete the treatment. As an example, see the prescription for the Black Hills complex mixed conifer Reference Site.

Second, we learned that some of the ponderosa pine complex stands were threatened by the invasion of lodgepole pine necessitating silvicultural treatment of these stands where that condition occurs.

Third, we realized that the dominant condition on the Klamath Forest was actually forest of simplified structure, but with residual old-growth trees. In fact, we discovered more residual old-growth ponderosa pine within the "simplified with residual" forest than within the "complex" forest.

Fourth, we were increasingly aware of the arbitrary nature of a diameter limit (usually 21") as a screen, above which tree harvest was generally not allowed, and below which anything could

Aftermath of wildfire, salvage, and replanting near Yainax Ridge presumably be removed. An initial problem with this diameter limit was that young-to-mature trees of more shade-tolerant species (typically white fir and Douglas-fir)—which formed key ladder fuels and needed to be removed to protect residual old-growth pine—sometimes exceeded 21 inches in dbh We adjusted for this by allowing for removal of young and mature trees up to 24 inches in dbh if necessary to protect residual pines. A second problem with the diameter limit was that there are significant numbers of old-growth ponderosa pine trees that are less than 21 inches dbh These small but old orange-bark trees also may have significant ecological value and are, in any case, a part of the old-growth pine population that we are trying to maintain and restore.

Wet meadow in the Wright's Meadows complex

These issues associated with the 21-inch dbh limit were subsequently discussed during several field trips with stakeholders, including professionals from the Klamath Tribes and Winema National Forest. Both our findings and subsequent discussions have led us to conclude that, given the restoration objective of the plan**,** couching our strategy in terms of a general 21-inch dbh limit on trees that can be removed is inappropriate**.** We therefore propose to replace this limit with a policy that is premised on (1) retention of *all* old-growth trees (live and dead), regardless of size and species, (2) removal of young-growth (non-old-growth) trees as necessary to protect residual old-growth trees and reduce stand density regardless of their size, with a special focus on removal of white fir and lodgepole pine and (3) use of the 21" demarcation to describe targets for the basal area of large trees by plant association.

Appropriate silvicultural activities are expected to include spatially variable stand thinning regimes that enhance stand diversity as well as individual tree development. Any old trees that are encountered are to be retained and protected. Target levels for such variables as basal area and old tree populations should be done by individual plant associations. Silvicultural activities should give high priority to: (1) protection of old trees from wildfire and competition, such as by removing fuels and competing vegetation, and (2) restoration of historic old tree population levels.

General objectives of silvicultural activities should be to:

1) reduce basal areas in overstocked stands
2) increase the mean diameter of stands
3) shift composition toward more fire- and drought-tolerant species, such as ponderosa pine, sugar pine, and western larch
4) restore historical levels of spatial heterogeneity
5) protect existing old growth
6) provide for restoration and maintenance of historic old growth population levels by management of younger stand components

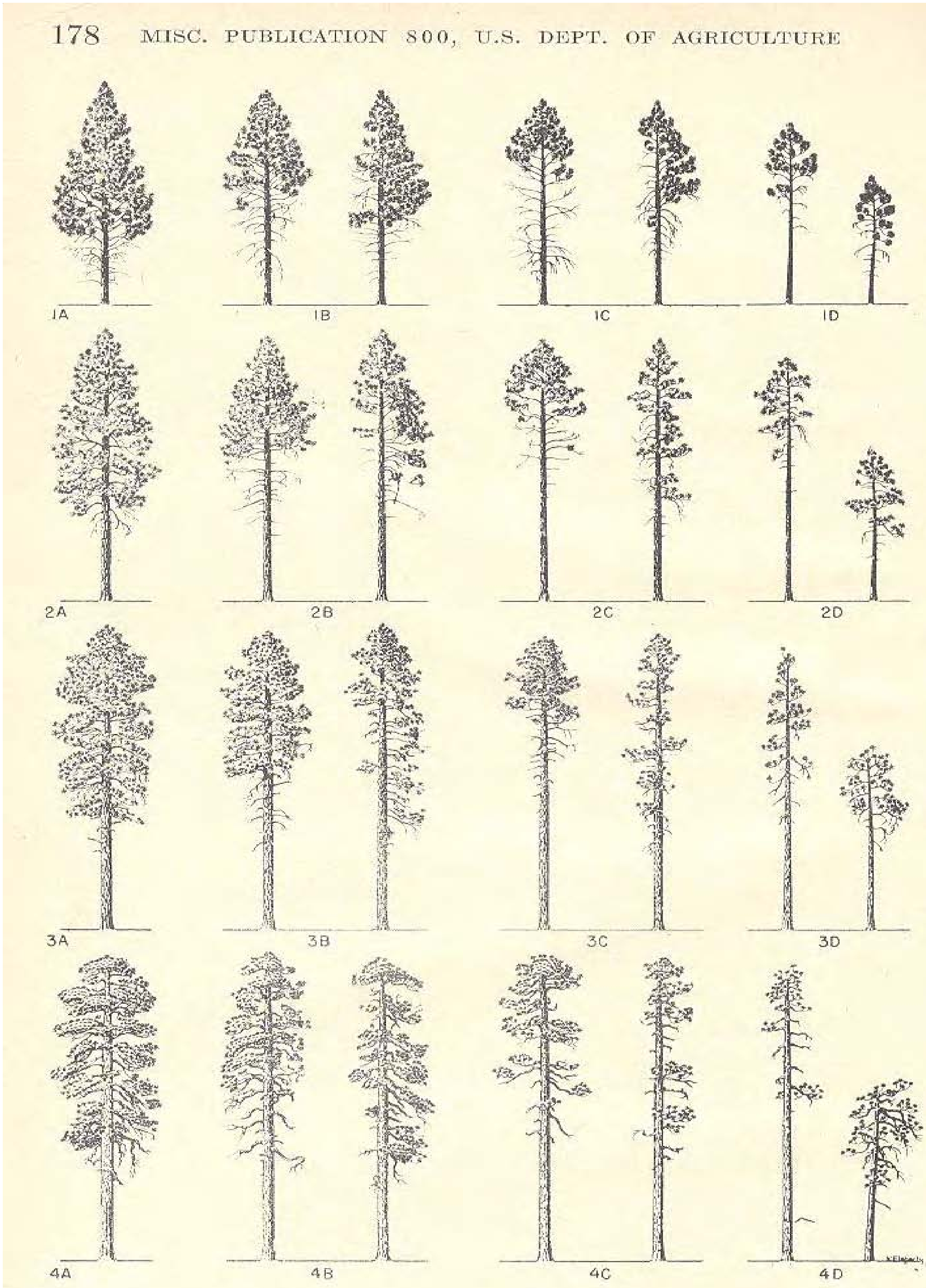


Figure 3a. Ponoderosa Pine tree classification, based on age and vigor. Age increases from 1 to 4, and vigor decreases from A to D (Miller and Keen 1960).

Character	Class 1	Class 2	Class 3	Class 4
Age	Usually less than 80 years	Approximately 80 to 180 years	Approximately 180 to 300 years	More than 300 years
Height	In lower canopy usually less than 60% of total height of mature canopy	Height usually less than 90% of mature canopy	Height practically that of general crown canopy (except of intermediate, suppressed, or topkilled trees)	Full height of general canopy (except suppressed, spike-topped, or broken trees)
Growth & taper	Thrifty trees making rapid height and diameter growth. Rapid taper	Considerable height growth still in progress; good diameter growth in thrifty trees. Taper considerable.	Height growth practically complete; diameter growth slow. Moderate taper.	Making no height growth; diameter growth very slow. Least taper.
Bark color	Dark grayish brown to black (except at extreme base)	Dark reddish brown on lower half of bole; dark bark on upper half.	Light reddish brown on lower three-fourths of bole; dark bark showing in upper one-forth of bole.	Light yellow; uniform color throughout bole (except at extreme top)
Bark Plates	No plates. Rough bark, deeply furrowed, with narrow ridges between fissures	Narrow smooth plates between fissures	Moderately large plates between fissures	Plates usually very wide, long, and smooth; fissures often rather shallow
Branches	Branches upturned in upper three-fourths of crown; small for diameter of bole	Mostly upturned in upper half of crown; lower half horizontal or drooping; small to medium for diameter of bole	Upturned near top; middle horizontal; lower ones drooping; moderate for size of bole.	Large, heavy limbs, often gnarled or crooked; mostly drooping, except in extreme top.
Whorls	Whorls distinct in upper crown	Whorls distinct in upper half of crown	Whorls indistinct except at extreme top of crown	Whorls indistinct and incomplete
Top	Top usually pointed	To usually pointed, sometimes rounded	Top usually pyramidal or rounded, sometimes pointed	Usually flat, occasionally rounded or irregular

Character	Class A	Class B	Class C	Class D
Crown vigor	Full, vigorous	Good to fair	Fair to poor	Very poor
Crown length	Long, 55% or more of total height; or less only if more than average width	Average length, less than 55% of total height (approximately 30% to 55% if full and wide) or a longer crown if narrow or somewhat thin	Short (from 10% to 30% of height, if crown of normal density) or long, sparse, and narrow	Very short (less than 10% of total height) sometimes merely a tuft at top of tree, or somewhat longer than sparse and ragged
Crown width	Usually average width or wider (narrower if very long and dense)	Usually average width or narrower; may be flat on one side	Usually narrow or flat on one or more sides	Usually very narrow and sparse, or limbs all on one side
Crown density	Usually full and dense or of medium density if longer than 55%	Usually of full to medium density, not sparse or ragged	Often sparse and ragged except at very top	Sparse and ragged
Foliage	Needles of average length or longer, usually dense and thrifty	Needles of average length, usually dense and thrifty	Needles often short and thinly distributed, but of normal length and density when confined to top one-third of crown	Needles often short; foliage sparse or scattered or only partially developed, but of normal length if reduced in quantity
Position	Usually isolated or dominant, rarely codominant	Usually codominant; sometimes isolated or dominant, rarely intermediate	Usually intermediate; sometimes codominant or suppressed, but rarely isolated or dominant	Usually suppressed or intermediate, but may occupy other positions if greatly reduced in vigor.
Diameter	Large for age	Average or above for age	Usually below average for age	Decidedly subnormal for age, but very old trees may be of large diameter

Figure 3b. Crown vigor and age class descriptions adapted from Barrett, 1979.

A generalized prescription for both ponderosa pine and mixed-conifer habitat types is as follows:

1) Identify old growth trees as follows: a) Keen class 3 and 4 for ponderosa pine (Figure 3) and b) all trees of other species over 150 years (breast height age) using bark and form characteristics.

2) Retain all old growth trees while removing competing trees and ground and ladder fuels within a diameter of the tree drip-line multiplied by two;

3) Identify denser patches of saplings and/or poles to remain untreated (not thinned) totaling approximately 10-15% of the area of the stand;

4) Thin the remainder of the stand under the following guidance:

    a) Achieve overall basal area goals for trees under 21" inches dbh on a stand basis (Table 5), leaving a distribution of diameter classes favoring the pines (ponderosa and sugar pine) where they occur. Put the highest priority on removing young growth white fir and lodgepole pine wherever they occur. In this process, release mature trees with potential to be old tree replacements, thus providing a continuing flow of mature trees keyed to achieving and sustaining the desired future condition.

    Do not harvest old growth trees under 21". In general, this should be an issue only for ponderosa pine trees, as other species will generally be over 21" by 150 years of age. It may also occasionally be an issue for lodgepole pine.

    b) Thin young-growth trees over 21" as follows:

    i) White fir trees— kill young-growth white fir over 21" as needed to meet the goal of an average of two snags per acre in the stand over 21" in the mixed conifer types. Other large, young-growth white fir can be removed from ponderosa pine and mixed conifer types as needed to meet species and stand structure goals. An average of two large, live white fir per acre in the stand (including any old growth trees) should be left in the moist mixed conifer type.

    ii) Other species: Young-growth trees over 21" can be removed as long as the average residual basal area of trees over 21" in the stand meets or exceeds the minimum (Table 5). In this process, ponderosa pine and sugar pine should be favored for retention.

5) Prescribe burn following thinning, as needed, to reduce fuel loadings while recognizing the need to restore/maintain a healthy bitterbrush population where this shrub is present.

Inventory and Monitoring

In this section, we suggest an inventory and monitoring plan for the Klamath Reservation Forest (Table 7). We frame this plan within the general structure of adaptive management.

Adaptive management has four key elements (from Davis, et al. 2000):

1) A ruthless hold on uncertainty (Gunderson 1999). Adaptive management starts with an acknowledgment of the uncertainties surrounding proposed management policies. Ideally, management policies are a means to one or more goals. Whether these policies will in fact achieve the goals is uncertain. Often, some "key bet" underlying the policy must hold for the policy to move the organization toward its goals. Identifying those key bets about which you are uncertain is critical in successful application of adaptive management. They enable forest managers to focus their energies on crucial assumptions made in development of policies. We have identified key bets about which we or others might be uncertain in the matrix shown below under the column entitled key bets/hypotheses. As an example, the first key bet is that harvest will retain old, large trees. They are grouped into four major categories: 1) project implementation (Did the managers take the actions prescribed in the projects? Did they undertake the projects in a cost-effective manner?), 2) forest-wide (landscape) implementation (Did the projects consider the landscape context and priorities for treatment described in the forest management plan?), 3) project effectiveness (Did the projects have the intended effect on the project area?), and 4) forest-wide (landscape) effectiveness (Is the forest condition moving toward the desired condition? Are desired goods and services being produced at a reasonable cost?) We feel that Table 7 is a good start in identifying the key bets that the Tribes will want to use to evaluate the forest plan, but, undoubtedly, more will need to be added as the plan is implemented.

2) The description of key bets as testable hypotheses. It is important to describe these key bets as testable hypotheses such that information can be gathered about them. Given these key bets, we turn them into testable hypotheses by adding two attributes to each bet: 1) what will be measured to assess the validity of the hypothesis, 2) the standard or expectation to which the results will be compared to judge whether the hypothesis should be accepted or rejected. As an example, the key bet that harvest will retain old growth trees becomes the testable hypothesis by adding how this supposition will be measured (number of old growth trees cut) and the standard to which the measurements will be compared (no old growth trees cut).

3) The search for, and use of, information that will allow testing the hypothesis or hypotheses. This can range from informal observations of foresters and other specialists, to the study of the latest research results, to formal replicated experimental design, but do require a conscious attempt to assess the validity of the hypothesis or hypotheses in question. For each hypothesis, we suggest the kind of measurement that would be used in the last column of the table. As an example, the measurement of the number of old growth trees cut would be done through a post project survey of the project area.

4) An institutional mechanism that ensures that the hypotheses will undergo periodic, fair-minded review and management policies can change as a result of that review. As part of this review, evidence of policy failure must be able to surface and be fairly considered.

> Many people (Bella, 1993, Davis, et al 2001) have noted that it is often difficult for people and organizations to admit that policies, in which they are invested, have not been successful in helping achieve their intended goals. It is important to have some mechanism to ensure that policy success and failure can be fairly considered and policies can change as a result.

As an institutional mechanism here, we suggest that a Klamath Forest Review Board (KFRB) be established that will meet periodically to assess how well the management of the Reservation Forest meets the goals set forth in the Forest Management Plan. The board would be composed of well-known scientists and managers with knowledge of the types of forests found on the Reservation. We would suggest that the scientists have expertise in ecology, economics, biometrics, and silviculture, and that the managers have experience in administering large forested areas with goals similar to those of the Reservation Forest. At least one of the scientists should have been a participant in the creation of the Interforest restoration strategy that provides the strategic objective for the plan.

We suggest that the KFRB be given the assignment of assessing whether the actions being undertaken under the Forest Plan were helping to meet the goals of the Forest Plan. To answer this question, we envision that the KFRB would 1) meet annually or biannually with the meeting including a field visit to the Reservation Forest; 2) utilize the monitoring results to test the hypotheses of the adaptive management plan; 3) suggest changes in management, as needed, to enable a closer match between the plan goals and the actions taken under it; 4) suggest changes in the monitoring plan, as needed, to enable better assess management performance; and 5) report their findings and recommendations to the Tribal Council both orally and in writing.

Table 7.

Hypothesis	*Measure*	*Standard*	*Monitoring method*
PROJECT IMPLEMENTATION			
TIMBER HARVEST			
Timber harvest will retain old trees	Number of old trees cut	No old trees cut	Post project survey
Timber harvest will move the stand closer to the desired structure	Number of trees by diameter class and basal area by species	Desired distribution (historical distribution slightly modified by wildlife and other goals)	Pre and post project surveys
Timber harvest will reduce fuel loadings to levels such that fires will tend to have their historical effects	Stand density; also some other measure of fuel hazard such as crown mass and measure of ladder fuels	Density targets met; other fuel hazard standards met; harvest moves stand at least 80% towards historical densities	Post project survey
Timber harvest will reduce the direct fuel hazard to large, old trees	Proportion of large, old trees surrounded by ladder fuels judged significant enough to move a hot ground fire into the old tree canopy.	Less than 10% of large, old trees surrounded by ladder fuels likely to move a hot ground fire into their canopy.	Post project survey
Timber harvest will cause little damage to residual stand	Number of trees over 12” with moderate to heavy damage from logging	Few trees over 12” suffering moderate to heavy damage from logging	Post project surveys
Timber harvest will leave a residual stand with the desired spatial heterogeneity	Number of patches of saplings and poles; size of patches; interior density of patches	Further analysis needed to set standard	Post project survey
Timber harvest will retain snags	Proportion of snags retained after harvest	All snags retained after harvest, except for those felled (and left in place) for safety reasons.	Post project survey
Timber harvest will provide down wood	Down wood levels	Designated down wood levels	Post project surveys
Timber harvest will reduce conifer competition in hardwood patches	Percentage of hardwood patches in which conifer competition has been substantially reduced	Further analysis needed to set the standard	Post project survey
Timber harvest will create conditions conducive to bitterbrush revitalization	Amount of area opened up and disturbed??	Further analysis needed to set standard	Post project survey

PRESCRIBED FIRE			
Prescribed fire will reduce fuel loadings to levels such that fires will tend to have their historical effects	Stand density; also some other measure of fuel hazard such as crown mass and measure of ladder fuels	Stand density targets met; other fuel hazard standards met; harvest moves stand at least 80% towards historical densities	Post project survey
Prescribed fire will burn in a patchy fashion leaving a residual stand with the desired spatial heterogeneity	Percent of area burned/number and size of burned or unburned/lightly burned patches	Analysis needed to set the standard	Post project survey
Prescribed fire will kill few large, old trees beyond those needed for snags	Number of large, old trees killed by fire	Number of large, old trees killed that exceed snag targets	Post project surveys (2 surveys at least 2 years apart)
Prescribed fire will help reduce conifer competition in hardwood patches	Percentage of hardwood patches in which conifer competition has been substantially reduced	To be determined (varies between uplands and draws)	Post project survey

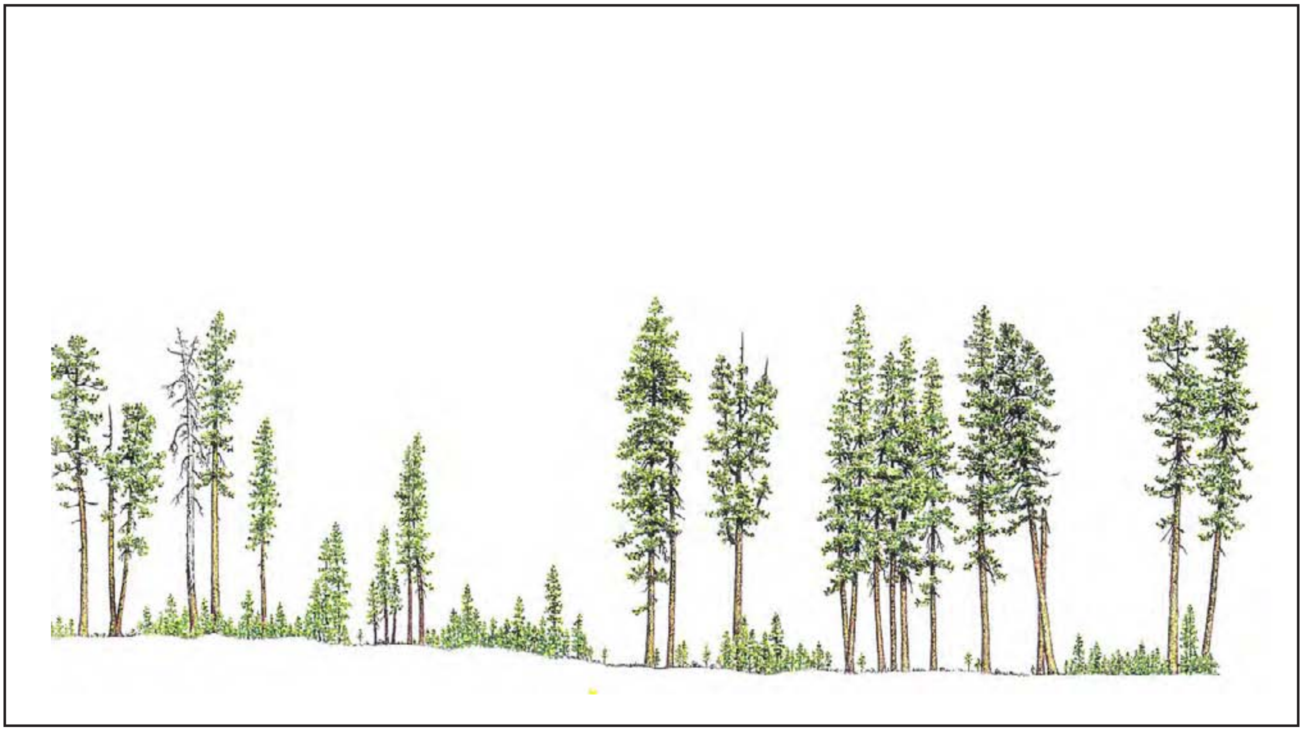
Hypothesis	***Measure***	***Standard***	***Monitoring method***
FORESTWIDE LANDSCAPE LEVEL IMPLEMENTATION			
Projects will focus on protecting and enhancing existing complex forest and associated remnant forest and simple with high fire hazard	Location of project areas in relation to complex forest identified as having a high fire hazard. Degree to which project encompasses adjacent remnant and simple forest	To be determined	GIS analysis
Treatment units will be designed to retard fire spread	Size and distribution of treatment units	To be determined	GIS Analysis
Mechanical treatments cover their costs	Net return	> 0	Past project analysis

Hypothesis	*Measure*	*Standard*	*Monitoring method*
PROJECT EFFECTIVENESS			
Treatments will help revitalize bitterbrush	Amount and vitality of bitterbrush such as number of new plants and shoot production on old plants	To be determined	Pre and post project surveys
Treatments will help revitalize hardwoods	Density, basal area, and growth of hardwoods	To be determined	Pre and post project surveys
Treatments will help revitalize hardwoods and forbs in the ephemeral draws	Vitality of hardwoods and forbs in ephemeral draws	To be determined	Pre and post project surveys
Wildfire running through project areas will have historical characteristics	Severity of burn	Most of the forest (outside of moist mixed conifer) receives low severity burn; over 90% receives low or moderate severity burn	Post fire survey
Wildfire in project areas will reflect historical characteristics more than outside of project areas	Severity of burn	Fire in project areas will have substantially more acreage in low severity burn	Post fire survey

2002 Skunk Fire

Hypothesis	*Measure*	*Standard*	*Monitoring method*
Forest-wide Landscape Effectiveness			
The forest will move toward the desired future condition over time. a) trees	# of live trees and snags by diameter class	Movement toward the desired # of trees by diameter class and Keen class as compared to the previous measurement	CVS
b) spatial heterogeneity	#, size, and density of patches of saplings and poles	Movement toward desired #, size, and density of patches as compared to previous measurement	CVS
c) snags	# and size	Movement toward desired # and size of snags as compared to the previous measurement	CVS
d) bitterbrush	Amount and vitality	Movement toward desired amount and vitality as compared to previous measurement	CVS
e) hardwoods	Amount and vitality	Movement toward desired amount and vitality as compared to previous measurement	CVS
Wildlife habitat will improve for mule deer and other species	Habitat Effectiveness Index	HEI shows upward trend	To be determined
Wildfires will reflect more of their historical characteristics through time	Severity of burn	Distribution of burned area among severity classes will increasingly reflect historical distributions	Post fire survey
Desirable plant species in meadows will increase	Percent cover by species	To be determined	Pre and post treatment surveys

Prescriptions for Reference Areas



Structural Cross-section

Canopy Profile 150 m x 20 m
Bluejay Springs

1. Ponderosa Pine/Bitterbrush Complex
Wildhorse Ridge/Bluejay Springs

Landscape maintenance and bitterbrush revitalization in a complex forest covering a large area.

Bluejay Springs

Wildhorse Ridge

Partial cutting has reduced the number of large, old pine trees, but many still remain within a spatially complex landscape composed of large, old trees interspersed with patches of regeneration. An understory of bitterbrush needs treatment to increase its vigor. In places, lodgepole pine has invaded and needs to be removed.

Overall goal: Maintain structurally complex, ponderosa pine-dominated forest and a vigorous population of bitterbrush using prescribed fire and mowing, while removing lodgepole pine.

Specific objectives:

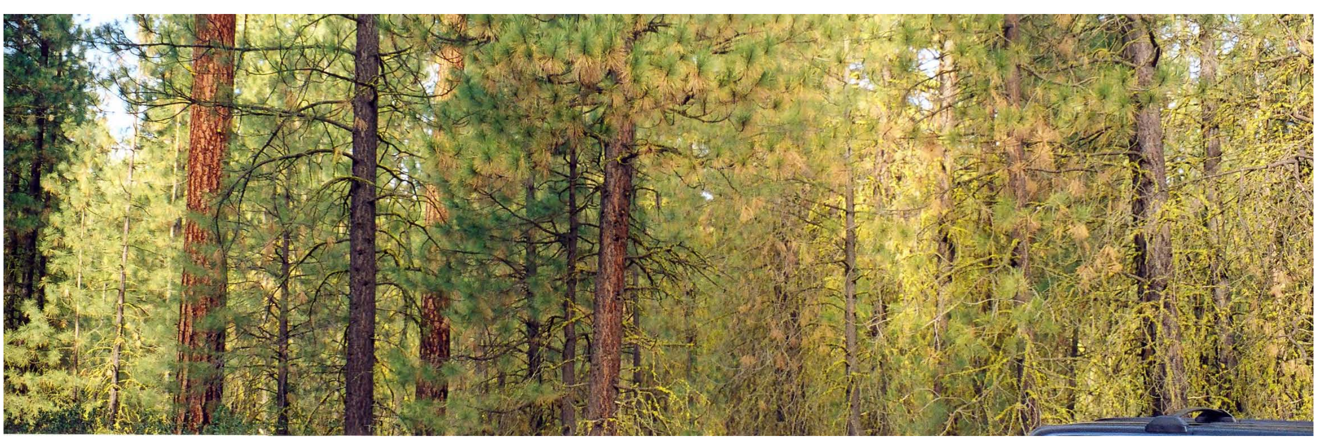
1. Maintain desired basal area and fuel loadings;
2. Provide opportunity for ponderosa pine regeneration; and
3. Rejuvenate bitterbrush understory

Prescription elements:

1. Retain all old-growth structures (live and dead).
2. Prescribe burn portions of Wildhorse Ridge using cool season fire with protection of large, old ponderosa pine using hand, water, or chemical lines. The goal is to treat 25% of the area during the initial program, distributed throughout the area in 25 to 40 acre burn units;
3. Exclude Bluejay Springs RNA from burning until experience in broadcast burning techniques and data on stand response has been accumulated;
4. Mow selected areas of bitterbrush following the initial burning treatments; and
5. Select additional areas of bitterbrush outside of the burn areas for mowing and, possibly, scarification to provide mineral soil for establishment of new bitterbrush plants.
6. Kill the lodgepole pine, perhaps removing commercial-sized trees. Burn slash piles.

Wildhorse Ridge

2. Ponderosa Pine/Bitterbrush Simplified with Remnant
Spring Hill



Landscape restoration and fuel hazard reduction in an area that was originally logged in 1920-1925 resulting in a dense pole-size stand which contains a remnant (5-8 trees per acre) old growth legacy. Move landscape toward restoration target (historical) conditions. An additional consideration is that the site is part of a Late Successional Reserve under the Northwest Forest Plan.

Specific objectives:

1. Reduce the potential for stand replacement fire and loss of old growth legacies by:
   a. Reducing overall density by thinning, and
   b. Eliminating ladder and other fuels around old-growth trees.

2. Improve wildlife values by:
   a. Improving vigor of existing forage;
   b. Establishing additional forbs and shrubs, with openings and patchy burning;
   c. Improving hiding cover by retaining/establishing some thickets of pine saplings;
   d. Increasing snag population.

3. Shift stand composition away from lodgepole pine to ponderosa pine.

4. Move stand toward target structure by:
   a. Enhancing spatial heterogeneity in stands through variable density thinning (skips and gaps); and
   b. Creating the potential for additional large trees and old growth replacements.

5. Improve habitat diversity by improving structural diversity.

Prescription elements include:

1. Retain all old-growth structures (live and dead);

2. Remove ladder and other fuels from vicinity (two times diameter of tree drip-line)

3. Reduce stand density:
   a. using a basal area target of 20-30 sq ft of basal area/acre less than 21" and 55-65 sq ft of basal area/acre greater than 21". In places of few remnants, more than 30 sq ft/acre need to be left to meet all prescription elements.
   b. by thinning non-uniformly—
   Leaving 10-15% gaps (retain some structure), 1/8 to 1/2 acre in size;
   Leaving 10-15% unthinned, retaining patches 1/8 to 1/2 acre in size.
   c. while retaining some leave trees as individuals (about 2/3) while some as clusters (about 1/3), and
   d. Burning or removing (biomass) the activity fuels, and prescribe burning small areas after harvest.

3. Ponderosa Pine/Bitterbrush Simplified
Corbell Butte south of Sprague River

These forest stands represent the densely stocked, even-structured, small-diameter ponderosa pine stands created as a result of previous logging activities, which included the selective removal of all of the mature and old pines. Stands are characterized by structurally homogeneous, dense stands of pole and small standard sizes (e.g., mean diameters of 8 to 18 inches dbh). Some stands have been invaded by lodgepole pine.

The overall management goal is to begin the process of moving the stands toward the desired future condition (structurally complex forest) and to reduce the potential for stand replacement fire. Collateral goals include revitalizing the bitterbrush understory and maintaining denser patches of thermal and hiding cover for mule deer populations.

These general objectives will be accomplished primarily by commercial thinning followed by prescribed fire.
Specific elements of the prescription are:
1. Retain all old-growth structures (live and dead),
2. Reduce overall stand density to within 25% of the ultimate basal area objectives for

trees < 21” in the first entry (20-30 sq ft of basal area/acre). A variable density thinning prescription will be used and 10-15% of the stand will be maintained as dense, unthinned patches. Openings of approximately comparable extent will be created if there are insufficient natural openings;

3. Preferentially retain ponderosa pine and sugar pine, and remove lodgepole pine;
4. Select individual or clusters of dominant trees for complete release with the goal of achieving maximum growth;
5. Conduct prescribed burn (either broadcast or as patches, depending upon fuels).

4. Ponderosa Pine/Bitterbrush — Simplified
East of Blue Jay Springs

These areas generally originated as clearcuts during the last 30 years. They could be the result of green timber sales or salvage after wildfire. Many have been successfully regenerated with new trees; others are only partially stocked. The long-term goal for clearcut areas is to restore these sites to structurally complex forests. However, this is going to require at least two centuries, given the time to develop old-growth ponderosa pine trees, large diameter snags, and large down wood on the forest floor.

The immediate management goal for stands of this type is density management to ensure that: (1) dense closed-canopy stands do not develop; (2) undesirable fuel loadings do not accumulate; and (3) high growth rates are maintained on dominant and codominant trees. Development of dense closed-canopy stands would create undesirable conditions from the standpoint of fire behavior, growth of dominant trees, and impacts on other biota, including bitterbrush.

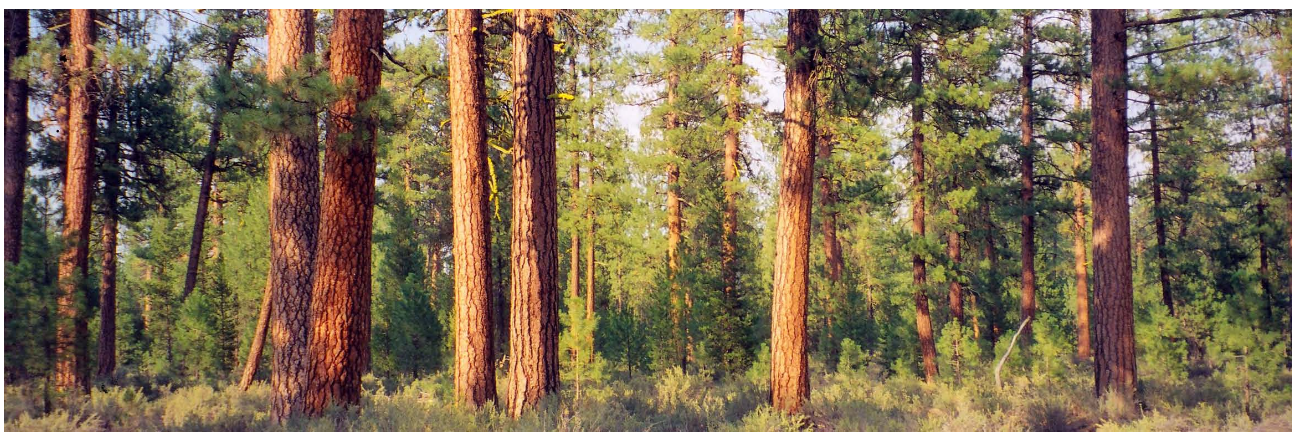
The primary silvicultural prescription will be heavy and spatially variable pre-commercial thinning in the regenerating clearcuts. The objective will be to create average low sapling densities (100 to 250 trees per acre) but with varying density throughout the unit. In addition, small unstocked areas (e.g., up to 0.1 acre) dispersed through the clearcut contribute to desirable spatial heterogeneity.

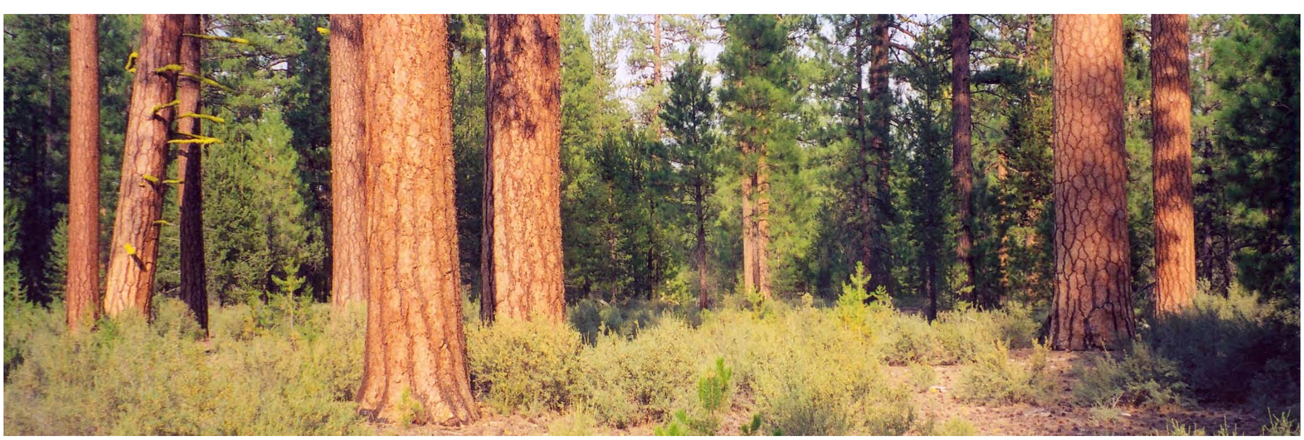
Prescribed burning may provide a cost-effective alternative to pre-commercial thinning for treatment of regenerated clearcut areas. Issues include sufficiency of fuel to carry prescribed fire and pine regeneration survival under such regimes. Prescribed burning may also have benefits from the standpoint of generating spatial complexity in the young stands, which will also be investigated.

5. Ponderosa Pine/Bitterbrush — Superlative Stand
Bull Pasture

Bull Pasture represents the finest remaining stand of old-growth ponderosa pine found on the Klamath Reservation lands. It needs to be recognized as such, although because of the extraordinary size and density of the large trees, it probably is not appropriate to use it as a general model of the desired future condition for stands belonging to this forest type.

Overall goal for the Bull Pasture stand is to maintain the current condition, primarily by preventing large fuel accumulations and logging in the stand, and providing for replacement trees for the current dominants. The stand is currently in relatively good condition with regards to fuel loadings.





No silvicultural treatment is currently required. Prescribed burning should be considered, so as to reduce the risk of prematurely losing some of the old trees. The Tribe should also consider limiting site use to day only so as to reduce the potential for damage due to camping and wildfires.

6. Mixed-Conifer/Snowbrush Complex
Little Yamsay Mountain

This is a complex forest stand with a substantial residual stand of large diameter, old-growth ponderosa pine trees, including many of Keen Class 4. The stand was selectively harvested following termination and, as a result of both harvesting and fire suppression, has been invaded by substantial quantities of white fir and has accumulated large amounts of fuels. The residual old-growth trees are at high risk of loss to either competitive pressures or fire because of the dense surrounding populations of fir and lodgepole pine.

The overall goals of silvicultural treatment in this stand are to:

1. Reduce competition and ladder fuels around old growth trees;
2. Reduce the potential for stand replacement fire;
3. Reverse compositional change in forest cover by reducing the white fir component;
4. Provide for regeneration of additional ponderosa pine

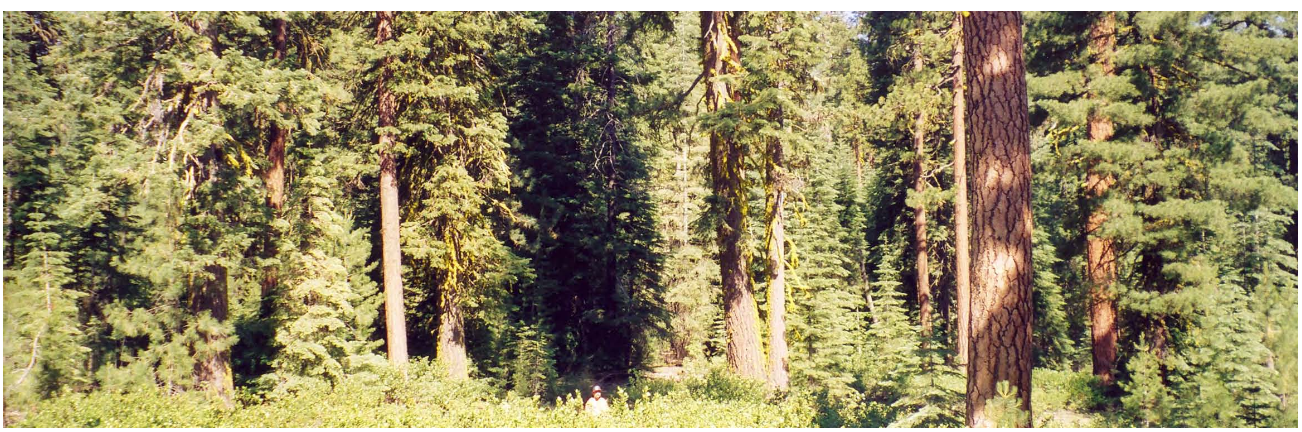


These general objectives will be accomplished by a silvicultural treatment that will include the following elements:

1. Retain all old-growth structures (live and dead);
2. Remove ladder fuels and competing tree species from the vicinity (two times the diameter of the tree drip line) of all old growth trees. Remove slash and logs from the cleared circles;
3. Remove essentially all young-growth white fir, except retain/create an average of approximately 2 white fir snags per acre over 21" (where possible) and retain some dense patches (as needed) as described below.
4. Retain at least one untreated, dense patch per 2 ½ acres with patches heavy to ponderosa pine, as the first choice and patches heavy to white fir as the second choice. These patches will be 1/8 to 1/2 acre in size, irregular in shape, and contain no more than 2 old ponderosa pine. On the average they should cover about 15% of the area.
5. Work toward a basal area target for trees less than 21" of 30-40 sq ft of basal area/ acre of ponderosa pine. In some places, less than 30 sq ft may be left if needed to comply with other parts of the prescription;
6. Burn concentrations of slash with prior piling of material, if necessary. Carry out burning following the initiation of fall rains or in the spring. Where possible, broadcast burn so as to provide additional control on white fir and generation of mineral soil seedbed for regeneration of pines; during this process, special effort should be made to protect the old growth pine trees.
7. Mow shrubs on selected sites following the fuel treatment.

7. Mixed-Conifer/Snowbrush Complex Black Hills

This is an uneven-aged stand of ponderosa pine, sugar pine, white fir, and Douglas-fir with a dense understory of shrubs and white fir regeneration outside of dense patches of white fir poles and small veterans. Fuel loadings and ladder fuels have accumulated as a result of fire sup-



pression programs and now provide the potential for uncharacteristic stand-replacement wildfire, which would kill the remaining old-growth pine component. Competition from dense populations of white fir may also be causing accelerated mortality of the old pine trees.

The objectives of stand treatment are to:

1. Reduce competition and ladder fuels around old growth trees;

2. Reduce the potential for stand replacement fire;
3. Reverse compositional change in forest cover by reducing the white fir component;
4. Provide for regeneration of additional ponderosa pine and sugar pine

These general objectives will be accomplished by actions that will include the following elements:

1. Retain all old-growth structures (live and dead);
2. Remove ladder fuels and competing tree species from the vicinity (two times the diameter of the tree drip line) of all old growth trees. Remove slash and logs from the cleared circles;
3. Remove essentially all young-growth white fir, except retain/create an average of approximately 2 white fir snags per acre over 21" (where possible) and retain some dense patches (as needed) as described below.
4. Retain at least one unthinned, dense patch per 2 ½ acres with patches heavy to ponderosa pine, sugar pine, and Douglas-fir, as the first choice and patches heavy to white fir as the second choice. These patches will be 1/8 to 1/2 acre in size, irregular in shape, and contain no more than 2 old ponderosa pine trees. On the average they should cover about 15% of the area.
5. Work toward a basal area target for trees less than 21" of 30-40 sq ft of basal area/acre of ponderosa pine, sugar pine, and Douglas-fir. In some places, less than 30 sq ft may be left if needed to comply with other parts of the prescription;
6. Burn concentrations of slash with prior piling of material, if necessary. Carry out burning following the initiation of fall rains. Where possible, broadcast burn so as to provide additional control on white fir and generation of mineral soil seedbed for regeneration of pines; during this process, special effort should be made to protect the old growth pine trees.

8. Mixed-Conifer/Snowbrush — Simplified with Remnant
South Chiloquin

The old-growth tree component of this forest stand has been heavily harvested leaving a residual scattering of old-growth ponderosa pine within a stand mosaic dominated by poles (12-20" dbh) of Douglas-fir, white fir, ponderosa pine, incense cedar, and sugar pine. Fuel accumulations and ladder fuels are sufficient to provide the potential for a stand replacement fire and destruction of the residual old-growth pines.

The overall goals of silvicultural treatment in this stand are to:

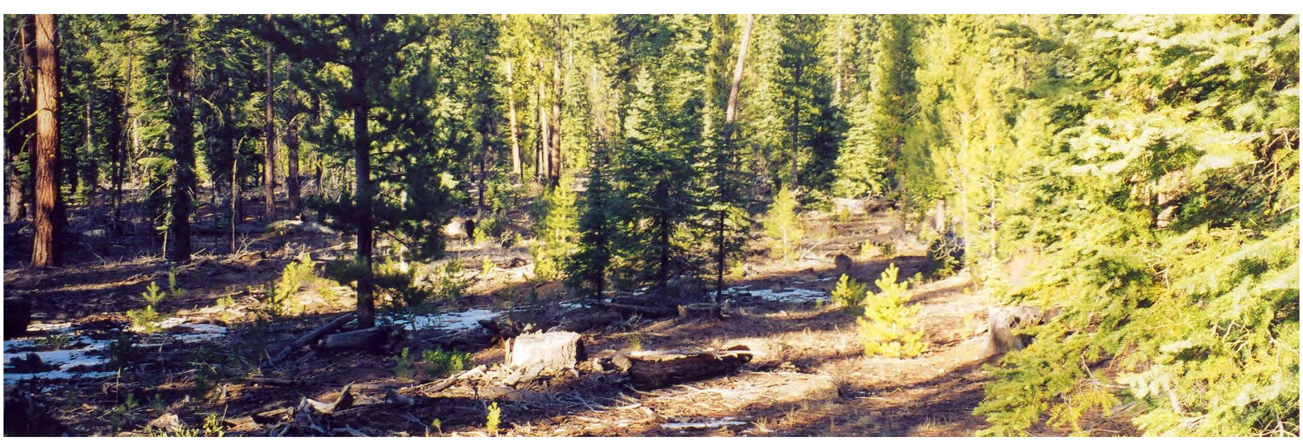
1. Reduce stand densities to levels that will reduce or eliminate the potential for crown fires and accumulations of ladder fuels;
2. Reduce competition and eliminate ladder fuels around the residual old-growth ponderosa pine trees;
3. Bring overall stand densities down to target basal areas for the Mixed-Conifer/Snowbrush type, while maintaining substantial spatial variability in stand density; and
4. Provide for regeneration of additional ponderosa and sugar pine.

The initial silvicultural treatment in this stand will be a variable density, commercial harvest focused on removal of merchantable white fir and Douglas-fir within the stand. Specific elements of the prescription will include:

1. Retain all old-growth structures (live and dead);
2. Reduce average stand density to the basal area goal for Mixed Conifer/Snowbrush, primarily by cutting and, where merchantable, removing white fir and Douglas-fir;
3. Remove all trees of pole size or larger for ½ tree height around residual old-growth yellow pine trees to eliminate competition and ladder fuels;
4. Pile and burn concentrations of slash; and
5. Retain one 1/4 to 1/2 acre patch of untreated forest per 2 1/2 acres of treated area. These patches of unthinned forest should include some large diameter Douglas-fir or white fir trees but preferably not any of the residual ponderosa pine.

9. Mixed Conifer/Snowbrush — Simplified
Yamsay Mountain

Clearcut sites belonging to the Mixed Conifer/Snowbrush type are typified by both artificial (planted pine) and natural (ponderosa pine, lodgepole pine, white fir, Douglas-fir) regeneration and may have significant shrub cover of snowbrush and other species. Often they will contain residual trees of various sizes and conditions. Regeneration, in many cases, can be sufficiently dense such that development of closed-canopy stands will be expected in two or three decades, with the potential for stand replacement crown fire events.



Overall goals for the management of these stands are:

1. Reduce stand densities to levels that will reduce or eliminate the potential for crown fires and accumulations of ladder fuels;
2. Develop and maintain spatially variable stand densities;
3. Maintain a significant understory shrub component; and
4. Maintain ponderosa pine as a dominant.

10. Moist Mixed Conifer Complex South Chiloquin

This is an, uneven-aged, multi-storied stand that includes old-growth sugar pine, ponderosa pine, Douglas-fir, and white fir with a dense mid- and understory dominated by white fir and Douglas-fir. The potential for stand replacement fire is very high because of the high fuel loadings, including ladder fuels that will carry ground fires into the crowns of the largest trees. Large old ponderosa and sugar pines are also being lost to competition from the dense populations of white and Douglas-fir that surround them.

The primary goals of management in this stand are to reduce the potential for stand replacement fire and loss of the pine component.

The initial silvicultural prescription in this stand will involve a commercial thinning to achieve the following goals:

1. Retain all old-growth structures (live and dead);
2. Remove competing shade-tolerant trees from within two times the drip-line diameter of all old-growth ponderosa and sugar pines to eliminate ladder fuels and competition;
3. Treat the remaining area to lower average stand densities to the ultimate target basal areas for Moist Mixed Conifer habitats, with harvest to be focused on white fir and Douglas-fir;
4. Remove most of the young-growth white fir, except retain/create an average of two white fir snags per acre over 21” (where possible) and retain an average of two other live white fir per acre over 21”;
5. Retain residual 1/8 to 1/2 acre patches in an unthinned condition;
6. Provide opportunities (patches with sufficient light level) for reproduction of ponderosa pine;
7. Pile and burn logging slash.

11. Moist Mixed Conifer — Ya Whee Plateau — *Simplified with Remnant*

This stand is a mixture of a few large ponderosa pine and white fir with a pole-sized stand of white fir with some small ponderosa pine and sugar pine. It is a result of high grading which eliminated most merchantable trees.

The overall goal in this stand is to retain the remaining large pine trees, encourage pine reproduction, and reduce the competition from white fir. Treatment might be delayed until the stand has reached an average diameter that will support a commercial thinning operation.

The treatment regime should follow the general silvicultural prescription for moist mixed conifer complex except there are much fewer large, old trees to work with. Remaining old growth structures should be retained and competing shade tolerant trees should be removed from around them. Stand densities should be lowered to achieve the target basal areas for moist mixed conifer habitats, with the harvest focused on white fir. The treatment should result in both openings and thickets across the landscape.

Great care needs to be taken in this thinning operation to reduce damage to the residual stand. This is necessary due to the high potential for wounded white fir to develop wood decays. Aspects of the treatment that could reduce logging damage involve the design of skid trails and choice of equipment.

12. Moist Mixed Conifer — Ya Whee Plateau — *Simplified*

This is a pole-sized stand of white fir with some small ponderosa pine and sugar pine, resulting from an overstory removal of the large, old ponderosa pine and white fir. Few, if any, old growth

trees remain. The overall goal for this condition is to begin the conversion back to a pine-dominated stand. Achievement of this goal is far into the future.

Treatments should generally follow the silvicultural prescription for moist mixed conifer remnant. Any remaining old growth structures should be retained and competing shade tolerant trees should be removed from around them. Young ponderosa and sugar pine trees should be favored. Stand densities should be lowered to achieve the target basal areas for moist mixed conifer habitats, with the harvest focused on white fir. The treatment should result in both openings and thickets across the landscape.

Great care needs to be taken in this thinning operation to reduce damage to the residual stand. This is necessary due to the high potential for wounded white fir to develop wood decays. Aspects of the treatment that could reduce logging damage involve the design of skid trails and choice of equipment.

13. Lodgepole Pine/Bitterbrush — Mature

Along the 49 Road north of the Williamson River

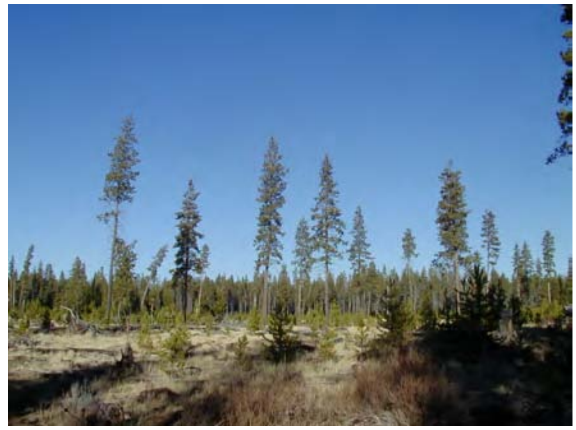
This site represents typical mature lodgepole pine stands with a bitterbrush understory. Such stands are susceptible to outbreaks of mountain pine beetle. The next action will be a regeneration harvest.

The primary management approach for lodgepole pine/bitterbrush is to emulate historical disturbance processes though the use of a variable rotation age of 75-150 averaging a little over 100 years; The silvicultural prescription for a regeneration harvest has the following elements:

1. Retention of 25 +/- 5% green tree retention;
2. Minimum 50% of retention to be in form of aggregates of 1-5 acres;
3. Retention of snags and trees to meet 60% potential population level of cavity nesters
4. Natural regeneration of lodgepole pine;
5. Consideration of bitterbrush populations in design and implementation of logging and burning programs (see below).
6. Retention of all ponderosa pine
7. Regeneration generally accomplished by natural seeding.
8. An adaptive management program aimed at understanding the effect of management on the structure of Lodgepole pine/Bitterbrush forests and on the habitats for key species.

14. Lodgepole Pine/Bitterbrush — Young

Along the 49 Road north of the Williamson River



The primary goal of management in this stand is to keep stand densities at sufficiently low levels for high rates of growth on dominant and co-dominant trees and for good development of the bitterbrush understory.

The initial silvicultural prescription in this stand will involve a pre-commercial thinning to achieve desired tree densities. Elements of the prescription include:

1. Pre-commercial thinning from below;
2. Retention of specimens of tree species other than lodgepole pine; and
3. Retention of unthinnned 1/8 to 1/2 acre patches per 2 ½ acres of stand.

15. Wet Lodgepole Pine — Mature

Wildhorse

These stands are dominated by a mature lodgepole pine stand of moderate density that include a scattered component of quaking aspen. Prior to fire suppression programs such sites typically had low densities of pine and frequent, vigorous clones of quaking aspen with herb-rich understories. The dense lodgepole development is a result of the fire suppression.

The primary goal in management of these stands is to drastically reduce the lodgepole pine component of the stand and significantly increase the quaking aspen and herb understory components of the site. This will be accomplished primarily by removal of lodgepole pine and prescribed burning of the sites.

The silvicultural prescription includes the following elements:

1. Commercial logging of the mature lodgepole pine with retention of sufficient live trees, snags, and logs to provide for wildlife needs; and
2. Broadcast prescribed burning of the site. Artificial regeneration of quaking aspen will be considered if establishment of new individuals is judged inadequate 3 years after treatment.

16. Wet Lodgepole Pine
Corbell Butte

This stand is dominated by young pole-sized lodgepole pine and small amounts of ponderosa pine and quaking aspen. Prior to fire suppression such sites typically had low density stands that included large diameter ponderosa pine and groves and individual stems of quaking aspen. Fire suppression and selective removal of the large ponderosa pines has resulted in the simplified structures.

The primary goal in management of these stands is to dramatically reduce stand densities with the objectives of substantially increasing the density, size, and vigor of the quaking aspen and

provide conditions suitable for development of rich herbaceous understories.

Silvicultural prescriptions include the following elements:

1. Commercial thinning of the lodgepole pine component with retention of sufficient snags and down logs to provide for wildlife needs; and
2. Slash disposal and site preparation by broadcast slash burning or pile and burning throughout the process of logging and slash disposal.
3. Protection and eventual release of the aspen clones that are present is a major objective.

17. Marginal Site Lodgepole Pine
Skellock Draw

These low productivity lodgepole pine stands are typically found in frost pockets. They are often very difficult to regenerate.

Management goals for these stands do not involve silvicultural treatments. Stands are expected to undergo natural replacement through gap and stand-level disturbance events.

18. High Elevation Lodgepole Pine
Yamsay Mountain

These low productivity lodgepole pine stands are typically found at higher elevations. Stand structure typically includes many dead and down trees and a sparse understory of grouse whortleberry, pinemat manzanita, and other shrubs and forbs.

Management goals for these stands do not involve silvicultural treatments. Stands are expected to undergo natural replacement through gap and stand-level disturbance events.

Part III: Current Inventory and Growth, Harvest Estimates, Costs, Revenues, and Organization

Inventory Data

The Continuous Vegetation Survey (CVS) inventory plots were established in 1999 on a 1.7 mile systematic grid throughout the Klamath Reservation forest. There are approximately 354 forested permanent sample points made up of 1/100th, 1/24th and 1/5.3 acre nested subplots; all five are nested within a 1 hectare fixed plot.

These plots are distributed throughout the habitat types (Map 10, Appendix A) and can be used to help evaluate trends in species and diameter distribution of live and dead trees.

Subplot size/ Line intercept length	**# samples/ point**	**Trees/Vegetation Measured**	**Variables**
1/100th ac (11.8' radius)	5	Live conifers 1" – 4.9" Dead conifers & hardwoods 3" – 4.9" Seedlings	Species, dbh, height, growth, age, crown ratio, crown class, insect & disease, damage.
1/24th ac (24' radius)	5	Live and dead trees 3" – 12.9" Stumps 5" – 12.9" Hardwood clumps Understory indicator species	Same as 1/100th acre plot + condition of snags and use of snags and trees by cavity nesters, # of hardwood stems, % cover indicator species
1/5.3 ac (51.1' radius)	5	Live and dead trees 13" – 31.9" Stumps >= 13"	Same as 1/100th acre plot
51.1 feet	5	Down wood > 3" intersect diameter	Species, intersect diameter, length, condition/usage, large end diameter
10 feet	5	Down wood < 3" intersect diameter	Piece count
50 feet	5	Vegetation cover	Length by species
1 ha (185.1' radius)	1	Live and dead trees > 32"	Same as 1/100th acre plot

We used the CVS plots and the FVS growth and yield simulator to quantify the inventory on the 622,000 forested acres in the Klamath Reservation Forest. The CVS plots were projected to the year 2006. The acres of habitat types based on plot calls match up fairly well with the acres of habitat types based on the plant association maps (Table 6, and Map 10 in Appendix A). We developed stand and stock tables for most of the forest types/structural conditions in our analysis as indicated by table numbers in the representation of our classification below. These tables can be found in Appendix C at the end of the report. The "a" tables are stand tables, the "b" tables are stock tables, and the "c" tables are growth tables.

All forest types (Tables I1a, I1b)

- Ponderosa pine/mixed conifer/moist mixed conifer (I2a, I2b, I2c)
  - Ponderosa pine/bitterbrush (I3a, I3b)
    - Complex (I4a, I4b)
    - Simplified with remnants (I5a, I5b)
    - Simplified (I6a, I6b)
  - Mixed conifer (I7a, I7b)
    - Complex (I8a, I8b)
    - Simplified with remnants (I9a, I9b)
    - Simplified
  - Moist mixed conifer (I10a, I10b)
    - Complex (I11a, I11b)
    - Simplified with remnants (I12a, I12b)
    - Simplified

- Lodgepole pine
  - Lodgepole/bitterbrush (I13a, I13b)
  - Wet lodgepole (not currently available)
  - High elevation/marginal lodgepole (not currently available)

Table 6. Comparison of habitat type acres according to the habitat map (Map 2, Apendix A) and according to the CVS plots.

354 forested plots
622,238 forested acres
1757.734 acres/plot

Habitat Type (Map)	**Map Acres**	**# of plots**	**Plot Acres**
Ponderosa pine/sagebrush	16,515	9	15,820
Ponderosa pine/bitterbrush	360,362	214	376,155
Mixed conifer/snowbrush	89,277	52	91,402
Moist mixed conifer	40,529	22	38,670
Lodgepole pine/bitterbrush	76,759	32	56,247
Marginal site & High elevation lodgepole	15,881	21	36,912
Wet lodgepole	22,915	4	7,031
Total	**622,238**	**354**	**622,238**

Habitat Type (Plots)	**Complex**	**Remnant**	**Simplified**
Ponderosa pine/sagebrush	0	7	2
Ponderosa pine/bitterbrush	33	131	40
Mixed conifer/snowbrush	12	36	2
Moist mixed conifer	4	17	1
Lodgepole pine/bitterbrush	4	4	13
Ponderosa pine/lodgepole/bitterbrush		8	2
Marginal site & High elevation lodgepole	1	9	11
Wet lodgepole	1	2	1

All Forest Types

Considering all 622,000 acres of forest, we have the following summary statistics (from Tables I1a and I1b, Appendix C):

	# trees	# trees >21"DBH	# trees >32"DBH	Cubic volume	Board foot volume
Ave. per acre	383	6.7	1.2	1,988	11,178
Total (millions)	283	4.1	.7	1,236	6,995

Thus, the Klamath Reservation Forests contains over 4,000,000 trees over 21" in dbh. Approximately 2/3 of these trees are in areas outside of "complex" forest areas, scattered through the forests.

The Ponderosa Pine/Mixed Conifer Types

The forested acres include approximately 522,000 acres in the ponderosa pine/mixed-conifer habitat types that have traditionally been seen as the commercial forests. (The remaining 100, 000 acres are largely lodgepole pine forests.) The ponderosa pine/mixed-conifer forests have the following characteristics (from Tables I2a, I2b, I2c, Appendix C):

	# trees	# trees >21"DBH	# trees >32"DBH	Cubic volume	Board foot volume
Ave. per acre	371	7.5	1.3	2,112	11,992
Total (millions)	194	3.9	.7	1,103	6,260

Thus, the ponderosa pine/mixed-conifer forests contain 95% of the trees over 21" and 100% of the trees over 32". The 5% of trees over 21" not in these forests are, by and large, ponderosa pine trees in the transition zone between lodgepole pine and ponderosa pine habitat types—an area often classified as a lodgepole pine habitat type.

By diameter class, we see the following basal area and volume distribution per acre:

DBH class	Basal area	Cubic volume	Board foot volume	Cubic volume	Board foot volume
	——per acre——			——total (millions)——	
0-12	34.9	167	1,016	87	422
10-21	33.7	873	6,059	456	2,286
21-32	19.6	690	4,632	360	2,178
32+	9.1	382	2,362	199	1,373
Total	97.3	2,112	11,992	1,103	6,260

By species, we see the following basal area and volume distribution per acre:

Species	Basal area	Cubic volume	Board foot volume	Cubic volume	Board foot volume	%
	per acre			total (millions)		
White fir	15.9	357	1,994	187	1,047	17
Lodgepole pine	10.0	155	791	82	415	7
Sugar pine	3.2	75	440	39	230	4
Ponderosa pine	63.7	1,444	8,328	755	4,351	68
Douglas-fir	2.0	55	309	28	163	3
Other species	2.3	22	101	11	54	1
Total	97.3	2,112	11,992	1,103	6,260	100

Historically, we estimate that over 2/3 of the basal areas was in trees over 21" (See Part I for a presentation of historical information). Now over 2/3 of the basal area is under 21".

Wilcox and Mezger (1954) estimated that approximately 95% of the Klamath Reservation Forest volume was in ponderosa pine in 1910. The 25% of volume now in white fir/lodgepole pine is also a significant increase from historical conditions—due both to fire suppression and harvest of the big, old pine trees.

Current Growth on the Ponderosa Pine/Mixed-Conifer Types

In terms of basal area and volume growth per acre and total on these 522,000 acres, we see the following in terms of the estimated average *annual* growth over the period 1996-2006 :

DBH class	Basal area			Volume (bd ft.)		
	Amt/ acre	% of growth	% increase	Amt/ acre	% of growth	% increase
0-12	.41	30	1.3	11.8	7	1.7
10-22	.70	50	2.4	105.1	58	2.8
22-32	.15	11	1.0	32.7	17	.9
32+	.12	9	1.4	33.4	18	1.4
	1.38	100	1.6	183.4	100	1.8

Species	Basal area			Volume (bd ft.)		
	Amt/ acre	% of growth	% increase	Amt/ acre	% of growth	% increase
White fir	.23	18	1.7	42.9	23	2.7
Lodgepole pine	.16	11	1.7	19.6	11	3.3
Sugar pine	.09	6	2.8	10.2	5	3.0
Ponderosa pine	.84	61	1.3	104.2	57	1.4
Douglas fir	.02	1	1.0	3.6	2	1.3
Other species	.04	3	1.7	2.7	1	3.0
Total	1.38	100	1.6	183.2	100	1.8

While ponderosa pine still dominates in terms of basal area or board foot growth, a disproportionate share of the growth is occurring in white fir, sugar pine, and lodgepole pine. These higher growth rates are occurring mainly in the mixed-conifer habitat types, but also in the ponderosa pine types where lodgepole pine is present.

We estimate a current growth rate of 183 board feet/acre/year or a total growth on these acres of 95 million board feet/year.

In terms of cubic foot growth, we estimate that these acres currently average 33 cubic feet/acre/year. By forest type the growth is approximately as follows:

Habitat type	Cubic foot growth/acre/year
Ponderosa pine/bitterbrush	27
Mixed conifer/snowbrush	37
Moist mixed conifer	45

Biomass

We also estimated the potential amount of biomass in the portion of the trees that would not render commercial volume. We first estimated the recoverable oven-dry weight (ODW) of biomass per tree (Appendix C, Table 14). For 7-inch and smaller dbh trees, we have assumed processing the entire above ground tree into biomass, minus 10% waste. (Actually, there is so little volume in the 3-inch trees that they are probably not economic to take, but deducting them would make relatively little difference in the results.) For the 9-inch trees, we assumed that 70% of these trees (50% for PP) would be cut for saw logs and the remaining trees, tops, and limbs would be processed for biomass, minus 10% waste. We used a 6-inch minimum dib for ponderosa sawlogs and 5-inches for the other species. For 11-inch and larger trees, we assumed processing the top, limbs, and 4% of the stem into biomass, again minus 10% waste. Additional biomass might also be available from sawlog processing, if this were done by a local mill. Sawlog biomass is not included in these estimates.

We applied these estimates of ODW/tree to the ponderosa pine/mixed-conifer inventory (Appendix C, Table 15). Based on this information, we average 33,700 pounds/acre of biomass after deduction of the portion of the bole that could be turned into commercial products or about 17.6 billion pounds in total (Appendix C, Table 15). Actually, perhaps 2/3 of this biomass would be considered excess to achieving the desired future conditions. Thus, the total available (as of 2006) might be (at an upper bound), 11-12 billion pounds or 22,000 pounds/acre. Of course, forests grow, so this amount would also grow over time, unless wildfires burn it up.

Comparison of Desired Future Conditions and Current Conditions

Current conditions can be compared with desired future conditions using data from the CVS plots for the Klamath Reservation Forest (Table 7). The desired future conditions come from our previous discussion in Part I. The characteristics of the different structural classes come from the inventory reports (Appendix C, Tables 1 to 13) and a summary analysis that we did of the inventory plots (Appendix C, Table 16). The summary analysis includes the selected characteristics of each plot to help display the variability we found in the plots of each habitat type/structural class.

Table 7. Comparison of the desired future condition (DFC) of the forest types to the current condition (average, complex, remnant, simplified)

	Total BA	BA <21	BA >21"	BA >32"	Acres
	--------------------------------(Sq. ft./acre)--------------------------------				(thousands)
Ponderosa pine/bitterbrush					
DFC	*75-95*	*20-30*	*55-65*	*25-30*	
Average (all stands)	88	66	23	8	376
Complex	103	55	48	19	58
Remnant	96	70	25	7	230
Simplified	75	72	3	1	70
Mixed conifer					
DFC	*100-120*	*30-40*	*70-80*	*30-35*	
Average(all stands)	*120*	*79*	*40*	*15*	91
Complex	151	86	65	27	21
Remnant	119	81	38	12	63
Moist mixed conifer					
DFC	*120-140*	*30-40*	*90-100*	*35-40*	
Average (all stands)	122	81	41	11	39
Complex	182	82	101	26	7
Remnant	108	80	28	8	30

Note: the average (all stands) includes more stands than shown in the breakdown into structural classes; hence the acres for the structural classes do not total to the acreage for the forest types.

General conclusions from this comparison are:

1) The density of trees less than 21 inches dbh is much above desired levels.

2) The density of trees over 21 inches is generally below desired levels, especially for remnant and simplified stands. Complex moist mixed conifer is within desired limits for large trees, but that is largely because of the high density of large young-growth white fir.

They also suggest the general direction of future management:

1) Greatly reduce the density of trees less than 21 inches dbh while retaining the remainder primarily in a patchwork pattern, and retaining all old growth trees of any size.

2) Generally retain trees over 21", except for large, second growth white fir. As discussed in the prescriptions, we recommend extensive removal of large second growth white fir. In many cases, fast growing white fir has invaded mixed-conifer stands after removal of the ponderosa pine overstory. To help reintroduce ponderosa pine, these white fir should be removed so as to reduce ladder fuels and release ponderosa pine reproduction from competition (see prescriptions for more details).

Testing Treatment Effectiveness

We utilized the Fire and Fuels Extension of FVS to test the effectiveness of our treatments. We used this software to categorize the fire hazard for our inventory plots before and after treatment in terms of torching index (the minimum wind speed required for ground fire to spread into the crowns and crowning index (the minimum wind speed required for fire to carry between crowns). Our approach is very similar to that taken in the study by Fried, et al. (2002).

Crown fires are a common source of stand replacing fires and a well-known phenomena. Fiedler et al. (2001) defined high hazard conditions as having a crowning index <25 mph, moderate hazard from 25-50 mph, and low hazard >50 mph. Torching appears to be an important cause of stand replacing fires in the Klamath Reservation Forest as evidenced by fire behavior in the recent Skunk and Tool Box fires (personal communication, Steve Mooney, Chiloquin Ranger District and pictures of the two fires in the picture section).

We could not find a similar classification for high, moderate, and low hazard for torching.

Results

Note: Treatment occurred if the torching index was less than 20. lp = lodgepole pine; wf = white fir; Df = Douglas-fir

1) Torching (from ladder fuels) is a problem throughout the ponderosa pine/mixed-conifer forests

2) The simulated treatments can increase the wind speed needed to cause torching across the forest with the biggest impact in the mixed- conifer stands.

3) Crowning is a problem in mixed-conifer stands (the average wind speed needed to crown between high and medium hazard), but not in the ponderosa pine forests.

4) The simulated treatments can increase the wind speed needed to cause crowning enough to shift mixed-conifer stands from high/medium hazard to low hazard.

5) The mixed-conifer complex treatment is more effective if Douglas-fir is removed. The average values obscure the effect somewhat, but it is very apparent when we consider only mixed-conifer stands where Douglas-fir is a major component.

We feel that field application of the prescriptions will improve performance of our treatments, especially in ponderosa pine complex, remnant, and mixed-conifer remnant. As an example, we call for the removal of ladder fuels around old growth trees as the highest priority—that refinement is difficult to represent in our simulations.

Landscape planning for fuels management on the Klamath Reservation

(Done with the assistance of Jonathan Thompson, Oregon State University)

Fire spread is a function of fuels, topography, and weather. Of these, only fuels can be managed. Fuel treatments designed to reduce fire spread and severity can target three elements of forest structure 1) surface fuels, through prescribed burning or mechanical treatments that remove, compact, or reduce the continuity of fine fuels lower than 2 meters; 2) ladder fuels, through thinning small diameter trees or prescribed burning to decrease vertical continuity between surface and crown fuels, or; 3) canopy fuels through overstory thinning to reduce horizontal continuity of crowns (Finney 2003).

Table 8. Results from test of treatment effectiveness.

Habitat type/condition	Treatment	#treated/ total # Residual Basal Area Per acre	Torching index before/after	# that increased by at least 10 MPH in torching index	Crowning index before/after	# that increased by at least 10 MPH in crowning index
Moist mixed conifer						
Complex	Remove wf< 24" DBH	3 / 4 97 sq ft	5/70	3/3	21/81	3/3
Remnant	Remove wf<24" DBH	17/17 79 sq ft	4/28	8/17	27/70	10/17
Mixed conifer						
Complex	Remove lp, wf<24" DBH; prescribed fire	12/12 89 sq ft	3/34	5/12	25/65	10/12
Complex	Remove lp, wf<24" DBH, some DF< 21" DBH; prescribed fire	12/12 80 sq ft	3/60	8/12	25/70	10/12
Remnant	Remove lp, wf<24". Thin 0-10" DBH to 10 sq ft BA; thin 10-21" DBH to 20 sq ft BA; prescribed fire	17/17 68 sq ft	3/15	9/17	27/63	17/17
Ponderosa pine						
Complex	Thin from below to 40 sq ft BA Prescribed fire	17/18 76 sq ft	5/15	10/17	50/65	9/18
Remnant	Thin 0-10"DBH to 8 BA Thin 10-21" DBH to 20 BA Prescribed fire	18/18 56 sq ft	5/12	6/18	55/75	14/18

Fuel management has been shown to reduce the extent and severity of some wildfires, in the first five to ten years after treatment (Raymond 2004 Finney 2005). Large fires will typically not react to small or isolated fuel-reduction projects; rather, the fire will move around the treatment and have little effect on overall fire size (Finney 2001). Consideration of the spatial configurations of fuel treatments can increase their effectiveness. Two methods can be applied 1) create treatments that are large relative to fire size, or 2) create a pattern of treatments that collectively disrupts the growth of fires (Finney 2001). Due to limitations in time and resources, the second option is often the most practical.

One way to produce a network of fuel treatments is through the construction of shaded fuelbreaks (Agee 2000). A shaded fuelbreak is created by altering surface fuels, increasing the height to the base of the live crown, and opening the canopy by removing trees. This configuration results in lower fire line intensity, less probability of torching, and lower probability of independent crown fires. Two caveats exist however; grasses used as ground cover in fuelbreaks can increase the rate of spread (though backburns can alleviate this problem) (Weatherspoon and Skinner 1995), and opening canopies can lower fuel moisture and increase surface wind-speed within the fuelbreak (Agee 2000). The wider the break the more effective it is at reducing the spread of fire. Several width recommendations have been made; most range from 100 to 400 meters. Varying widths have also been used on primary and secondary fuelbreaks. We feel that our desired future conditions for the different habitat types can function as “shaded fuel breaks;” strategic considerations to control fire spread can help guide the placement of the treatments to achieve these conditions.

The question of spatial layout of fuel treatments on the Klamath Reservation is complicated by the heterogeneous landscape. There are few empirical studies of large wildfire behavior in the

presence of fuel breaks. A simulation experiment using FARSITE supports their use, but assumed homogeneous landscapes and a known ignition point (Finney 2001). This study outlined a set of four primary considerations for placement of treatments: 1) Treatment units need to overlap in an anticipated spread direction. 2) The treatment pattern should target specific weather and fuel conditions because of their characteristic sizes and spread rates under those conditions. 3) The relationship between separation and overlap should consider the expected fire shape and relative spread rates in the treated areas (these simulations assumed a simple ellipse). 4) Separation of treated areas must be small compared to the fire sizes. (This paper has several useful diagrams of potential fuel treatment layouts: an overlapping herringbone design seems most effective.) Homogeneous sub-units may be created in the Klamath Reservation to better incorporate the lessons derived from these results.

The location of treatments within the Klamath landscape is further complicated by the unpredictability of ignition sources. Ideally, treatments should be situated downwind from potential ignition sources (defined by predominate wind direction during periods of extreme fire danger—this may differ from general wind patterns) (Agee 2000). Recent large fires on the Klamath Reservation Forest have generally traveled from west to east, but a few have traveled south to north. The Klamath Reservation lies within "lightning alley" and therefore potential sites for natural ignition exist throughout the landscape. Further, human caused ignitions are most often associated with roads, which exist throughout much of the region. All this complicates strategic placement of treatments.

As decisions are made about the priority for treatment, it may be prudent to integrate high priority stands into a pattern of overlapping treatments. These stands could be used in conjunction with topographical features such as ridge-tops and valley bottoms that are logical locations for treatments. Existing roads can also be incorporated into the treatment network. To effectively prioritize the locations of fuels treatment and anticipate fire behavior, detailed, landscape-scale fuel maps could be developed (Kean et al. 2001).

Potential Economic Return from Timber Sales on the Klamath Reservation Forest

(Done with the assistance of Jim Spitz, AFC, Bend, Oregon)

Market Discussion

The number of wood product manufacturers within economic hauling distance of the former Klamath tribal forest has declined, during recent years with the decrease in available raw material supply. Still this market contains lumber, plywood, particleboard, hardboard, and cogeneration plants and is capable of efficiently processing all of the species and sizes of timber likely to be harvested from the Klamath Reservation Forest. Fortunately, there are still enough log and stumpage buyers in this area to maintain a reasonably competitive market. Further possible reductions in the number of buyers could seriously reduce competition between buyers and is of concern to forest landowners. Larger more competitive wood-product markets still exist in the Medford and Roseburg areas. Although haul costs across the Cascade Mountains to these markets may be prohibitive for low-value materials, access to these markets maintains an additional and important element of competition.

The value of logs and, especially stumpage, has always been extremely volatile. The cost of manufacturing and delivering logs is fairly stable, so the net value of stumpage moves up and down nearly dollar-for-dollar with delivered log prices. Stumpage values commonly double or triple during strong markets and decline by 50 percent or more during weak markets. As a result primarily of an increase in international supply and the development of competing products, including engineered wood products, the real prices of many solid wood products in the United States are now near 20-year lows, despite high wood product consumption rates. Contrarily, prices for pulp chips, hog fuel, and other by-products are near their historical highs, due to curtailments in primary wood product manufacturing operations.

Because of the volatile and unpredictable nature of wood products markets, there are a number of actions that timber sellers can take to be successful suppliers of these products. Foremost is conservative financial management. Creating a strong financial position, including financial reserves, allows an organization to continuously participate in these markets, to negotiate transactions from a position of strength, and to negotiate timberland and other asset purchases, when prices are low. Contrarily, financially overextended organizations often are forced to sell their products to make debt payments or to meet other cash flow needs during depressed markets.

Obtaining maximum value from a harvest requires cutting each tree into the highest value product mix available and then sorting and selling each of these products to the buyer, who can pay the highest price for it. Common products include sawlogs, veneer logs, poles, piling, pulp chips, and hog fuel. Each of these products has minimum specifications (species, length, diameter, maximum defect, etc.). Manufacturing facilities operate most efficiently within a limited range of raw materials—a particular species and diameter range for example. Thus, each buyer can afford to pay a premium for his optimum raw material. Computer programs are available to help optimize these cutting, sorting, and delivery decisions.

Maintaining reasonable continuity of sales and use of long-term supply agreements are also important elements for success for many large suppliers of logs and stumpage. Continuity of supply includes consideration of species, quality, and size. With continuity of supply, wood product manufacturers are able to reduce their manufacturing costs by selecting the most appropriate manufacturing equipment and by keeping this equipment operating near capacity for extended periods of time. With continuity of supply, manufacturers are also better able to increase their sales revenue by developing niche markets and by providing their customers with continuity of supply. As a possible major supplier, the Klamath Tribe should try to maintain reasonable continuity of sales and should evaluate its potential for obtaining higher prices by the use of long-term sales agreements. The most difficult element of these agreements is usually establishing a means for adjusting prices with market changes. To ensure that it has good, current market information, the Tribe should reserve at least a small portion of the full spectrum of its production for sale outside of long-term supply agreements.

Obtaining certification from the Forest Stewardship Council or similar organizations should also be evaluated for its potential to increase selling prices. There is also an increasing market for electricity from "green" sources. A number of electricity suppliers are offering to pay up to 1 cent per kilowatt more for wholesale power from green sources. It is likely that biomass from a certified forest would qualify as such a power source.

Another significant decision that the Tribe needs to make about its sales program is whether it will sell stumpage, further manufactured products (like logs, chips, or hog fuel), or some combination of each. Stumpage sales are simplest, and sometimes, buyers are willing to pay a premium for stumpage because it gives them greater control over log lengths and delivery schedules. On the other hand, product sales provide the Tribe with more employment opportunities and greater profit potential. A large forest landowner in the local market has realized good financial returns by sorting and negotiating log sales from its low- and medium-value stands to appropriate manufacturers and by selling stumpage from its high-value stands to the highest bidder.

Sample Appraisals

We developed sample "appraisals" on three hypothetical, but typical, potential restoration projects on the Klamath Reservation Forest: 1) a treatment in ponderosa pine/bitterbrush with low volumes (2 MBF) removed per acre, primarily of ponderosa pine. 2) a treatment in a lodgepole pine/bitterbrush with somewhat higher volumes (4 MBF) removed per acre, primarily of lodgepole pine, 3) a treatment in mixed-conifer with (4 MBF) removed per acre.

We have assumed the following treatments in these appraisals: merchantable wood will be mechanically cut, bunched separately and moved to market. Sub-merchantable material (4-9" dbh) will be mechanically cut, bunched in a small opening near the stump and burned there or, occasionally, left for wildlife habitat Also, this sub-merchantable material might be skidded and decked, but that might be more costly, requires larger landings, and might damage soils with the hot slash burn. Surplus trees smaller than 4" dbh will be hand felled, lopped, and left in place. Over 90% of the Klamath Reservation Forest is "tractor ground." We assumed that all logging would occur on this type of terrain. Further, we assumed that trees less than 21" would be available for harvest, excepting white fir where trees up to 24" might be cut.

We have attempted to use "average" conditions, rather than focus on the higher volume stands. Using 3 species groups helps with this averaging. We have assumed slightly below average economic conditions for the projects that we would expect during the first decade of treatments in these appraisals. Extremely dense, doghair stands (relatively uncommon on the Klamath Reservation Forest) are not included in these appraisals, since they would have poorer economic returns and, likely, would be treated separately as special projects, when appropriate funding is available.

Our sample appraisals (Tables 9 -- 11) suggest that restoration might just cover direct production costs of tree removal, including dealing with the sub-merchantable material. They would not cover planning costs or other treatments such as prescribed fire that might be used after mechanical treatment. This is generally consistent with recent Chiloquin District experience and also with published work (Lynch, et al. 2000. Forest Restoration in southwest ponderosa pine. Journal for Forestry. 98(8) 17-24). District experience and the Lynch article suggest the ability to more than cover costs if high enough volumes per acre can be achieved. We used relatively low average volumes reflective of what might be achieved across a landscape.

Eastside Buyers

Interfor Pacific, Gilchrist
PP and LP preferred
90 mmbf/yr
Often needs additional logs.
Currently buy small logs down to 5 inches diameter inside bark.
Large log side runs occasionally.
Fremont Sawmill (Div of Collins Pine), Lakeview
PP 69%, WF 26%, LP 3%, IC 2%
30 mmbf/yr
Medium and large logs
FSC certified.

Thomas Lumber (Div Of Jeld-Wen), K. Falls
PP 95%, SP 5%
30 mmbf/yr
Medium and large logs

Columbia Forest Products (Hardwood faced plywood), K. Falls
WF and DF preferred. Use some PP and LP for corestock.
Fairly large plywood mill.
27" maximum log diameter
FSC certified

Collins Products LLC mills, Klamath Falls
Particleboard mill uses mill by-products
Hardboard mill makes siding using mill by-products
FSC certified.
Westside Buyers

Boise Cascade, White City
All species
Lumber and plywood mills
SFI certified.

Glide Lumber Products (Swanson Group), Glide
DF, hem-fir, LP, IC, and Other
75 mmbf/yr
Looking for a reliable supply of LP.

Roseburg Forest Products, Dillard
All species.
Small and medium logs.
Stud mill, particleboard, plywood, and engineered wood products are stable or expanding.
FSC certified.
Douglas County Forest Products
DF, HF, and LP
Small mill
Aggressive and innovative

Note: Due to high prices for wood chips, primary manufacturers are currently using surplus in-mill chipping capacity for whole-log chipping. Some in-woods chipping operations are starting, but there is considerable cautiousness about investing in equipment for a whole-log chip market which may not last.

Table 9

Klamath Reservation Forest Typical Ponderosa Pine Harvest Value Per MBF in Restoration Projects, 1/07									
Pond Value of Ponderosa Pine Logs in Klamath Falls									
6-11" dib			$280	/mbf	x	85%	mbf	=	$240
12-16" dib			480	/mbf	x	15%	mbf	=	70
						100%	mbf		**310**
Minus Logging Costs									
Stump-to-Truck Logging								=	-140
Road Maintenance and Use Fees								=	-4
Log Haul	-$65	/hr x	3	hrs/ld	÷	3.5	mbf/ld	=	-60
									-204
Minus Precommercial Tree Removal & Slash Abatement Costs									
Mechanized Cut and Pile 4-8" DBH			-$75	/acre	÷	1.8	nbf/ac	=	-40
Hand Fell and Lop Whips			-40	/acre	÷	1.8	nbf/ac	=	-20
Burn Landing Slash and Most Precommercial Piles			-15	/acre	÷	1.8	nbf/ac	=	-10
									-70
Minus Timber Harvest Administration, Cost of Capital, & Risk									
8% x Pond Value of Logs								=	**-25**
Minus Forestry Taxes									
Oregon Harvest Tax								=	**-2**
Equals Immediate Harvest Value per MBF								=	**9**

Notes:

1. This appraisal includes the harvest phase of operations only. The cost of harvest planning, environmental assessment, tree and unit marking, preparing Forest Service contracts, and other presale activities are not included here.
2. There are economically viable markets for pulp logs and hog fuel in this area at this time. These markets have not been included in this appraisal, because they are transitory and usually not viab
3. Firewood utilization and winter burning of landing slash and most precommercial piles are include in slash abatement costs.
4. Harvest administration, cost of capital, and risk includes the cost of obtaining state harvest permit (for Federal, non-trust lands), hiring and supervising loggers, interest on money tied up in the project, and contingency for additional costs.
5. State harvest tax is included at Federal, non-trust rates.

Table 10

Klamath Reservation Forest Typical Lodgepole Pine Harvest Value Per MBF in Restoration Projects, 1/07				
Pond Value of Lodgepole Pine per MBF in Gilchrist			=	**$300**
Minus Logging Costs				
Stump-to-Truck Logging			=	-135
Road Maintenance and Use Fees			=	-6
Log Haul	-$65 /hr x	4 hrs/ld ÷	3.8 mbf/ld =	-70
				-211
Minus Precommercial Tree Removal & Slash Abatement Costs				
Mechanized Cut and Pile 4-8" DBH		-$100 /acre ÷	4 nbf/ac =	-30
Hand Fell and Lop Whips		-50 /acre ÷	4 nbf/ac =	-10
Burn Landing Slash and Most Precommercial Piles		-20 /acre ÷	4 nbf/ac =	-5
				-45
Minus Timber Harvest Administration, Cost of Capital, & Risk				
8% x Pond Value of Logs			=	**-24**
Minus Forestry Taxes				
Oregon Harvest Tax			=	**-2**
Equals Immediate Harvest Value per MBF			=	**18**

Notes:

1. This appraisal includes the harvest phase of operations only. The cost of harvest planning, environmental assessment, tree and unit marking, preparing Forest Service contracts, and other presale activities are not included here.
2. The log price in Gilchrist assumes that prices being paid by aggressive log buyers on the Westside would be met, net of additional haul costs.
3. There are economically viable markets for pulp logs and hog fuel in this area at this time. These markets have not been included in this appraisal, because they are transitory and usually not viable.
4. Firewood utilization and winter burning of landing slash and most precommercial piles are included in slash abatement costs.
5. Harvest administration, cost of capital, and risk includes the cost of obtaining state harvest permits (for Federal, non-trust lands), hiring and supervising loggers, interest on money tied up in the project, and contingency for additional costs.
6. State harvest tax is included at Federal, non-trust rates.

Table 11

Klamath Reservation Forest Typical White Fir Harvest Value Per MBF in Restoration Projects, 2/07				
Pond Value of White Fir per MBF in Klamath Falls			=	**$290**
Minus Logging Costs				
Stump-to-Truck Logging			=	-130
Road Maintenance and Use Fees			=	-8
Log Haul	-$65 /hr x	4 hrs/ld ÷	4.0 mbf/ld =	-70
				-208
Minus Precommercial Tree Removal & Slash Abatement Costs				
Mechanized Cut and Pile 4-8" DBH		-$125 /acre ÷	4 nbf/ac =	-31
Hand Fell and Lop Whips		-60 /acre ÷	4 nbf/ac =	-15
Burn Landing Slash and Most Precommercial Piles		-25 /acre ÷	4 nbf/ac =	-6
				-52
Minus Timber Harvest Administration, Cost of Capital, & Risk				
8% x Pond Value of Logs			=	**-23**
Minus Forestry Taxes				
Oregon Harvest Tax			=	**-2**
Equals Immediate Harvest Value per MBF			=	**5**

Notes:

1. This appraisal includes the harvest phase of operations only. The cost of harvest planning, environmental assessment, tree and unit marking, preparing Forest Service contracts, and other presale activities are not included here.
2. There are economically viable markets for pulp logs and hog fuel in this area at this time. These markets have not been included in this appraisal, because they are transitory and usually not viable.
3. Firewood utilization and winter burning of landing slash and some precommercial piles are included in slash abatement costs.
4. Harvest administration, cost of capital, and risk includes the cost of obtaining state harvest permits (for Federal, non-trust lands), hiring and supervising loggers, interest on money tied up in the project, and contingency for unforseen costs.
5. State harvest tax is included at Federal, non-trust rates.

Application of the Prescriptions: Residual Stand Conditions and Harvest Per Acre

We applied our revised prescriptions to the inventory in 2006 to estimate removals and residual conditions. In these simulations of the pine/mixed conifer plant associations, we generally retained trees over 21” dbh, except for white fir. A deficit of large trees exists on the forest, compared to historical conditions, for species other than white fir. Many more large white fir exist on the forest than in the past and we have attempted to bring their presence back to historical levels. Our priorities for density reduction were: 1) young-growth white fir across all diameters, 2) lodgepole pine (which rarely reaches 21” dbh and has invaded pine sites), and 3) other species less than 21” dbh, especially less than 12” dbh, to meet density targets. In density reductions of the smaller diameters, we favored ponderosa pine and sugar pine for retention.

-------------------------------- BA/acre in Residual trees < 21”--------------------------------

Type	PP	SP	WF	Other LP/DF/IC	Total	Goal
Ponderosa pine complex	27	2	0	0/0/0	29	20-30
Ponderosa pine remnant	31	0	0	00/0	31	20-30
Ponderosa pine simplified	40	0	0	0/0/0	40	20-30
Mixed conifer complex	20	11	0	0/6/1	38	30-40
Mixed conifer remnant	24	7	0	0/4/1	36	30-40
Moist mixed conifer complex	12	0	5	0/0/0	17	30-40
Moist mixed conifer remnant	25	5	5	0/1/4	40	30-40

-------------------------------- BA/acre in Residual trees > 21”----------------------------------

Type	PP	SP	WF	Other LP/DF/IC	Total	Goal
Ponderosa pine complex	45	1	0	0, 0,0	46	55-65
Ponderosa pine remnant	23	1	0	0,0,0	24	55-65
Ponderosa pine simplified	3	0	0	0,0,0	3	55-65
Mixed conifer complex	18	12	0 (8*)	0/9/1	40	70-80
Mixed conifer remnant	15	5	0 (8*)	0/3/1	24	70-80
Moist mixed conifer complex	34	0	10# (8*)	0,0,0	44	90-100
Moist mixed conifer remnant	14	2	7	0,1,2	26	90-100

* Assuming 8 cubic feet of white fir turned into snags. # Assuming 2 trees left as old growth white fir. &Assuming all large white fir left.

---------------------------------- Total Residual Basal Area/acre----------------------------------

Type	PP	SP	WF	Other LP/DF/IC	Total	Goal
Ponderosa pine complex	72	3	0	0,0,0	75	75-95
Ponderosa pine remnant	54	1	0	0,0,0	55	75-95
Ponderosa pine simplified	43	0	0	0,0,0	43	75-95
Mixed conifer complex	38	23	0 (8)*	0/15/2	78	100-120
Mixed conifer remnant	39	12	0 (8)*	0/7/2	60	100-120
Moist mixed conifer complex	46	0	15(8)#	0,0,0	61	120-140
Moist mixed conifer remnant	39	7	12(8)&	0,2,6	66	120-140

These simulations approximate likely outcomes of the application of recommended prescriptions in the field. (See Appendix D for the diameter distribution before and after application of our prescriptions by plant association group, the species and density of the residual stand and the removals, the volume/acre removed by species, and total volume by species.) That simulation gives the following result for each community type/structural condition in the ponderosa pine/mixed conifer:

From these results, we can draw a number of conclusions about the residual stands:

1) Residual basal areas less than 21" are generally within target levels, except for ponderosa pine simplified and mixed conifer complex. Ponderosa pine simplified have very few trees over 21" so more basal area was left of smaller trees to bring the stocking to approximately 40 sq ft/acre. Most of the basal area less than 21" in moist mixed conifer is white fir. We wish to reduce that species to a modest level (to 5 sq ft of basal area) to enable space for ponderosa pine to reproduce.

2) Slightly more basal area was left in ponderosa pine remnant than the target level to retain trees from 15-20 inches for rebuilding old-growth structure.

3) Residual basal area for trees over 21" falls short of the minimum targets for all types and structures. Especially, the mixed conifer types fall short once the large second growth white fir is removed.

4) Ponderosa pine remnant and ponderosa pine simplified—most of the ponderosa pine forest--would have a residual basal area between 40 and 60 square feet after treatment.

We also estimated basal area and board foot removals for the "average" acre:

-------------------------------- Removals in basal area/acre < 21"--------------------------------

Type	PP	SP	WF	Other LP/DF/IC	Total
Ponderosa pine complex	15	0	4	8/0/0	27
Ponderosa pine remnant	26	0	1	14/0/0	40
Ponderosa pine simplified	23	0	0	15/0/0	38
Mixed conifer complex	0	0	40	2/5/0	47
Mixed conifer remnant	0	0	44	7/2/0	53
Moist mixed conifer complex	0	0	70	4/0/0	74
Moist mixed conifer remnant	10	0	40	2/0/0	52

--------------------------------- Removals in basal area/acre > 21"--------------------------------

Type	PP	SP	WF	Other LP/DF/IC	Total
Ponderosa pine complex	0	0	0	0/0/0	0
Ponderosa pine remnant	0	0	0	1/0/0	1
Ponderosa pine simplified	0	0	0	0/0/0	0
Mixed conifer complex	0	0	25	0/0/0	25
Mixed conifer remnant	0	0	15	0/0/0	15
Moist mixed conifer complex	0	0	55	0/0/0	55
Moist mixed conifer remnant	0	0	0	0/0/0	0

---------------------------- Removals in basal area/acre (total stand)----------------------------

Type	PP	SP	WF	Other LP/DF/IC	Total
Ponderosa pine complex	19	0	4	8/0/0	31
Ponderosa pine remnant	29	0	1	15/0/0	45
Ponderosa pine simplified	23	0	0	15/0/0	38
Mixed conifer complex	0	0	65	2/5/0	72
Mixed conifer remnant	0	0	60	7/2/0	69
Moist mixed conifer complex	0	0	125	4/0/0	129
Moist mixed conifer remnant	10	0	40	2/0/0	52

---------------------------- Removals in board feet/acre (thousands) ----------------------------

Type	PP	SP	WF <21”/>21”	Other LP/DF/IC	Total
Ponderosa pine complex	.4	0	.3/0	.7/0/0	1.4
Ponderosa pine remnant	1.2	0	.1/0	1.2/0/0	2.6
Ponderosa pine simplified	.5	0	0/0	.9/0/0	1.4
Mixed conifer complex	0	0	4.6/3.0	.2/.5/0	8.3
Mixed conifer remnant	0	0	4.0/1.7	.5/.2/0	6.4
Moist mixed conifer complex	0	0	5.4/11.2	.1/0/0	17.2
Moist mixed conifer remnant	.7	0	4.0/0	.2/0/0	4.9

*net of large white fir left for snags

Some observations about these removals:

1) The mixed conifer commuity types/structural stages have higher board foot/acre removals due to the significant volumes of white fir that should be taken.

2) Harvest in the ponderosa pine complex and the ponderosa pine simplified would focus on very small trees and therefore would, on the average, probably not be economic unless combined with other community types/structural stages. Hovever, since these forests are intermixed with the larger acreage of ponderosa pine remanant, which has higher removals per acre, that probably would not cause difficulties.

3) It must be remembered that these are for average conditions and harvest is more likely to occur in heavier-than-average stands.

Potential Total Harvest over the Next 20 Years

We have discussed harvest occurring on one-half to two-thirds of the ponderosa pine/mixed conifer acres over 20 years. With these removals on two-thirds of the available acres (or, more likely, the half of the acres that are more densely stocked), our total harvest over 20 years might be (see Appendix D):

	Harvest Current Vol MM bd. ft.	% of Inven	Harv vol# Now+ 10 yrs MM bd. ft.
White fir	524	51 (65)*	575
Lodgepole pine in mixed conifer	292	67	321
Ponderosa pine	235	7	255
Douglas-fir	25	14	28
Total	1075	19/23	1179
Ave/year over 20 years	54		59

Now + 10 years is the middle of the 20 year projection period.

* The % in brackets includes cleaning out around big pine trees in the mixed conifer stands where density reduction will not be done (and assuming the cut trees are left) and creating 2 large snags per acre in the mixed conifer stands.

Note: this does not include lodgepole pine harvest from clearing the draws in the wet lodgepole type nor in converting ponderosa pine sites, currently mapped as lodgepole pine/bitterbrush, back to ponderosa (removing the lodgepole).

In our draft plan, we estimated an average annual harvest for 20 years of 40-60 MM bd ft. That still seems like a good estimate. On the one hand, the owl areas in South Chiloquin (see Standards and Guidelines) will reduce the acres that might be harvested. Also, for many reasons, such as steepness, other areas will be left. On the other hand, we have not counted here the lodgepole pine that will come from the wet lodgepole areas and from the areas that should be converted back to ponderosa pine. In all, we feel that 40 million board feet is a good beginning estimate of the annual harvest under these recommendations. Refinement of this estimate awaits detailed field implementation.

We estimate the total inventory on the ponderosa pine/mixed conifer type in 2006 as 6,260 MMBF and current net growth in the ponderosa pine/mixed conifer types as 95 MMBF/year. Over the 20 year period, harvest (+ snag creation) should remain less than growth, although growth will slow as the faster growing species (white fir/lodgepole) are targeted for removal. Also, droughts could increase episodic mortality, and prescribed fires and wildfires will undoubtedly kill some trees. Without major calamities, the KRF should have about the same inventory volume in 20 years as it has today. More of it will be in ponderosa pine and sugar pine in upper diameters. Also the forest would have about 1/2 -- 2/3 of the ponderosa pine/ mixed conifer types in a generally open condition and 1/3 -- 1/2 in a denser condition.

With luck, we might end up with not more than 300 million board feet in white fir—a substantial reduction from today. For comparison, our historical analysis suggests that KRF had approximately 288 MMBF in 1910. Lodgepole pine will be more concentrated in the lodgepole pine types than it is today.

Using Biomass from the Klamath Reservation Forest to Fuel a Biomass Plant

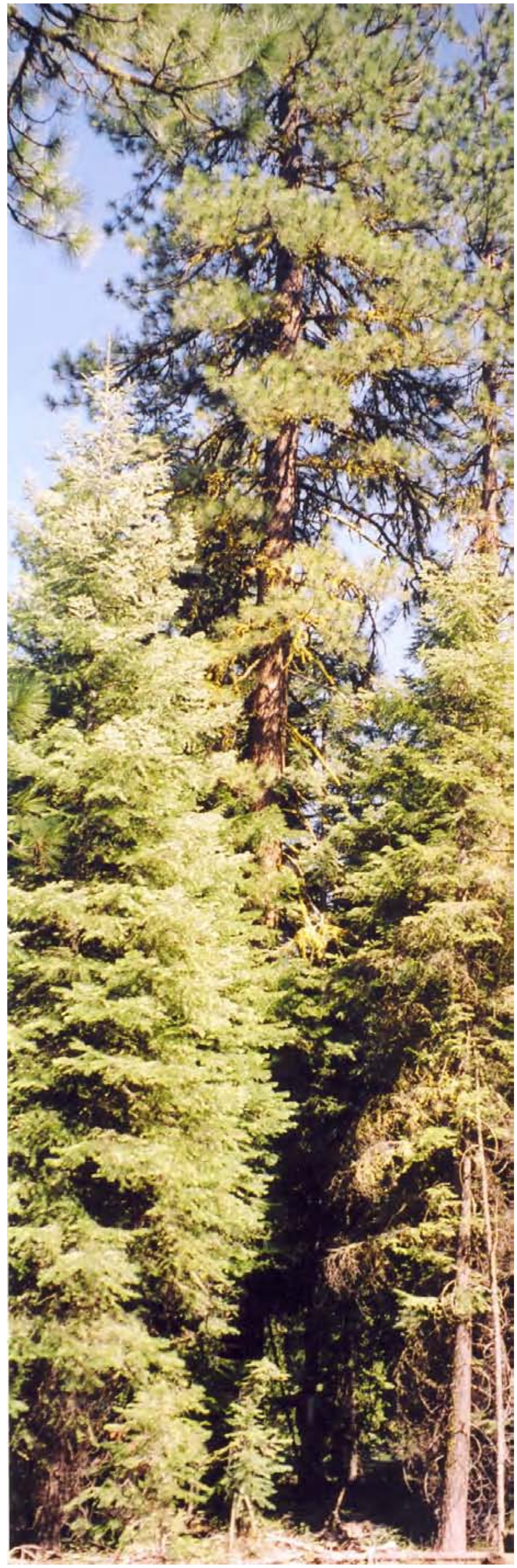
Using Biomass from the Klamath Reservation Forest to Fuel a Biomass Plant

Biomass power plant efficiency is greatest for large plants (say 20+ MW), but plants as small as 5 MW can be economically viable. This economy of scale largely results from the fact that large and small plants require approximately the same size of staffs and yard equipment for operations. A rule of thumb for financing and development of biomass plants is that fuel availability should be 2 to 3 times the volume necessary to sustain operations. Eighty thousand BDT of biomass annually would be needed to fuel a 10 MW plant 24 hours per day for 315 days per year. This is the equivalent of approximately 6,150 truck-loads of green biomass per year or 40 truck loads per day (assuming 160 delivery days per year and an average of 13 BDT per truck load). The biomass supply must be reliable for a biomass power plant to be economically successful. Supplies that are vulnerable to public appeal processes or sporadic, federal funding of fuels reduction programs are high-risk.

Based on the assumption of 13 BDT/truck load and an average of 11 BDT/acre available as a by-product of a harvest operations on the Klamath Reservation Forest (Table I15, Appendix C), it would take approximately 50 acres/day of this by-product to fuel a 10 MW plant. Assuming that all the fuel came from the Klamath Reservation Forest, it would take approximately 5100 acres a year to fuel the 10 MW plant. Without biomass use, much of this potential fuel would be burned on site after the solid wood products are removed.

Of course, if all the material from the harvests came off as biomass, it would take considerably less acres—only a few thousand acres would be needed per year.

Capital costs for a new biomass power plant at a green field site run as high as $2 to 3 million per MW. New plants that make use of existing facili-



ties (old mill yards, etc.) can cost as little as $1 million per MW. Investors typically want to see a 15% or greater return on investment based upon the assumption of 100% equity funding. However, debt financing of up to 80% of facility costs is common practice. Some federal and state grants and low-interest loans may be available to help with financing.

Proper siting of a plant is critical. The site should be large enough to store a 4-month supply of fuel, thus, a minimum of 7 acres would be needed to site a 10 MW plant. The site should be within 50 miles of the biomass fuel supply to keep fuel costs reasonable.

Biomass fuel must be deliverable for less than approximately $32 per bone dry ton for the plant to be economically viable. Locating close to municipal waste disposal sites, agricultural wastes, or natural gas pipelines can also make it possible to use additional or blended fuel supplies. Railroad access could reduce the cost of delivering more distant fuels. The plant must also be located near powerlines and substations capable of handling its production or bear the cost of building connecting lines and substations. A 10 MW plant requires approximately 300 gallons per hour of water for its operations and discharges approximately 10 gallons per hour of waste water, preferably to an agricultural use. Locating the plant next to a dry kiln, green house, large building complex, or other potential user of waste heat or recovered steam is also desirable. There also may be substantial tax and regulatory advantages to locating a plant on tribal trust land. Assuming that the plant was located in Klamath Falls, a significant portion of the forest would fall within 50 miles. Interestingly, most of the “high” rural population/wildland interface fire risk area would be within 50 miles (Map 12, Appendix A).

Obtaining a firm power sale agreement with a credit-worthy buyer at an economically viable rate is a critical early step and must be done prior to obtaining financing or beginning construction. A rate of over $.08 per kW hour is likely to needed to justify construction of a biomass power plant. Thirteen states have Renewable Portfolio Standard (RPS) laws, which require utilities to purchase a certain amount of their electricity supply from renewable sources, including biomass power. Oregon does not have an RPS law. A Federal RPS bill is presently in Congress, but its passage is uncertain. Pacific Power is voluntarily seeking substantial supplies of environmentally friendly electricity, but without compulsion may not be willing to pay a significant premium for this power. Selling power to a local utility or large local consumer (government agency, etc.) is ideal, because the power can be fed directly into their system. Selling to a distant customer is possible, but requires negotiating a wheeling agreement to send the power over other utilities’ transmission lines, which can be expensive.

Plan Implementation

As discussed above, we recommend that the Klamath Reservation Forest be treated over the next 20-25 years. Further we recommend that this work be done through two interconnected strategies:

1) Targeted fuels reduction near people and property

2) Density and fuels reduction across the Reservation Forest

Targeted fuels reduction near towns and settlements

Reducing fire severity around towns and settlements should be a top priority for management of the Klamath Reservation Forest. Recent fuel treatment projects around the town of Chiloquin and in the Sprague River Valley are examples of those projects. These types of efforts should continue.

Density and fuels reduction across the Reservation Forest – a landscape approach

Much of the Reservation Forest, however, is far from towns or settlements. For that area, we recommend that work proceed with treatment of one or two large areas finished per year. To achieve this goal, we have worked with Will Hatcher, Tribal Forester to break up the Forest into Restoration Units (Appendix A, Map 11) based on watershed boundaries. We felt that it was important that treatments should be coordinated over a relatively large area in each project to maximize their effect and to enable landscape-level considerations to come into play. Also, treating a large area at one time would enable stands where treatments produced a net income to offset those where treatments incurred a net cost. Once the treatments were finished for an area, we would not expect to return to the area for another 20 years unless natural disturbances caused the need for site restoration and recovery.

Twenty five restoration units were delineated in total, implying that one to two units would be treated per year to move over the Forest in approximately 20 years. Some of the criteria for setting priorities for selecting restoration units include:

1) Occurrence of extensive areas of large, old pine trees at high risk of stand-replacing fire

2) Proximity to people and dwellings (See Appendix A, Map 12)

3) Balancing restoration units that will yield a net revenue against those that will not

4) Recent major natural disturbances such as fire or insect outbreak

5) Spreading the units across the Forest so that all existing Forest Service Districts have a restoration unit within the first few years of plan implementation

Within these units, we would expect 1/2 to 2/3 of the area to be entered for treatment of some kind, although more detailed project analysis would be needed to identify particular stands for treatment. Some of the criteria for selecting ponderosa pine/mixed-conifer stands for treatment within the restoration unit include:

1) Direct threat of wildfire or insect attack to large, old pine trees through a buildup of understories

2) Proximity to people and their dwellings

3) Ability to reduce the rate of fire spread, such as through an overlapping herringbone design of treatment blocks, the placement of treatments along ridges or valley bottoms along roads, and the placement of treatments on the drier south and west facing slopes

4) Proximity to ignition sources

5) Ability to improve habitat for mule deer

Limits on the selection of stands for treatment include:

1) Land allocation: some allocations do not allow any treatments (Yamsay Mt.)

2) Standards and guidelines for particular species such as spotted owls, mule deer, and eagles, will call for some trees, patches and stands to be left that might otherwise be thinned (see more discussion below under standards and guidelines)

3) Stand condition—some stands will not have the buildup in understories such that they need treatment

4) Special considerations for the management of the northern spotted owl in South Chiloquin

Assume that all restoration units are treated in the first 20 years. What would happen then? We would start the second restoration cycle, going back through the restoration units in approximately the same order, unless other circumstances arose. In the second cycle some stands that were not treated the first time would be considered for treatment, as would those that had been previously entered. It is difficult now to develop exact prescriptions for that reentry. The Tribes will have learned much during the first restoration cycle. New restoration techniques might come available. Values might change. It is clear, though, that a second cycle will be needed and a third after that, to maintain conditions that will lead with a high likelihood to the desired future conditions.

Restoration actions and costs

Ponderosa pine/mixed conifer

Klamath Reservation Forest has about 520,000 acres of ponderosa pine/mixed conifer. Assuming that 1-2 restoration units can be treated per year, treatments might be implemented on a gross acreage of 30,000 per year. The net acreage treated will be smaller. Some areas will not need treatment; some will be too steep; and some will be reserved. Assuming that perhaps 1/2 to 2/3 of the area is treated, 15,000 to 20,000 acres per year would actually be treated.. As discussed above, at least 40 million board feet/year should be available to local mills along with biomass for fuel.

Type and cost for treatment of the ponderosa pine/mixed conifer at this level of activity:

As shown in the sample apprasials, we believe that direct stand treatments would break-even in an average to good market (see Tables 9-11) from the sale of sawlogs and chips. Development of a biomass market would provide additional revenue but we did not consider that here.

We believe that logging equipment can usually break up the brush sufficient such that a brush cutter is not needed. Further, we believe that, in general, mechanical treatment must often come before prescribed fire because of the build up of fuels, at least in the first treatments. Some of the 15,000- 20,000 mechanically treated acres will not be burned because of site conditions. Also, the number of days suitable for burning varies tremendously from year to year (two weeks to two months) and pulling the resources to do burning can be challenging. Perhaps, 50% of the treated area (10,000 acres) will be burned a year.

Lodgepole/bitterbrush and wet lodgepole

These two types total about 70,000-- 90,000 acres including some former ponderosa pine forest that has a remnant pine component (perhaps 20,000 acres). Three strategies will be applied to these types:

1) Lodgepole pine/bitterbrush will be managed on a 75-150 year rotation, except for designated reserves, as discussed previously.

2) Lodgepole pine/ponderosa pine/bitterbrush. Stands with a significant ponderosa pine component will be managed to return them to ponderosa pine-dominated stands. Much of the lodgepole in these stands will be removed when adjacent stands are being treated. This treatment should pay for itself.

3) Wet lodgepole will be managed to revitalize its forb/shrub/hardwood character along with encouraging occasional ponderosa pine along the edges. Much of the lodgepole pine will be removed and prescribed fire will be reintroduced. This treatment may pay for itself.

Overall restoration costs

A significant investment will be needed to restore the Klamath Reservation Forest. Funds will be needed to plan treatments and to develop environmental assessments. Also, funds will be needed to conduct the prescribed fire needed as part of the treatments. Fortunately most of the road system is established and useable at only a modest cost. In total, these costs might run 4-8 million dollars a year at the level of effort described above, starting at the higher cost and declining over time as experience is gained. Fire management costs (suppression, pre-suppression, and assistance on prescribed fire) would be additional.

Specific Goals, Standards, and Guidelines for Management of the Klamath Reservation Forest

In the previous sections, we have described, in general, the desired future conditions of the forest, the current conditions, and the proposed activities to move from the current forest to the desired future forest. In this section, we cover four topics:

1) Standards and guidelines for activities across the forest. Standards state the restrictions or requirements on activities carried out to achieve the goals of the Forest Plan. Guidelines provide advisory information.

   As part, of this section, we discuss special provisions for wildlife, including for mule deer and endangered species. Improving mule deer habitat is an important priority for management of the Klamath Reservation Forest. In this section, we describe the desired future condition and standards for activities, from the standpoint of mule deer, in both deer winter range and the across the forest. A number of endangered species use the Klamath Reservation Forest and the Tribes plan to do their part to protect and recover them.

2) Special management emphases, such as Complex Forests. Here we describe the special character of these areas, the goal and desired future conditions for the areas, and standards for actions within these areas

3) The relationship of the management strategy and associated standards proposed here to the Northwest Forest Plan

4) Approaches to post-fire treatments, including standards for these treatments

Forest-wide Goals, Standards, and Guidelines

Forest Management Strategies

General Goals

Restore and maintain as much healthy, diverse, and structurally complex forest ecosystems as possible.

Restore and maintain natural fire regimes and plant diversity through thinning and prescribed burning.

Implement management activities that will restore, protect, and enhance the forest, wildlife, water and soil resources through road closures, grazing restrictions, riparian buffers, soil conservation, and other means.

Maintain or expand the forestlands for wildlife habitat and other forest uses.

Tree Removal

Protect all existing old growth trees. Utilize basal area targets to guide harvest, with a high priority on removal of young-growth white fir and lodgepole pine of all sizes. See descriptions of desired conditions and reference area prescriptions for more details.

Snag and Down Wood

Snags and down wood will be retained in sufficient quantities to provide for wildlife and ecological needs, including long-term structural enrichment of the site.

In general, ponderosa pine and mixed-conifer stands are deficit in snags, compared to historical conditions, because of removals in the past, and a history of fire suppression. Therefore, treatments should generally work to retain existing snags and prohibit fire wood cutting in these habitat types. Rather firewood cutters should be encouraged to cut firewood from dead trees in lodgepole pine habitat types. In addition, snags should be created from large young-growth white fir as discussed in the reference-area prescriptions.

Fish, Wildlife, and Sensitive Plants

The Klamath Forest Plan described here focuses on restoring resiliency and productivity of Klamath Basin pine and mixed-conifer forests while generating and sustaining cultural, social, environmental and economic benefits for the tribes. Several hundred thousand acres of forest on the Klamath Reservation are currently at moderate to high risk of uncharacteristically intense fire, drought stress or insect attack. Thousands of other acres are functioning substantially below their productive capacity for desired resource values, e.g., mule deer and culturally important plants. Further ecological and economic losses will occur if restoration is not initiated, exemplified by continued low deer numbers and recent fires.

Wildlife

Historically, federal forest plans used a “regulated forest” approach to conserve wildlife habitats, i.e., standards for cover to forage ratios, snag standards, and riparian reserves. This plan aims to restore more naturally diverse and resilient forest conditions over the entire area of the reservation, including restoration of vibrant aspen and riparian communities. Thus, it aims to restore ecosystem conditions and processes similar to those under which native species evolved.

The regulated forest approach to wildlife conservation was developed to serve federal, state and private forest plans that aimed to change forests from naturally diverse and resilient forests to highly regulated, simpler ecosystems (Salwasser 2003). Many wildlife and fish species can be negatively impacted by unmitigated regulated forest management actions such as clearcutting followed by planting closely spaced trees for the primary purpose of growing wood, removing snags and down wood habitats, simplifying tree species diversity, age and size classes, and changing riparian areas through heavy grazing. Therefore, special management provisions are commonly put into regulated forest plans to protect sufficient habitat conditions to retain most, if not all, native species in the plan area. These special provisions range from state forest practice act rules, to federal forest plan standards and guidelines, to standards required by various certification schemes for forest sustainability.

The proposed Klamath Forest Plan starts with a fundamentally different objective: to restore and sustain a naturally diverse forest and its ecological processes. Thus, the tools and provisions for wildlife conservation suited for previous and currently existing forest plans, e.g., the Winema NF Plan and NWFP, may not be needed and could actually unnecessarily encumber effective and timely restoration under the proposed plan.

Species associated with complex forests, riparian and aspen communities, and mule deer should all benefit from planned restoration of complex forests with abundant understory shrubs and herbs. In many cases, additional standards for old-forest associated species or deer may not be needed given the habitat diversity and productivity that will ensue if planned restoration work occurs in ponderosa pine, mixed-conifer, aspen and riparian areas. We do, however, propose special consideration for federal and state-listed species at risk of extinction and species documented to be in decline such that they might be headed for listing as threatened or endangered. In addition, we propose special consideration for species of particular interest to the Tribes such as mule deer.

Mule Deer Habitat Objectives and Standards

Goal

Promote and restore habitats favorable for mule deer herd growth and expansion in the short and medium term. Allow natural processes, supplemented by active management, to provide high-quality deer habitat on a sustained, long-term basis.

History (adapted from a paper by Rick Ward)

Mule deer populations throughout the West have fluctuated dramatically over the past 100 years. Unregulated hunting and habitat loss led to very low population levels from the late 19th Century through the early 20th Century. Starting in the 1920's mule deer numbers began to steadily increase, reaching a high point in mid 1950's in northern California and southern Oregon (Salwasser 1979), and peaking again in the mid 1960's (Julander and Low, 1976). Populations then began a steady decline until about 1980, after which point mule deer numbers throughout most of the West remained steady or increased slightly (Kie and Czech 2000). However, mule deer populations within the Klamath Tribes' former reservation boundary have continued to steadily decline during the time period when other mule deer populations have maintained or increased in number. In fact, mule deer numbers have decreased by more than 63% since the Tribe began monitoring deer populations specific to the former reservation in 1981 (Fig. 3).

Several state herd management units (HMU) are partially contained within the former reservation. The Sprague HMU is contained almost entirely within the former reservation and comprises almost 45% of the public hunting lands available to tribal members. This HMU has been particularly hard hit with mule deer population declines. Mule deer numbers have declined by 90% in the last 38 years, from 31 deer per mile in 1965 to 3 deer per mile in 2003 (Fig. 4). This HMU also encompasses many traditional hunting areas used by Klamath Tribe members, as well as the community of Chiloquin, the traditional home base of the Klamath Indians.

Reasons for the decline in local mule deer populations are highly debated and likely include some combination of factors such as competition with elk and livestock, disease, habitat modification and loss, hunter harvest, and predation (Gill 1999).

Changes in forage quality and quantity have repeatedly been identified as one of the principal limiting factors for deer populations. Salwasser (1979) identified fawn survival as the primary limiting factor for the Devil's Garden Interstate Deer Herd, and implicated low-quality diet during late spring and fawning as the key determinant of fawn survivorship. Peek et al. (2001) identified fire suppression, and forest maturation and canopy closure as reasons for the diminished forage conditions. Peek et al. (2002) further correlated weather and forage quality and quantity to deer population declines in south-central Oregon.

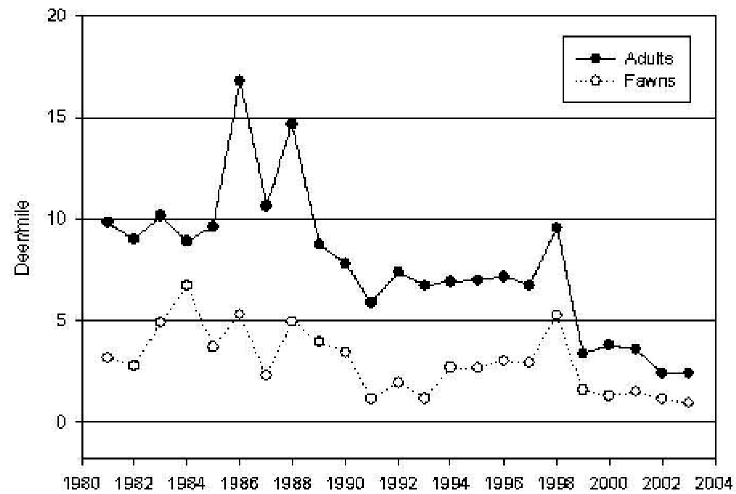


Fig. 3. Population trends for mule deer within the former Klamath Indian Reservation. Trend numbers are based on track counts conducted by the Klamath Tribes each August.

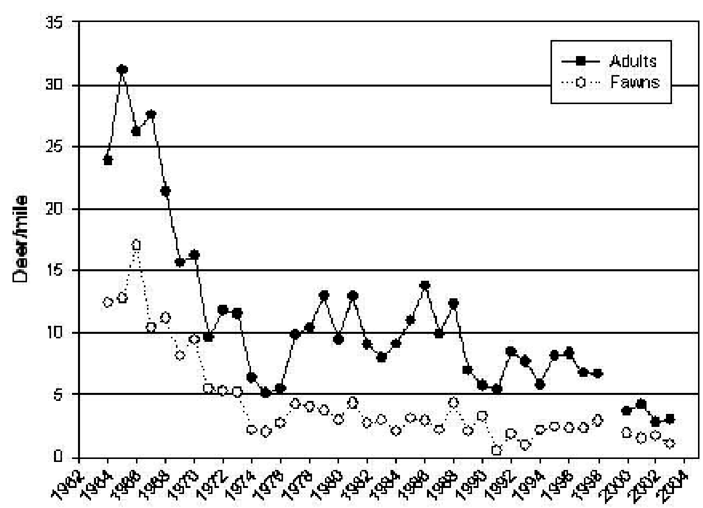


Figure 4. Population trends for mule deer within the Sprague Herd Management Unit from 1964-2003. Trend numbers are based on track counts conducted by ODFW from 1964-1980 and the Klamath Tribes from 1981-2003.

Approach

Deer management is often described as providing the optimal balance of forage and cover. In those terms, our approach focuses on forage deficiency as a key problem while still recognizing the need for patches of cover throughout the landscape. As pointed out in a review of the draft plan by Hal Salwasser: “Cover does two things: it reduces energy loss to heat and cold and it protects animals from predators (human included). Only forage, though, can “grow” deer and forage has been the most significant factor in mule deer declines since before I studied the herds in 1970s. The most important forage for population growth and big bucks is spring-summer forage, while does are in their third trimester and lactating and while males are bulking up for rut and winter. A diverse assortment of grasses, forbs and shrubs at stand and landscape scales is desired. Forage is in poor shape in nearly all sites and can be improved only by creating more early seral conditions and getting more sunlight below the forest canopy."

Desired future condition

Winter range
Providing high quality, abundant forage and adequate thermal cover is the emphasis on mule deer winter range. The desired future condition is a patchy mosaic of openings, dense patches of cover, and open stands of timber where forage is available. The management scale is that of a mule deer subpopulation where resources are provided for deer in a herd environment.

Openings should be occupied by vigorous browse, forbs, and grasses. Browse is composed primarily of vigorous young and middle-age bitterbrush, as well as curleaf mountain mahogany where site conditions permit. Open patches of forbs and grasses should be mixed in with browse. Optimal cover patches are 2 to 5 acres and within 600 ft. of each other although smaller, more widely-spaced patches are also valuable. Optimal cover patches have a minimum width of 300 ft. and are composed of shrubs and/or conifers at least 5 ft. tall, with 60% or greater crown closure. The optimal ratio of cover to forage is 70% forage to 30% cover. Human disturbance to wintering animals is minimized through seasonal road closures.

Forest-wide
Providing adequate fawning habitat and high quality, abundant forage is the emphasis in managing for mule deer forest-wide. Also, providing hiding and thermal cover is of concern. Again, the desired future condition is a patchy mosaic of cover and forage, but available within the area of a single home range and within fairly contiguous mature forests. Forage, hiding cover, thermal cover, and fawning habitat needs are met through diverse plant communities and heterogeneous forest structure. Riparian zones and edge habitat between forests and openings are of particular importance because they meet several key habitat needs, such as fawning areas, hiding cover, and abundant, diverse forage.
Fawning areas have the highest priority among mule deer habitats. Optimal fawning areas are 1 to 5 acre patches of low shrubs (deciduous preferred) or small trees (hardwoods preferred) 2 to 6 ft. tall with at least 40 percent canopy closure, that lie within 160 ft. of taller tree cover. They are located on slopes of 0 to 30 percent and within plant communities where forage is succulent and plentiful (riparian associated plant communities preferred), and potable water is available within 600 ft. during June. This habitat is found primarily in riparian and meadow margin communities. Human disturbance during fawning is minimized through seasonal road closures.

Optimal hiding cover patches range in size from 1 to 5 acres and have vegetation capable of hiding 90% of a standing adult deer from the view of a human at a distance equal to or less than 200 ft. Optimal thermal cover patches range in size from 1 to 5 acres and are composed of mature conifers with 40% or greater crown closure, have little or no shrub or small tree understory, and are located on the upper one-third of north-facing slopes.

Openings, ideally, have a ground cover of browse, forbs, and grasses. Browse is composed of a diverse array of shrubs, while grasses and forbs are abundant and interspersed with shrubs.

Forage habitat is characterized by productive and well developed understory communities composed of deciduous and evergreen shrubs, forbs, and grasses. In ponderosa pine and lodgepole pine forests at lower elevation the primary browse species is bitterbrush; the desired condition is a vigorous stand of bitterbrush, as measured by the production of new or young shoots. Guidelines on the balance between forage and browse are provided below.

Assuming that 100% of the Klamath Reservation Forest is managed for mule deer, the optimal distribution of cover and forage forest-wide would be approximately 60% forage habitat and 40% in cover habitat of various types. Forage habitat should provide hiding cover at distances of no greater than 600 feet, in addition to providing good quality browse in the understory (preceding paragraph); if they meet the definition of hiding cover, fawning areas may also fulfill the 600 foot hiding cover requirement. Cover habitat includes hiding cover, thermal cover, and fawning cover.

We believe that management direction for forests on the Klamath Reservation Forest is generally consistent with the desired conditions for mule deer, although the direction may result in somewhat less cover. Silvicultural prescriptions for forest restoration should help address both forage and cover needs. Reductions in stand density and application of prescribed fire will provide the vigorous understory communities needed to fulfill the goal of 60% forage habitat; restoration treatments will specifically target rejuvenation of decadent bitterbrush understories. Burning, mowing, and crushing should help revitalize shrub and forb communities as will reduction in tree density. Silvicultural prescriptions will also incorporate spatial variability in tree density, including retention of high density tree patches over an average of 10-15 % on the treated areas. The density of these patches, which are expected to vary from 1/2 to 5 acres in size, will readily meet visual requirements for hiding cover; the spatial distribution of these patches will also meet the 600-foot requirement. Restoration efforts in riparian areas and meadows will help achieve this fawning habitat as a by-product of revitalizing hardwoods and forbs located there. Areas valuable for thermal cover will need to be identified by a wildlife biologist, since they are located on specific portions of the landscape (generally the upper third of north facing slopes). These areas, ideally, have stands of mature conifers along with high density tree patches and little or no shrub or small tree understory. This description of thermal cover matches closely our goal for moist mixed-conifer habitat types (which often occur on the upper portion of north facing slopes) except that we expect to have some shrub understory and may have a lower crown closure.

Standards

Winter range

1) Proposed treatments in Winter Range will be evaluated against the optimal winter range conditions given above. While they can temporarily deviate from the quantitative standards described in the optimal conditions, they should achieve them over the long run.

2) Activities in bitterbrush stands will attempt to leave one-third of the live bitterbrush untreated and distributed in patches throughout the project area to serve as a seed source. Preferred size of leave patches is 1/4 to 1/3 acre.

3) Seasonal closures on all motorized forms of transportation, including snowmobiles, will be in effect from November 15 through April 30 on all winter ranges.

4) Domestic livestock grazing will be allowed on winter range only when it enhances mule deer habitat.

Forest-wide

1) Treatments will retain high density tree patches over an average of 10-15 % on the treated areas. To the degree technically feasible, patches will vary in size from 1/2 to 5 acres (two acre average preferred), and achieve a spatial distribution that generally meets the 600-foot requirement. Where patches cannot be found in this size range, smaller patches will be used.

2) Restoration of riparian and meadow border areas will assist in the provision of fawning cover. In general, at least 5% of the forest will have the conditions for fawning cover at any time (1 to 5 acre patches of low shrubs (deciduous preferred) or small trees (hardwoods preferred) 2 to 6 ft. tall located on slopes of 0 to 30 percent and within plant communities where forage is succulent and plentiful (riparian associated plant communities preferred), and potable water is available within 600 ft. during June.)

3) Stands on the upper 1/3 of north facing slopes will be managed in ways consistent with the provision of thermal cover. These prescriptions call for the retention and development of an overstory of mature conifers, reduction in the density of small trees, revitalization of the shrub and forb understory, and creation and maintenance of occasional dense patches.

4) Activities in bitterbrush stands will attempt to leave one-third of the live bitterbrush untreated and distributed in patches throughout the project area to serve as a seed source. Preferred size of leave patches is 1/4 to 1/3 acre.

5) Seasonal road closures will be in effect in areas near fawning habitat.

6) Hardwoods will be favored over conifers in areas where potential for hardwoods exists.

7) 1/4 mile buffer will be formed around designated mule deer and elk fawning and calving areas from May 1 - Jun 30

Guidelines

1) Edge habitat provides an opportunity for the best arrangement of forage quantity and quality in relation to cover. Restoration projects have the potential to increase edge habitat by enlarging meadows, scab-rock flats, and other openings.

2) Forest-wide forage areas with the potential for both browse species and palatable grasses and forbs, should have a ground cover composition of approximately 50% browse and 50% forbs and grasses. The exception to this is where browse species are needed to meet cover needs.

3) A diverse mix of browse species is desirable forest-wide. In addition, a diverse mix of seral browse species is desirable on winter range and forest-wide.

4) Juniper is preferred to ponderosa pine where trees are needed to meet cover requirements on winter range.

5) A mixture of plant communities provides better habitat than any single community.

6) Hiding cover has the greatest benefit when it is maintained where deer may otherwise be seen, such as along roads, between openings, and along travel corridors like riparian areas.

Raptors and Colonial Nesting Birds

Protect nest trees and likely alternative nest trees in an area of use. Protect active roost and nest sites (including rookeries) from human disturbance during nesting seasons. Generally, this will occur through the creation of a buffer around the nest until the young fledge. Northern goshawks, pileated woodpeckers, three-toed woodpeckers, golden eagles, great blue heron, osprey, great gray owls, prairie falcons, and flammulated owls all may occur on the Reservation Forest. In addition, a variety of hawks use the Forest, such as red-tailed hawks, sharp-shinned hawks, and Cooper's hawks, as do turkey vultures. Discovery of an active roost or nest site for any of these species should result in the creation of a buffer around the site until the young fledge.

The buffer for the great gray owl will include adjacent meadows. Search for nest sites, creation of the buffer, and monitoring of the site will be supervised by a qualified wildlife biologist.

Bald eagles

Bald eagles occur in many places on the Klamath Reservation Forest, and special management areas have been recognized (see Appendix A, Map 9). Eagle nests may be found outside these areas. Until recently the bald eagle was a federally listed species. They now are managed under

USFW

the National Bald Eagle Management Guidelines (USFWS 2007). Please see that plan for more direction on their management.

Threatened and Endangered Species

Threatened and endangered species will be identified and managed in cooperation with the USDI Fish and Wildlife Service, along with species proposed for listing by the USDI FWS. Lists of endangered, threatened, proposed, and sensitive plant and animal species will be maintained at Tribal Headquarters and updated on an annual basis. The Natural Heritage Database will be used as the source for sensitive species. Biological evaluations will be prepared for each project authorized, funded, or conducted on the Klamath Reservation Forest to determine the possible effects of the proposed activity on threatened, endangered, proposed, or sensitive species. Where endangered, threatened, or proposed species are present, a biological assessment process will be carried out according to the requirements of the Endangered Species Act (Public Law 93-205). Habitat for these species will be managed to achieve the objectives of recovery plans where those plans exist. Protection for federally threatened or endangered species will meet or exceed the resource protection requirements in the Oregon State Forest Practice Rules (section 629-655-0200). Relatively few sensitive species from the Natural Heritage Database appear to frequent the interior forest on the Klamath Reservation; edge habitats and meadows are more likely habitats. Projects will search for sensitive species that might occur within the project area and projects will be adjusted as needed to protect the habitats of these species.

Northern spotted owls

This federally listed species has been found in the southern and western portions of the Klamath Reservation Forest—the portion of the Reservation Forest within the Northwest Forest Plan (NWFP). Management for the northern spotted owl will follow the requirements in the Standard and Guidelines in the NWFP: an untreated area of 100 acres will be retained around existing Northern Spotted Owl (NSO) nesting sites. In addition, large dense patches will be left throughout its range as discussed below.

Water Quality and Riparian Management

Background

While the Klamath Reservation Forest has relatively few perennial streams, lakes or wetlands, it is crisscrossed by intermittent streams that flow during snow melt and intense storms. The area near these streams is of extraordinary value for sustaining the variety of life in these forests, including providing fawning habitat for mule deer.

In addition, the few perennial streams that do flow in the reservation are the focus of much of the human and animal life within the forest and provide the habitat for a variety of fish species that have enormous significance to the Tribes, such as the different species of sucker that spawn in these streams.

Revitalizing the flora -- hardwoods, forbs, and grasses -- of the draws, seeps, and intermittent streams of the Klamath Reservation Forest, while protecting the stream and riparian processes, will be a significant challenge. As an example, our suggested prescriptions for the wet lodgepole area call for harvest of the invasive lodgepole and reintroduction of fire.

Standards

Management of the Klamath Reservation Forest should generally meet or exceed the standards in the Inland Native Fish Strategy, developed for federal forests, marshes, meadows, and rangelands of the area. The standards in this strategy cover requirements on operations near streams, lakes, and wetlands along with the designation of buffer widths and goals and requirements for management within buffers. Within the area of the Northwest Forest Plan, the standards of the Aquatic Conservation Strategy should be met.

Standards and Guidelines for Specific Areas

Bald Eagle Management Areas

The management goal for this area is to maintain, enhance, and provide nesting, foraging, and winter roosting habitat for bald eagles consistent with the National Bald Eagle Management Guidelines (USFWS 2007).

Sycan Wild and Scenic River

In 1988, 59 miles of the Sycan River were designated as a Wild and Scenic River in the Oregon Omnibus Wild and Scenic Rivers Act of 1988. The Act amended Section 3(a) of the Wild and Scenic Rivers Act (Public Law 90-542, 82 Stat. 907; enacted October 2, 1968) by adding 40 additional rivers to the Wild and Scenic Rivers system.

The river was designated in three parts: 1) a 24 mile "upper" segment that extends from the headwaters to where the river enters the Sycan Marsh, 2) a 8.6 mile "middle" segment from where the river enters Sycan Marsh to where it exits the marsh, and 3) a 24 mile "lower" segment extending from where the river exits Sycan Marsh to the National Forest boundary at Coyote Bucket (USDA Forest Service Nov. 1992). The lower segment is, in part within the boundaries of the Klamath Forest Reservation and will be the focus of this section.

The lower was designated as a "scenic" river in the legislation. Scenic river areas were defined in the legislation as "Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

The Wild and Scenic Rivers Act of 1968 states that it is the policy of the United States that certain selected rivers of the Nation, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."

Further, the Wild and Scenic Rivers Act states that "each component of the national wild and scenic rivers system should be administered in such a manner as to protect and enhance the values which caused it to be included in said system without, insofar as is consistent therewith, limiting other uses that do not substantially interfere with public use and enjoyment of these values." It further states that management plans should be "based on the special attributes of the area," i.e., the "outstandingly remarkable values."

To qualify as an outstandingly remarkable river or river-related value, the value must be a unique, rare, or exemplary feature that is significant at a regional or national level. In January, 1991, a Resource Assessment of the Sycan River was completed. The "outstandingly remarkable" values identified in that assessment for the lower river segment are (USDA Forest Service Nov. 1992):

1) Scenic: This determination is based on the scenic value of the river canyon, the diversity of vegetation, and the gigantic water sculptured boulders. Also, the mature and over-mature ponderosa pine and rimrock add visual diversity.

2) Geologic: The gigantic water-sculptured boulders in the lower two miles of this segment, and the steep, narrow basalt canyon are both unique geologic features. No other river within the geographic region contains water sculptured boulders of the magnitude (both size and number) of what occurs here.

3) Fisheries—Species diversity is very high. Fish species known to inhabit this segment include rainbow, brook, and brown trout; Pacific lamprey, Pit-Klamath brook lamprey, speckled dace, chubs, and sculpins. In addition, The Klamath large-scale sucker, the Oregon lakes tui chub, and the redband trout, all federal category 2 sensitive species, have been found in this segment. Historically, this segment was also inhabited by the Shortnose sucker and the Lost River sucker, both endangered species on the federal list. Also, bull trout, another federal category 2 sensitive species, were probably present in this segment in the past.

Overall goal

The Klamath Tribes will manage the Sycan Wild and Scenic River for the outstandingly remarkable features of scenic quality, geology, and fisheries.

Wild and Scenic River Boundary

When the river was designated as a Wild and Scenic River, an area ¼ mile from either side of the river was designated as an interim corridor. Part of the development of a River Management Plan includes the establishment of a detailed boundary that is more congruent with the geography and responsive to the outstandingly remarkable value of the river, yet does not exceed and average of 320 acres per river mile. The Forest Service adopted these boundaries in its 1992 River Management Plan (USDA Forest Service Nov. 1992). The Tribes plan to use these boundaries in defining the Wild and Scenic River Corridor (see Appendix A, Map 7).

Standards

Generally, the forest wide goals and standards for the different forest conditions and forest types will be sufficient to meet the overall goals for the Wild and Scenic Corridor. Additional requirements are:

- Firewood gathering will be restricted to recreational purposes (i.e., campfires).

Bluejay Springs Research Natural Area

Bluejay Springs Research Natural Area (RNA) is an outstanding example of natural, unlogged old-growth ponderosa pine forest growing on a ponderosa pine/bitterbrush habitat type (see maps in Appendix A at the end of this report). The area was identified and set aside for scientific and educational purposes while the area was administered by the Forest Service as part of the Winema-Fremont National Forest. Under the Klamath Reservation Forest Management Plan the Bluejay Springs RNA will continue to be managed as a natural area following the standards and guidelines applicable to federal research natural areas.

Bluejay Springs RNA will be managed to provide a scientific reference area for an old-growth ponderosa pine/bitterbrush forest growing under natural conditions. The objective will be to allow natural stand development processes to occur, including periodic fire and natural mortality of trees. Bluejay Springs RNA will be managed so as to minimize activities that would significantly modify natural ecosystem processes, including stand development. Prescribed burning will be utilized as a substitute for uncontrolled natural fires, however, as has been done on research natural areas in fire-frequent forest types on federal lands in the Pacific Northwest.

Desired future condition

Maintain the forest in its current structurally complex and dynamic state, including re-incorporation of periodic, low to moderate intensity fire as a natural process within the RNA. Minimize unnatural modifications of the composition, structure, and processes within these ecosystems resulting from direct or indirect human activities adjacent to and within the RNA.

General Standards and Guidelines for Research Natural Areas

The purpose of RNAs is to provide scientific reference areas that are outstanding natural examples of specific ecosystem types and within which natural developmental processes are allowed to proceed and human modifications to conditions and processes are minimized. Most manipulative human activities, such as those that modify the environment or alter or removal trees or other biota, are generally not allowed. This includes research that involves significant manipulation of the environment or destructive sampling of the biota.

Current conditions in Bluejay Springs RNA

The outstanding natural feature of the Bluejay Springs RNA is the old-growth ponderosa pine/bitterbrush forest that dominates the tract. This is an excellent example of the structurally complex, old-growth forest that dominated much of the area of the Klamath Reservation Forest. The stand has a high density of large, healthy old trees, an excellent population of snags in various states of decay, and a patchy understory of pine seedlings, saplings, and poles. A well-developed community of bitterbrush dominates the ground layer.

Human modifications of the Bluejay Springs RNA are generally minor. A small area around Bluejay Springs has a low level of development as a recreational site. This site receives traditional use for meeting and camping by tribal members. There is some evidence that firewood and, possibly, a few sawlogs were harvested in the past; however, the impact on current stand structure is insignificant.

Some modification of the RNA has occurred as a result of fire suppression programs. Historically, the RNA experienced frequent, low to moderate intensity wildfires, probably on a return interval of 3 to 10 years. It has been about a century since the last fire of this type. As a consequence, fuels have accumulated, although not to the level that there is a potential for stand-replacement fire under most burning conditions. The RNA does have a high density of pine seedlings, saplings, and small poles relative to what it would probably have had under the natural fire regime. Also, the bitterbrush understory is relatively decadent with low browse production and few young plants.

The primary restoration management need is to restore fire to the RNA. This could be accomplished by either (1) allowing natural fires to burn or (2) using prescribed fire as a substitute for natural fire. This management plan will utilize prescribed fire rather than natural fires in order to minimize risks to the existing stand, particularly the old-growth pine trees and bitterbrush plants.

Standards and guidelines for human activities

Manipulative human activities that involve the alteration or removal of the native biota on the RNA will generally be prohibited. Specific activities that are prohibited include:

1) Commercial tree removal, including gathering of firewood;

2) Grazing by domestic livestock;

3) Mechanical thinning of trees and mowing understory bitterbrush;

4) Hunting and trapping small mammals and birds;

5) Camping or recreating outside of the existing developed area at Bluejay Springs; and

6) Use of motorized vehicles, including snowmobiles, off of existing open roads.

Activities that will be allowed include:

1) Non-manipulative scientific research, following review and approval by the Tribal Forest Manager;

2) Traditional Tribal uses of the existing Bluejay Springs site; and

3) Hunting deer and elk.

Standards and guidelines for fire management and prescribed burning

Wildfire

Suppression will be the general policy with regards to wildfires during at least the several decades of management. The goal is to prevent the area from being burned by a wildfire under weather conditions that could result in an intense partial or complete stand-replacement burn. This policy will be reconsidered once fuel conditions and stand densities have been reduced in the stand using prescribed burning.

The objective in wildfire suppression will be to prevent uncontrolled fire from burning into or through the RNA. To the degree feasible, active suppression activities, including creation of firelines, ignition of backfires, and aerial applications of retardants will be done outside of the RNA.

Allowing for natural recovery processes is generally the appropriate approach if a wildfire does occur within the RNA. Conditions following such a fire would, of course, have to be considered, including an assessment of the ability of the RNA to continue to fulfill its role as a scientific reference area for the ponderosa pine/bitterbrush type.

Prescribed fire

Prescribed fire is a manipulative activity that will be allowed within the Bluejay Springs RNA in order to provide for periodic burning at low to moderate intensities. Ponderosa pine/bitterbrush forests are naturally subject to frequent, light to moderate intensity wildfire and burning at this level is necessary to maintain the natural composition, structure, and processes within these forests.

Prescribed burning is an activity that can be allowed under the management guidelines for federal research natural areas, where low to moderate intensity fires are a part of the natural fire regime. In the Pacific Northwest prescribed burning programs currently are being conducted on the Metolius and Pringle Falls RNAs, for example. Hence, management in Bluejay Springs will follow current practice in RNAs on federal lands.

Goals of the prescribed burning with the Bluejay Springs RNA will include periodic:

- Reductions in stand density, particularly of tree seedlings, saplings, and poles;
- Rejuvenation of the bitterbrush understory;
- Reductions in overall fuel loadings; and
- Provision for other ecosystem processes associated with fire, such as effects on nutrient cycling.

The objective will be to maintain the levels of these parameters within the natural range of variability (NRV) for the ponderosa pine/bitterbrush ecosystem within this region. The extensive knowledge and experiential base developed by Forest Service scientists in eastern Oregon will be utilized in designing and implementing the controlled burning program at Bluejay Springs RNA.

Guidelines for prescribed burning will include the following. First, because of the extraordinary quality and importance of the Bluejay Springs RNA, prescribed burning will be carried out only after sufficient experience has been acquired in prescribed burning elsewhere in the KRF so as to assure a high probability of achieving the desired outcome, including low risk of loss of old trees.

Second, prescribed burning will be planned with participation of qualified scientists and managers within the region, including those that have been involved in burning programs on federal RNAs.

Third, large and old ponderosa pine trees will receive special protection during prescribed burning activities. The large, old pine trees are a scarce and valuable resource that have great ecological and cultural value. As such, special efforts will be taken to prevent excessive losses of these trees, at least during the initial prescribed burning programs. Activities to reduce damage and loss to these trees may include: (1) raking accumulations of bark from around the base of old trees and (2) protecting individual and groups of old trees during prescribed burns by providing protective dug, water, or foam firelines. Requirements for such protective activities can be considered after a decade of experience in implementing prescribed burns within the RNAs.

Fourth, frequency of prescribed burns will be determined after conferring with experienced fire scientists. A fire frequency of 15 years +/- 5 years is suggested for initial planning purposes. Rates of fuel accumulation on ponderosa pine/bitterbrush habitats probably do not necessitate burning at historic intervals of 3 to 10 years. However, the decision regarding burn frequency should ultimately be made based upon collective management goals for the area, including its role as a scientific reference area. Current research in eastern Oregon should provide critical information in deciding upon the appropriate prescribed burn interval.

Relationship of the Klamath Forest Plan to the Northwest Forest Plan

The Northwest Forest Plan (NWFP) applies to the portion of the Klamath Reservation west of Highway 97 and to the South Chiloquin block (Appendix A, Map 8). Three of the land-use allocations of the NWFP are represented: Late Successional Reserve (LSR), Riparian Reserve (RR), and Matrix.

Adoption of the Klamath tribal goals, as implemented in this management plan, represents a significant increase in emphasis on ecological objectives above that in the NWFP, as will be explained below. Basically, the entire property, including the lands included within the NWFP, will be managed with the goal of restoring and sustaining structurally complex, late-successional forest.

Late Successional Reserves

LSRs are the central element of the NWFP strategy to provide for an extensive and well distributed network of late-successional forest ecosystems and habitat for old-growth related species. The standards and guidelines are “designed to restore and maintain such ecosystems and to protect them from loss due to large-scale fire, insect and disease epidemics. . . The intent is to maintain natural ecosystem processes such as . . . low-intensity fire . . . the use of silvicultural practices [are encouraged] to reduce the risk to [LSRs] from severe impacts resulting from large-scale disturbances. . .” (USDA Forest Service and USDI Bureau of Land Management 1994b, p B-1). The standards and guides for LSRs further provide that, “Management may be required to reintroduce natural disturbance, such as fire [where] suppression has resulted in significant increases in accumulated fuels. . . silviculture aimed at reducing the risk of stand-replacing fires may be appropriate . . . [including] thinning and underburning. Due to fire suppression, some forests have become quite dense and multi-storied, primarily from the invasion of shade-tolerant species. Density reduction in mid-level canopy layers by thinning may reduce the probability of crown fires” (USDA Forest Service and USDI Bureau of Land Management 1994b, p. B-7). Finally, regarding guidelines on reducing risks of large-scale disturbance east of the Cascades and in the Oregon Klamath Province: “Large-scale disturbances are natural events, such as fire, that can eliminate spotted owl habitat on hundreds or thousands of acres. Certain risk management activities, if properly planned and implemented, may reduce the probability of these major stand-replacing events...Levels of risk [of catastrophic fire on some] Late-Successional Reserves are particularly high and may require activities... in currently late-successional habitat if: (1) the proposed management activities will clearly result in greater assurance of long-term maintenance of habitat, (2) the activities are clearly needed to reduce risks, and (3) the activities will not prevent the Late-Successional Reserves from playing an effective role in the objectives for which they were established" (USDA Forest Service and USDI Bureau of Land Management 1994b, p. C12-13).

The overall goal of restoring complex forest ***throughout*** the Klamath Reservation Forest is completely consistent with management direction for the NWFP LSRs as reflected in the preceding paragraph. Standards and guidelines for management of the two LSRs located on KRF will provide, therefore, for restoration and subsequent maintenance of sustainable, complex late-successional forest. The two LSRs are located predominantly on habitats (Mixed Conifer/Snowbrush and Ponderosa Pine/Bitterbrush, respectively) that were naturally subject to frequent, light to moderate intensity fire regimes. Fuel treatments and prescribed burning will be necessary to achieve sustainable, complex late-successional forest conditions by eliminating the current high potential for a stand replacement fire within the LSRs. The general standards and guidelines for KRF provide most of the relevant standards, such as with regards to retention of large-diameter trees and of snags and logs. Additional standards and guidelines for Late Successional Reserves in KRF are:

1) Retention of an untreated area of 100 acres around existing Northern Spotted Owl (NSO) nesting sites as required in the NWFP. Maintaining an untreated block with large fuel accumulations should be possible if it is embedded in a much larger area that has been treated. This appears to be the best prospect for providing sustainable NSO nesting and roosting habitat within these fire-prone habitats.

2) Retention of additional untreated, densely stocked areas of 20 to 50 acres dispersed through the treated landscape to sustain species dependent upon denser stands and to provide additional roosting habitat for NSO.

3) Untreated areas, including (1) and (2) above, should be sufficiently limited to avoid compromising the effectiveness of the fuel treatments in preventing a stand replacement fire; a target of 20 to 30% of the treated LSR landscape is a guideline.

Also, see the discussion below for more details on applying this strategy for the northern spotted owl in South Chiloquin.

Riparian Reserves

Riparian Reserves (RRs) in the Northwest Forest Plan are designated areas adjacent to streams (including intermittent streams), rivers, wetlands, lakes, ponds, and reservoirs, which are managed to sustain and protect those aquatic ecosystems. RRs are intended to maintain and restore riparian structures and functions of streams and rivers, confer benefits to aquatic and riparian-dependent and associated species, and improve travel, dispersal and habitat conditions for terrestrial animals and plants. Interim widths of RRs are at least one site-tree height from the aquatic feature (e.g., both sides of a stream).

Management direction within RRs is strongly focused on restoration and maintenance of riparian and aquatic ecosystem functions and biota, goals shared by the Klamath Tribe.

As discussed above, most of the Klamath Reservation Forest falls outside the Northwest Forest Plan and is currently under the riparian guidance of the Inland Native Fish Strategy (INFISH). This strategy covers requirements on operations near streams, lakes, and wetlands along with the designation of buffer widths and goals and requirements for management within buffers. INFISH standards should be used under this proposed plan across the entire Klamath Reservation Forest to avoid confusion in management. The wider buffer widths from the NWFP, though, should still be applied within the NWFP area.

Matrix

The matrix consists of federal lands that are not incorporated into the six categories of designated areas (e.g., LSRs and RRs). The Matrix includes lands that are available for tree removal and other traditional silvicultural activities. NWFP standards and guidelines do provide for constraints on tree removal. For example, there are requirements for structural retention at regeneration harvest, retention of last old-growth fragments in watersheds, and coarse wood habitats (USDA Forest Service and USDI Bureau of Land Management 1994a). Also, 100 acres of forest are reserved (LSR standards) around all Northern Spotted Owl activity centers known as of January, 1994.

The Klamath tribal goal of restoring sustainable late-successional forest conditions throughout the Klamath Reservation Forest effectively makes the Matrix allocation irrelevant. That is, the Matrix lands under this management plan are managed identically to LSRs or RRs. Hence, additional guidelines for Matrix lands are not needed.

Post-fire Actions

After wildfires, efforts may at times be necessary to meet restoration goals. The Tribes have adopted a management principle that reads as follows: “In keeping with the Klamath Tribes Forest Management Plan, salvage efforts may at times be necessary to remove salvageable materials in excess of what is required to meet ecological needs. Ecological needs shall be determined using the best available science and will be periodically reviewed and incorporated into the Tribes’ Forest Management Plan.” One of the purposes of this section is to define “salvageable materials in excess of ecological needs” in areas that have experienced wildfire.

Treatment of areas following occurrence of major fires is a complex and controversial topic. Complexities include the trade-offs among various resource management objectives, such as fire fuel management objectives and provision of wildlife habitat. Conflicts often exist between economic and ecological objectives; timber salvage is generally directed at salvaging economic values, not at enhancing ecological recovery.

A further complication is that restoration treatments have only recently received serious consideration by ecological scientists; no general ecological and environmental guide to post-fire treatment issues currently exists.

Some areas may be designated for management emphases that do not allow post-fire treatments. In the case of the Klamath Tribes, that might be the Yamsay Mt. Special Area. These guides on treatment are not intended to apply to those areas; rather they apply to areas where treatment is permitted under the standards and guidelines.

Post-fire treatments on the Klamath Reservation Forest will be guided by the general principle of doing no additional harm to the resource values following a major fire:

- activities will be focused on assisting in ecological recovery; and

- activities that detract from ecological recovery will not knowingly be conducted.

Removal of live and dead trees following stand replacement wildfire is one of the most controversial post-fire activities due to competition for these trees between ecological and economic objectives. Removal ("salvage") of dead wood and of living trees expected to die generally has been economically motivated. Economic objectives may include the goal of generating funds to carry out other post-treatment activities, which may include some activities that contribute to ecological goals.

Ecological concerns with the removal of dead wood have to do with the numerous ecological roles played by wood including:

- Long-term sources of energy and nutrients;

- Aggregated sources of soil organic matter, important components of the soil matrix;

- Structural elements influencing hydrologic and geomorphic processes within streams, riparian zones, and in upland areas; and, especially,

- Critical habitat for many animal species, including the majority of both vertebrate and invertebrate species found in these forests.

Large snags and logs are generated by natural mortality processes in living forests that include mature and old trees, providing for continuing replenishment of this important resource. This process is totally disrupted by a stand-replacement fire. Such fires do generate a large pulse of dying, dead and down material. After a stand-replacement fire, that pulse of large wood is all of the large wood that the recovering ecosystem is going to get for the next century or more—i.e., until trees of large size are once again a part of the stand. Some of this dead wood legacy will persist and fulfill important functional roles in the recovering forest for many decades and, in the case of the largest and most decay resistant material, even for a century or more.

On the other hand, removal of trees after fire can reduce overall fuel levels which could, in turn, reduce the intensity of a subsequent fire or make reintroduction of prescribed burning easier. This is an especially important issue in forests where a buildup of fuels beyond historical levels has occurred.

Therefore, we recommend that the silvicultural manipulation of forests after wildfire on the Klamath Reservation Forest follow the same approach as we suggest for these forests before wildfire: reduce the stand density to that associated with the desired future condition.

We believe that using the same target stand structures before and after wildfire has several advantages by: 1) Utilizing the same ecological template in both cases; 2) Eliminating debates over whether damaged trees will die—controversies that can increase the difficulty of post-fire strategies; and 3) Utilizing prescriptions that will be well-known to foresters who work on the Klamath Reservation Forest.

Further we recommend that occurrence of wildfire should shift the priorities for action among the different watersheds: restoration actions should shift to those that experience wildfire, undertaking all prescribed treatments on the burned and unburned portions of the area.

Of course, any actions on the post-fire landscape would only be considered after an environmental review that considers the often fragile state of watersheds after fire. Still we feel that use of similar prescriptions for forest restoration, before and after wildfire, is the soundest ecological approach for these forests.

Standards and Guidelines for Removal of Trees in Burned Areas

Special analysis is required to assess whether harvest can be done, given the fragile nature of many sites after wildfire. The guidance below applies to those areas where harvest after fire will not cause unacceptable damage.

1) The same prescriptions and retention levels as suggested for the unburned landscape should be applied in the burned landscape. Where enough live trees do not exist to meet the retention targets, utilize dead (burned) trees of comparable size and species.

2) All actions within riparian areas and throughout the watersheds should be consistent with the Inland Native Fish Strategy or the Aquatic Conservation Strategy, as applicable.

3) Tree removal and other restorative activities should be conducted so as to maintain desirable soil physical and biological properties.

Standards and Guidelines for Other Post-fire Restoration Activities

Artificial seeding of exotic grasses and other plants generally will be avoided as a part of post-fire restoration treatments. Grasses and other exotic species have the potential to compete with and thereby deter establishment of native species, including tree regeneration.

The need for artificial reforestation will be carefully evaluated, especially in areas that have been subject to uncharacteristic wildfire. This evaluation will consider such issues as the availability of surviving seed trees, the potential for sprouting brush species to occupy uncharacteristically large areas of the burn, and characteristic tree densities and spatial distribution on the site.

1) When a decision is made to do artificial reforestation, the guideline will be to set the stage for attainment of the desired future condition. In the case of the Klamath Reservation Forest, that will most often be attainment of a mature pine stand with 12-120 trees per acre over 21+" dbh and with some intervening denser patches. The reforestation goal will be to avoid establishing dense, uncharacteristic, "fully stocked" forests, thereby perpetuating the potential for uncharacteristic fire.

2) Once desired planting levels have been determined, the distributional guide for planting will be to create an irregular or variable density pattern rather than a uniform pattern of seedlings. The desired pattern could be described as a low density of seedlings planted on an irregular pattern over the majority of the area with occasional densely planted patches. This approach provides the opportunity for planters to seek out more favorable locations for tree seedlings than is possible under a systematic grid. Also, areas with greater forest growth potential can be selected as sites for denser plantings.

3) Only local seed sources will be used in reforestation and other revegetation programs.

Herbicides generally will not be utilized as a part of post-fire restoration activities. However there may be circumstances in which other means of achieving restoration goals do not seem promising:

1) When invasive species have taken over the site and mechanical removal or prescribed fire does not seem likely to be successful in eradicating the species.

2) When the restoration goal for the site includes trees, and shrub competition is likely to prevent establishment of minimal numbers of conifers (>50/acre) within 20 years, and elimination of the shrub competition using mechanical or prescribed fire means is not viewed as feasible.

In these cases, herbicides can be considered as a last resort under the following stipulations: Herbicides will be applied in a manner that minimizes their impact on non-target plants, such as with backpack application around planting spots. Blanket applications that reduce the variety of native plants should be avoided.

The decision to reforest the site should not be tied to the decision to remove trees. Some sites where tree removal occurs might best be left to naturally reforest and some sites where removal does not occur might best be planted. It must be recognized, though, that reforestation under burned trees must occur within a few years after the fire to meet safety concerns.

Broader Landscape Considerations

Post-fire recovery takes precedence over the planning of other restoration activities. Unless swift action occurs, it may be unsafe to reforest sites amongst the residual snags and dying trees, shrub response may set back tree regeneration, and the economic value in any trees that might be removed could be lost.

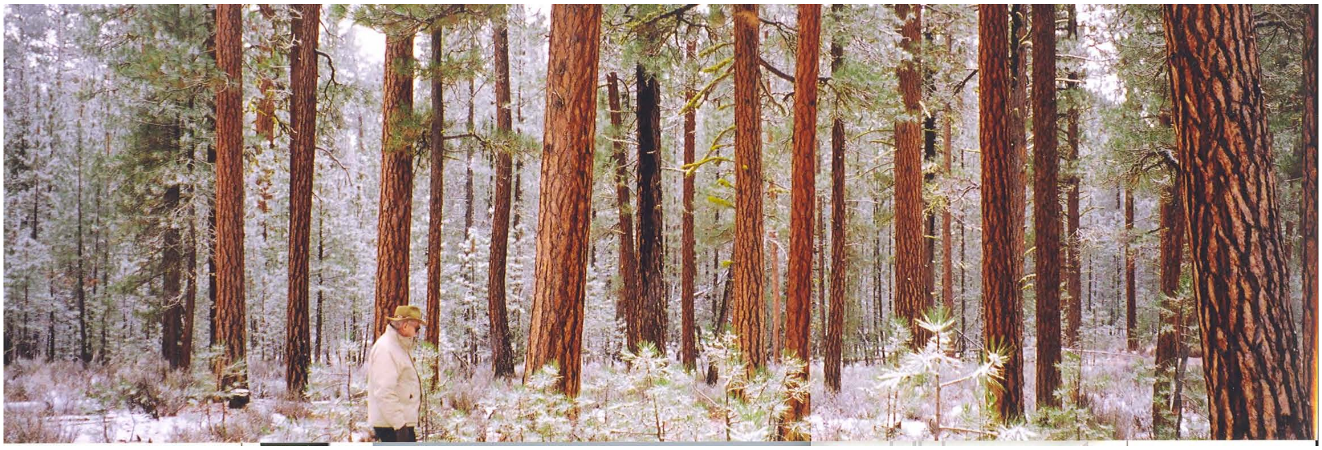
Where the wildfire area is relatively small, the plan for recovery might focus just on the burned areas. Where it is of any size, though, (such as over 1000 acres), consideration should be given to locating a larger restoration unit in the area that surrounds the wildfire site and treats the adjacent green forest according to the restoration standards discussed in this report.

Special Consideration for the Northern Spotted Owl in South Chiloquin

Landscapes located within the range of the Northern Spotted Owl require a landscape-level design and treatment in order to provide conditions for maintenance of populations of owls and their primary prey. It is clear from recent fire history that the mixed-conifer landscapes currently occupied by NSO in eastern Oregon and eastern Washington are at extreme risk of loss to uncharacteristic stand-replacement wildfire. For example, on the Sisters District of the Deschutes National Forest, 18 out of 24 NSO home ranges have been lost to stand-replacement fires, all of these within designated Late Successional Reserves. Although, there have not yet been any large and intense fires in NSO habitat on the Klamath Reservation Forest, there is significant potential for this to occur in current designated habitat. The science review of the NSO (Courtrey et al. 2004) identified the loss of eastside NSO forest habitat to fire and insects to be a significant current threat.

If treatment of these forests, with their potential for uncharacteristic stand-replacement fire, is not undertaken, there is potential to lose both the forests and the Northern Spotted Owl (USFWS 2005). However, the habitat requirements of the owl and its prey require that this be planned and conducted at the level of large landscape units, since the habitat required by the owl is potentially subject to stand-replacement fire. Consequently, the islands of suitable owl habitat must be embedded in a larger landscape that will no longer carry a stand-replacement fire.

The basic premises underlying treatments within the range of the Northern Spotted Owl (NSO) are listed below. They are based partially upon discussions during a field trip with Dr. Eric Forsman in 2005, one of the leading experts on NSO. These premises are:



A stand with many “small” old growth ponderosa pine trees.

1) NSO and key prey species require some denser forest patches, such as those characterized by an abundance of white fire and Douglas-fir or both.
2) Percentage of the dense forest habitat needed in a landscape is approximately 25 to 30%.
3) These patches should be at least 200-300 acres in size.
4) Some targeted silvicultural treatment (e.g., 10 to 20% of the area) can be allowed within dense forest patches to reduce potential for loss of old growth veterans to fire or competition.
5) The remaining landscape, outside of the 25-30% in dense patches, would be treated, as needed, to eliminate the potential for continuous stand-replacement fire;
6) Areas retained in dense forest cover for NSO and their prey can be on northern exposures and steeper slopes. In fact, these habitats are preferred**;** and
7) Treatments have to be planned and implemented at large (e.g., 10,000 to 20,000 acre) spatial scales.

These premises should be considered as working hypotheses that need to be implemented in an adaptive management strategy with careful design so that credible inferences can be drawn. They are generally consistent with the work of Camp, et al. (2005) who analyzed the size and distribution of patches of forest in the Wenatchee Mountains of eastern Washington that had been minimally affected by successive fires. They called these patches “refugia” islands of older forest in a younger forest matrix. They identified less than 20% of the pre-settlement landscape as these historical fire refugia. The patches were usually less than 25 acres, but sometimes up to 100 acres and were generally not connected except by younger stands within the matrix. They found their location to be correlated with conditions of high soil and fuel moisture levels like those found adjacent to stream confluences, within valley bottoms, and on northerly slopes.

We used the premises above as guidelines to develop a set of northern spotted owl conservation areas for the South Chiloquin forests within the range of the northern spotted owl (Appendix A, Map13-16). Most of South Chiloquin is covered with mixed conifer forests (either mixed conifer/ snowbrush or moist mixed conifer in our classification). To the degree possible, we located the areas on north facing, steep, mixed conifer stands. Also, within the mixed conifer types, we emphasized placement in old growth (complex) forests. These patches average about 250 acres in size and cover approximately 23% of the South Chiloquin area and approximately 33% of the mixed conifer forests with the South Chiloquin.

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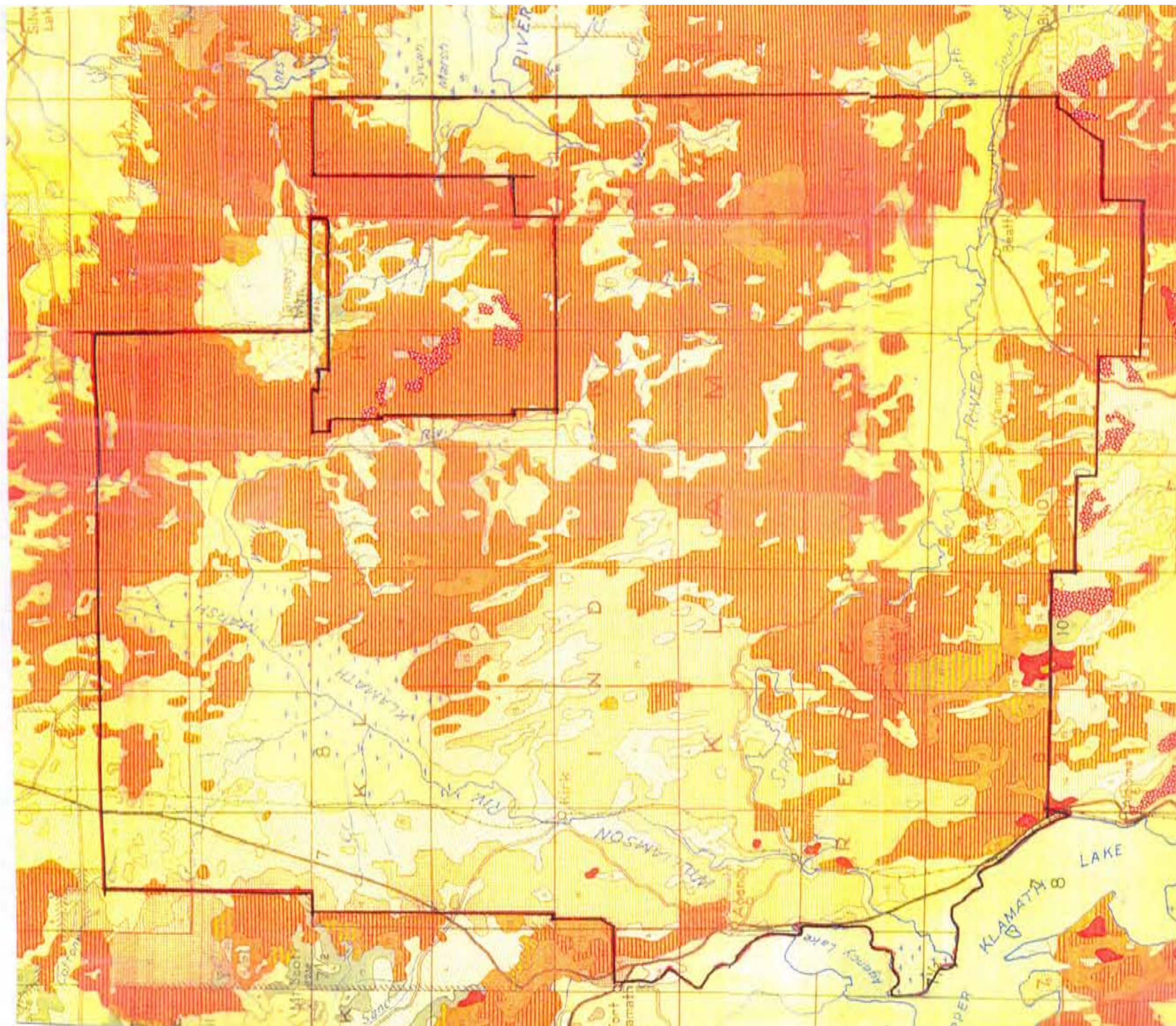
Appendix A Maps



1936 Type Map

Ponderosa Pine, Large.—
Forests containing at least 50 percent by volume of ponderosa pine, sugar pine or Jeffrey pine, or all of them in combination, where the predominating trees are over about 22 inches in diameter (over about 150 or 200 years old), and where no material amount of the stand has ever been cut.

Pure Ponderosa Pine, Large.—
Forests containing at least 80 percent by volume of ponderosa or Jeffrey pine, where the predominating trees are over about 22 inches in diameter (over about 150 or 200 years old), and where no material amount of the stand has ever been cut.

Ponderosa Pine, Small.—
Forests containing at least 50 percent by volume of either ponderosa pine, sugar pine, or Jeffrey pine, or all of them in combination, where the majority of the volume is in immature trees ordinarily between 12 and 22 inches in diameter and amounts to more than 1,000 board feet per acre; such stands may consist either of (a) selectively cut stands of any age, or (b) uncut immature stands (so-called "bull pine" stands, under 150 or 200 years old).

Ponderosa Pine, Seedlings, Saplings, and /or Poles.—
Forests on old burns or heavily cut land where the majority of the trees under 12 inches in diameter are ponderosa pine and the stand of larger ponderosa pine, if any, amounts to less than 1,000 board feet of sawtimber per acre.

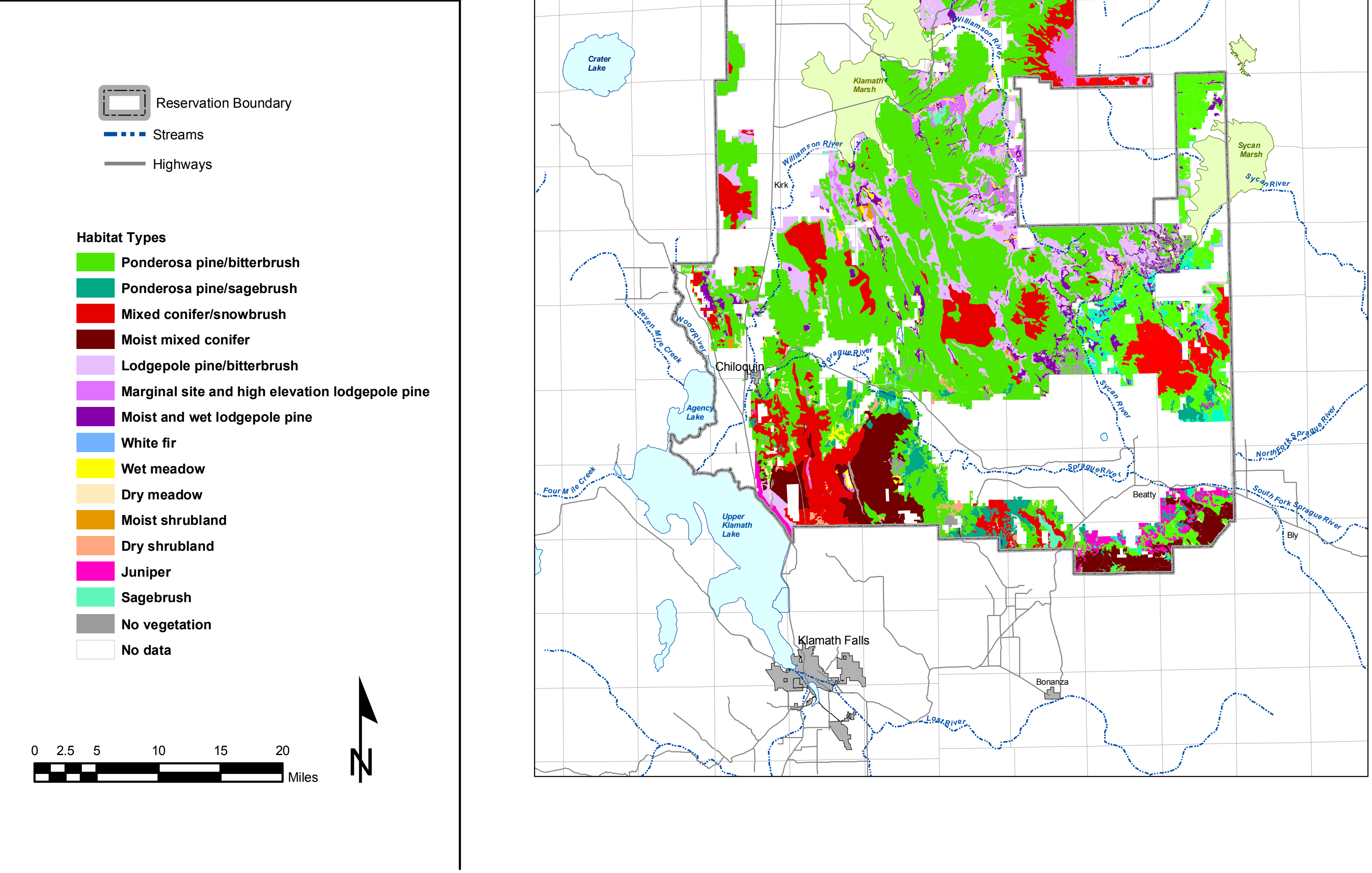
Pine Mixture, Large.—
A mixed forest in which ponderosa pine comprises about 20 to 50 percent by volume, with a variable amount of western larch, white fir, Douglas fir, white pine, and other species, where the majority of the volume is in trees over 12 inches in diameter and where no material amount of cutting has been done.

Pine Mixture, Small.—
A mixed forest where 20 to 50 percent of the dominant trees are ponderosa pine and are less than 12 inches in diameter.

Map 2

Habitat Types

Klamath Reservation



Map 3a

Historical Fire Regimes for Forested Potential Vegetation Groups

Klamath Reservation

Reservation Boundary

Streams

Highways

Lethal

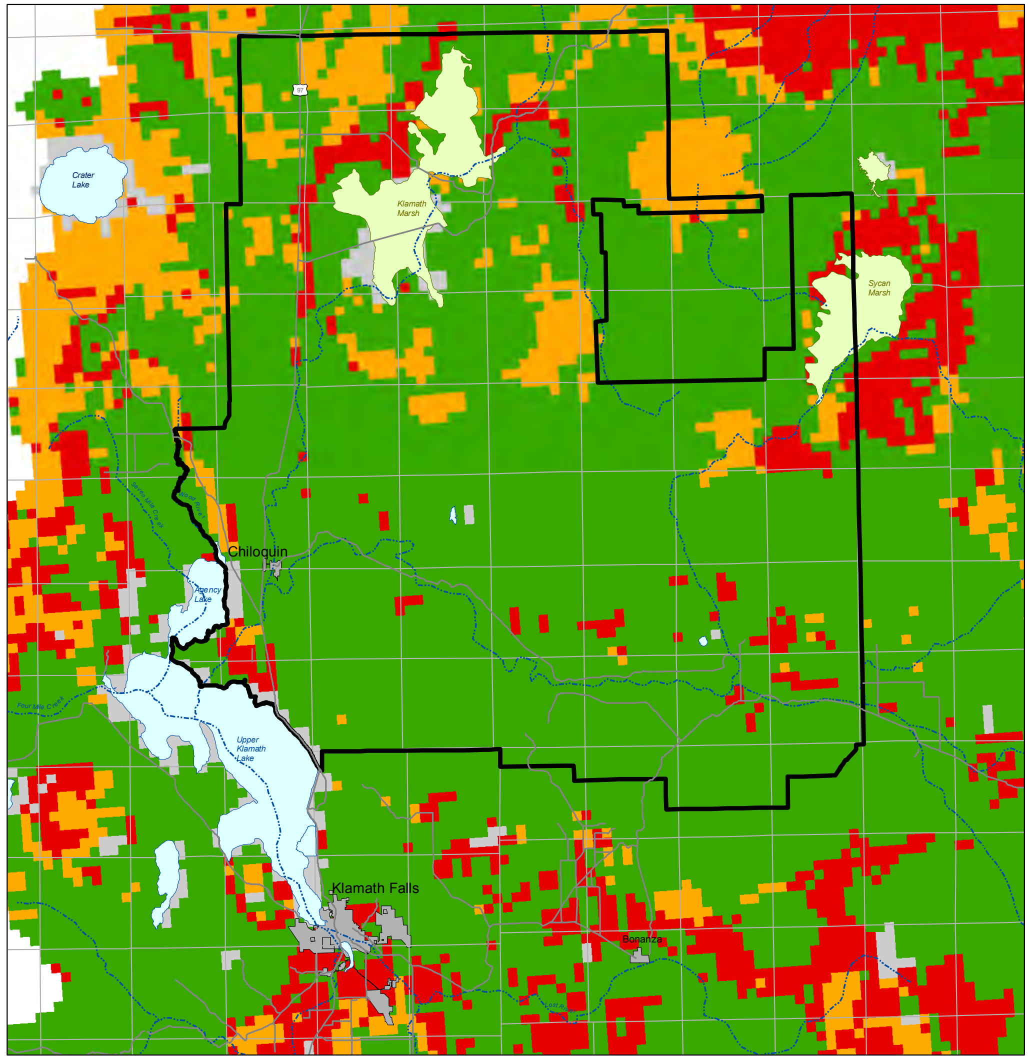
Mixed

Nonlethal

Rarely

0 2.5 5 10 15 20 Miles

N



Source: Interior Columbia Basin Ecosystem Management Project. 1996. http://www.icbemp.gov/spatial/disturbance/

Map 3b

Current Fire Regimes for Forested Potential Vegetation Groups

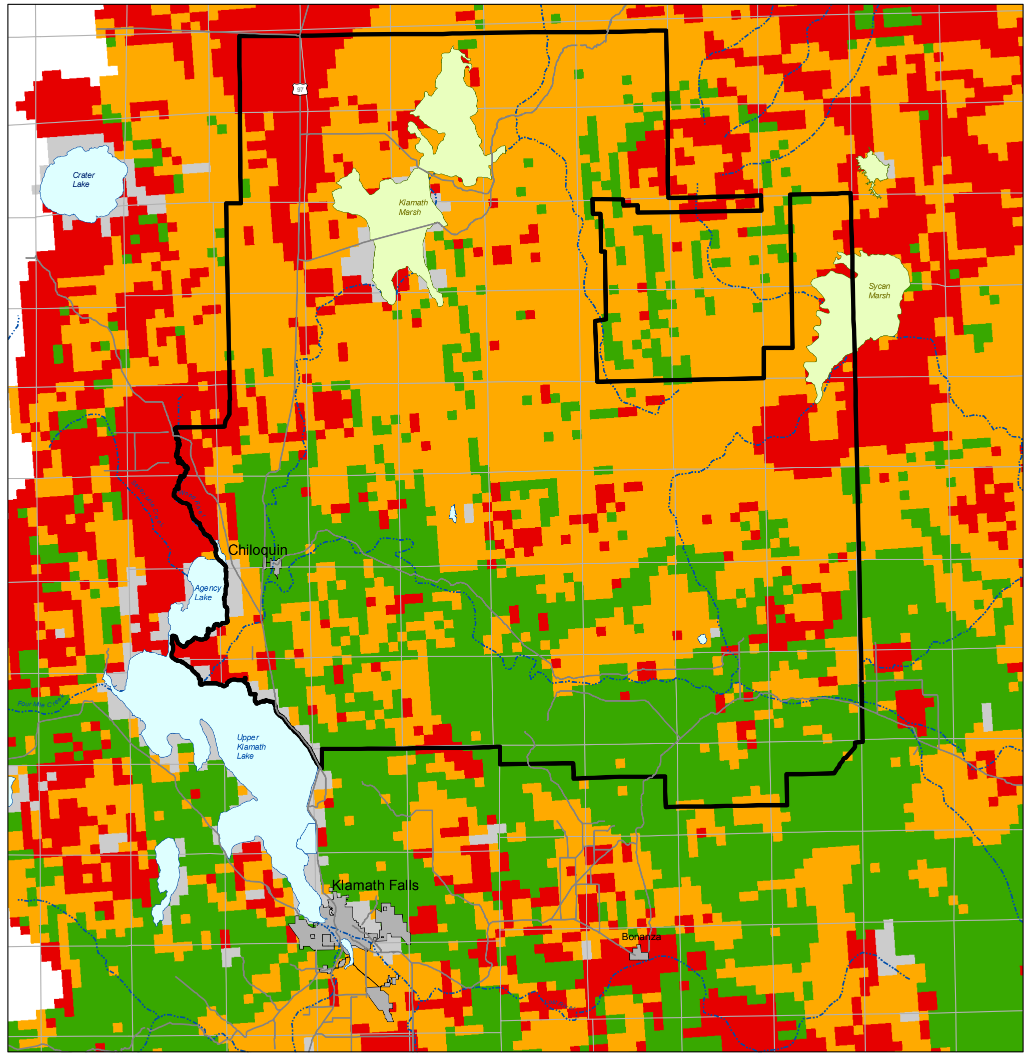
Klamath Reservation

Reservation Boundary
Streams
Highways

Lethal
Mixed
Nonlethal
Rarely

0 2.5 5 10 15 20 Miles

N



Source: Interior Columbia Basin Ecosystem Management Project. 1996. http://www.icbemp.gov/spatial/disturbance/

Map 4

Complex Forest (Old Growth)

Klamath Reservation

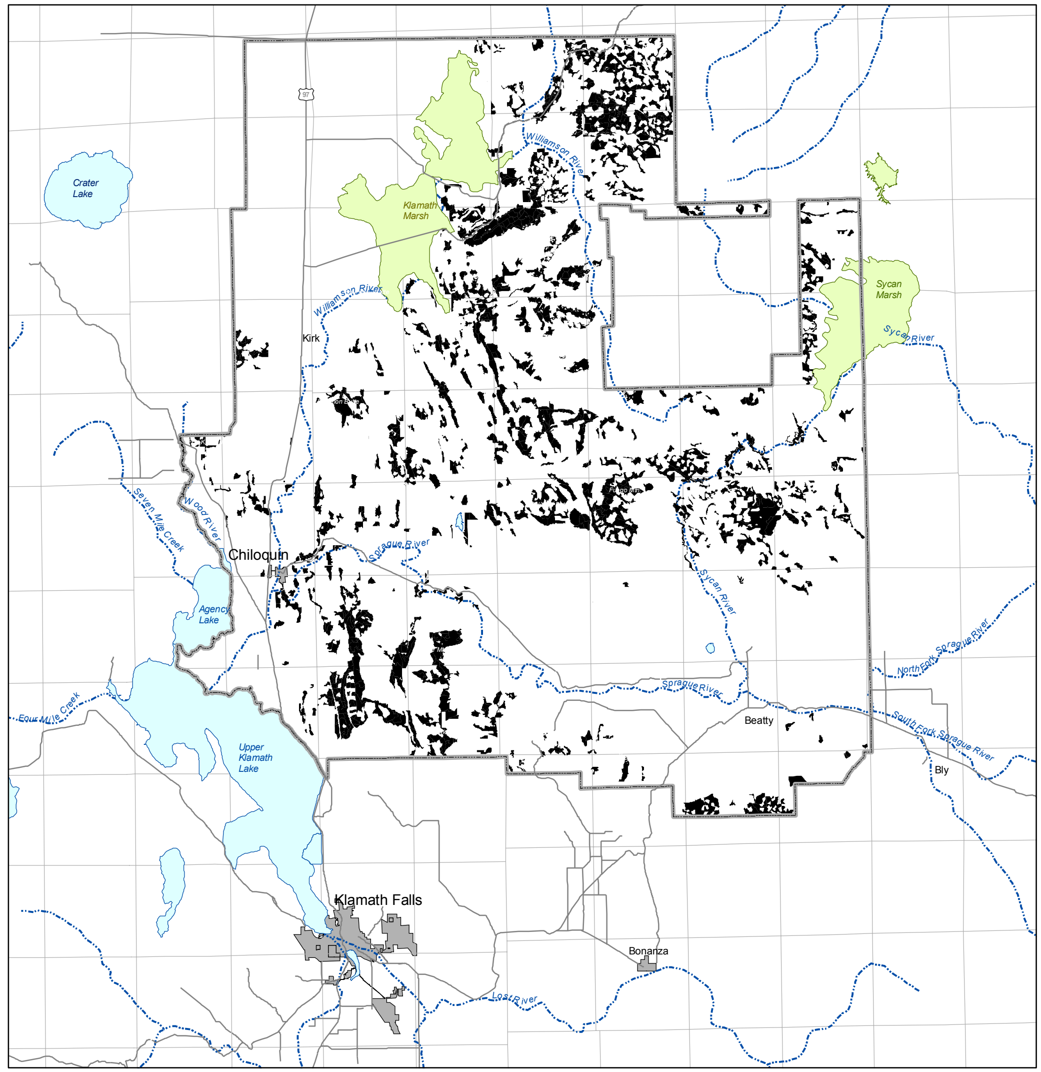
Reservation Boundary

Streams

Highways

0 2.5 5 10 15 20 Miles

N



Map 5

Habitat Types with Complex Forest

Klamath Reservation

Reservation Boundary

Streams

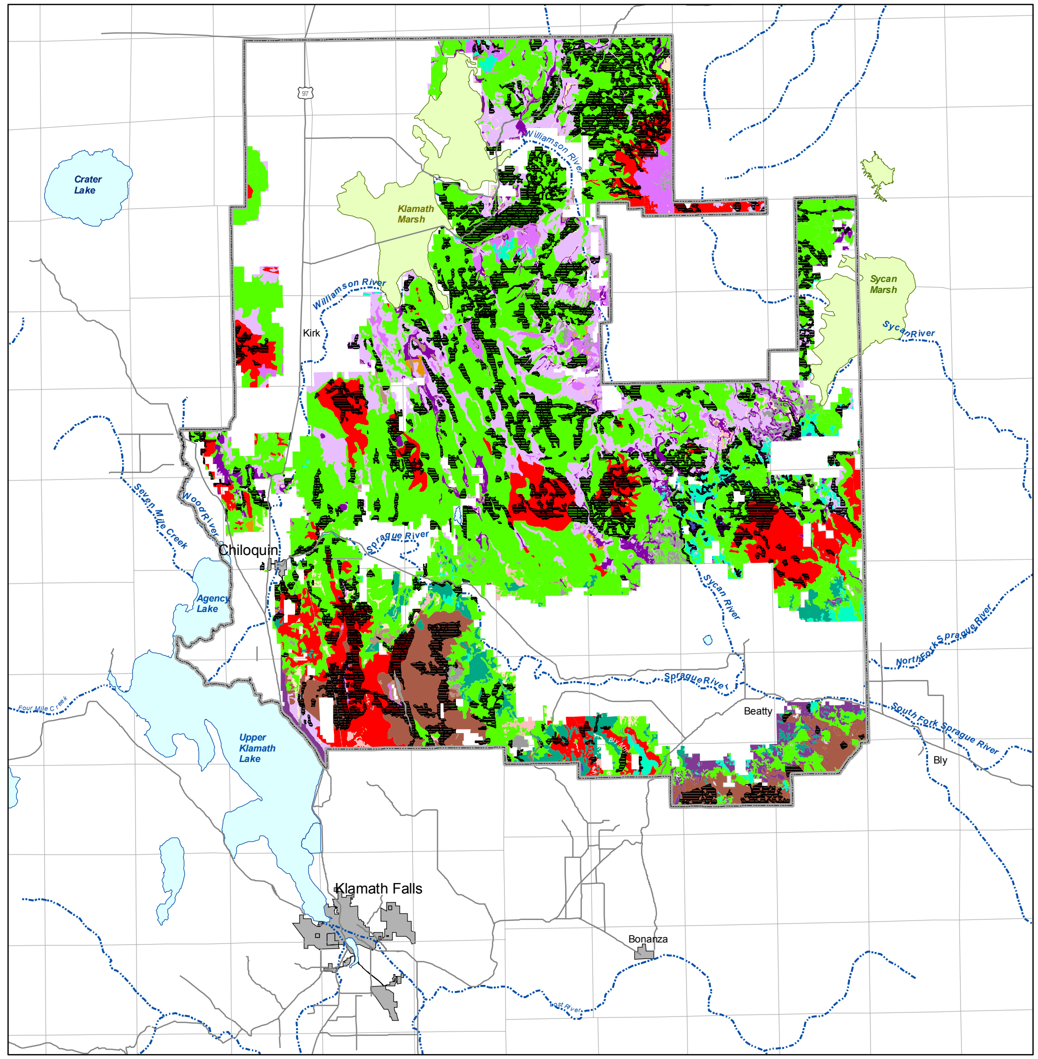
Highways

Habitat Types

- **Ponderosa pine/bitterbrush**
- **Ponderosa pine/sagebrush**
- **Mixed conifer/snowbrush**
- **Moist mixed conifer**
- **Lodgepole pine/bitterbrush**
- **Marginal site and high elevation lodgepole pine**
- **Moist and wet lodgepole pine**
- **White fir**
- **Wet meadow**
- **Dry meadow**
- **Moist shrubland**
- **Dry shrubland**
- **Juniper**
- **Sagebrush**
- **No vegetation**
- **No data**

0 2.5 5 10 15 20 Miles

N



Map 6

Watersheds

Klamath Reservation

Reservation Boundary

Streams

Highways

Willamson

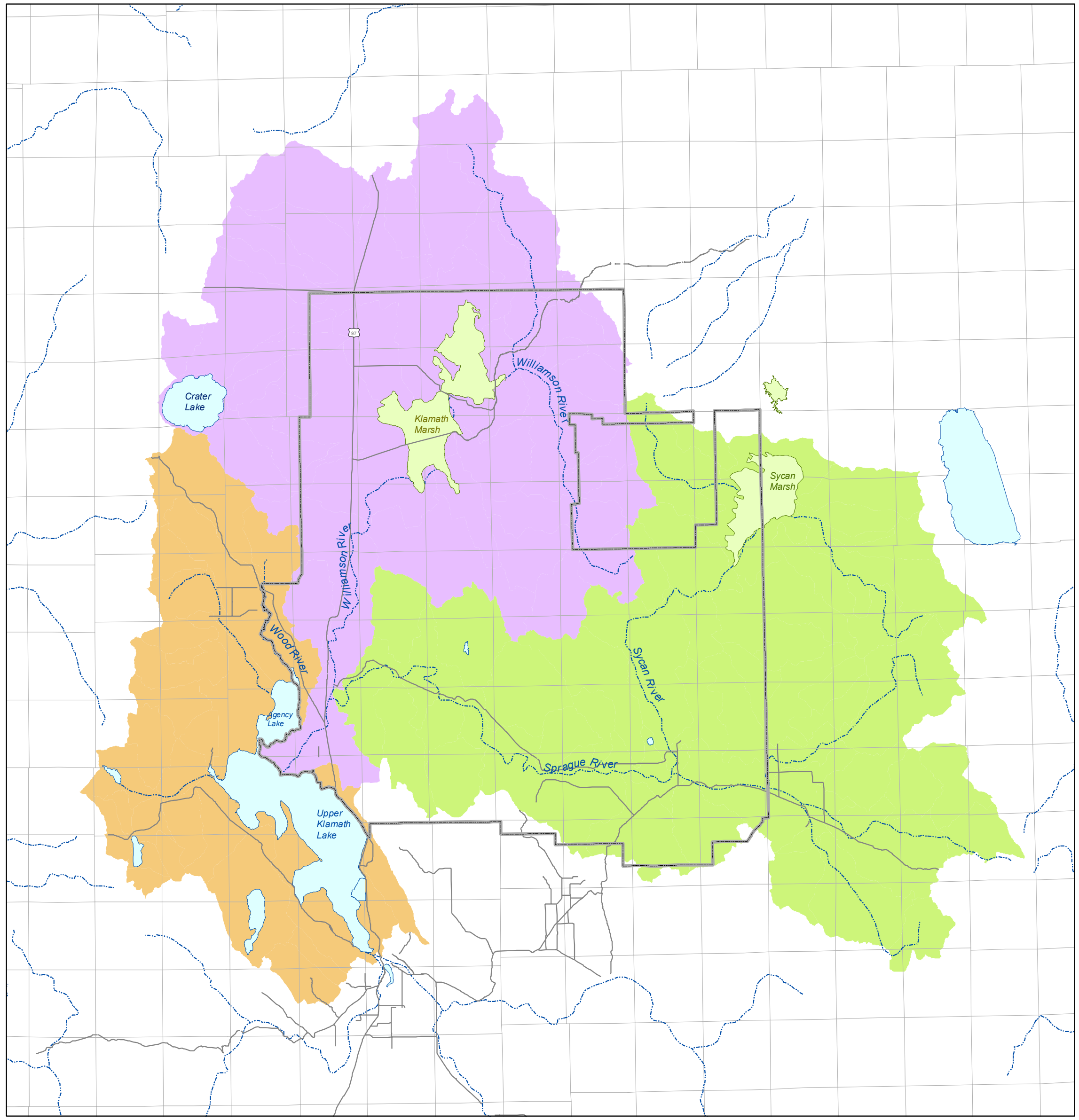
Sprague

Upper Klamath

0 3 6 12 18 24

Miles

N



Map 7

Proposed Management Emphasis

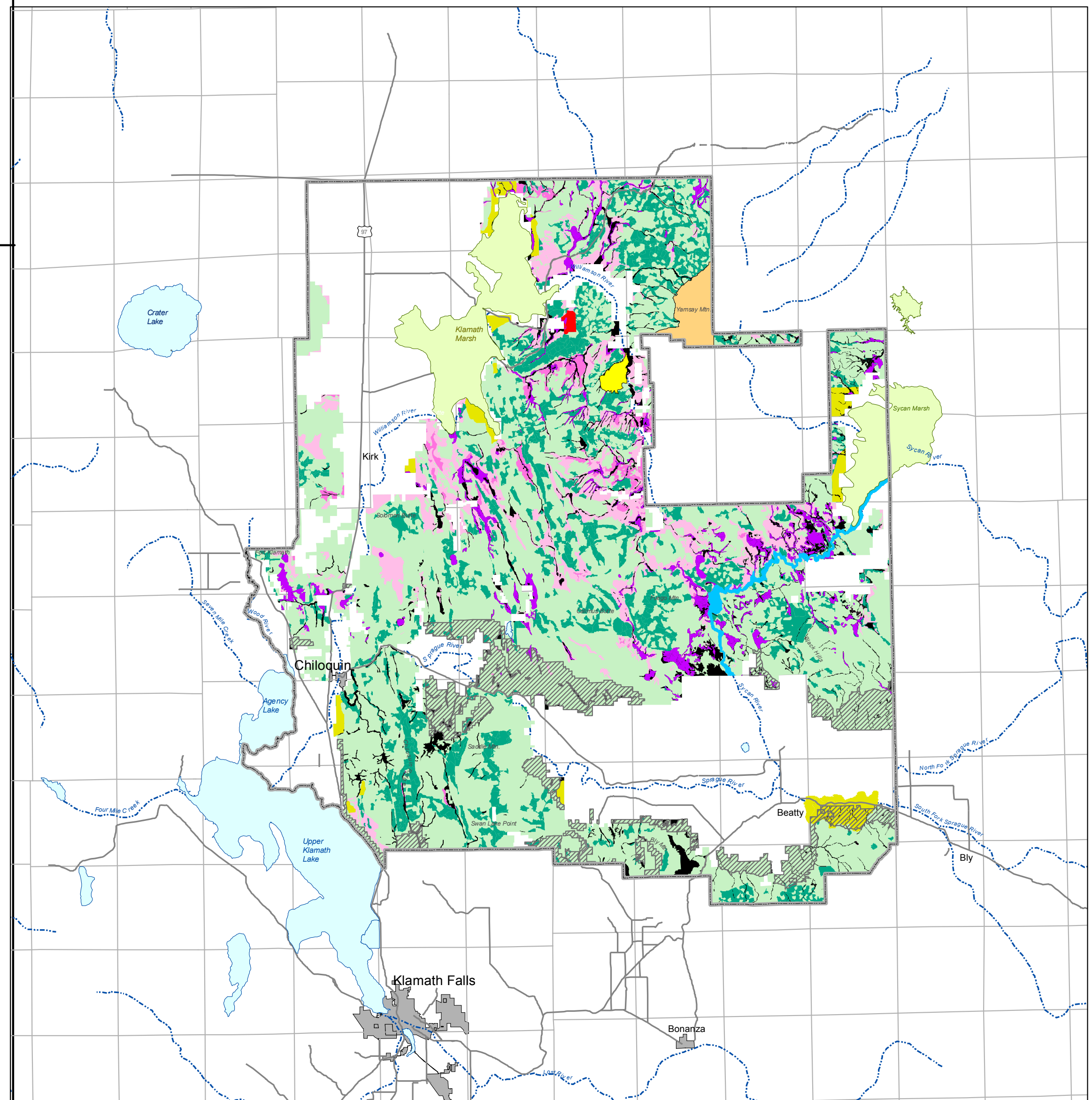
Klamath Reservation

Reservation Boundary
Streams
Highways

Forest Restoration Areas
Complex Forest
Lodgepole Pine/Bitterbrush
Marginal Site and High Elevation Lodgepole
Wet Lodgepole
Riparian Areas
Bald Eagle Habitat
Sycan Wild and Scenic River
Research Natural Area
Mule Deer Winter Range
Rocky Ford
Yamsay Mtn

0 2.5 5 10 15 20 Miles

N



Map 8

Forest Service Land Allocation

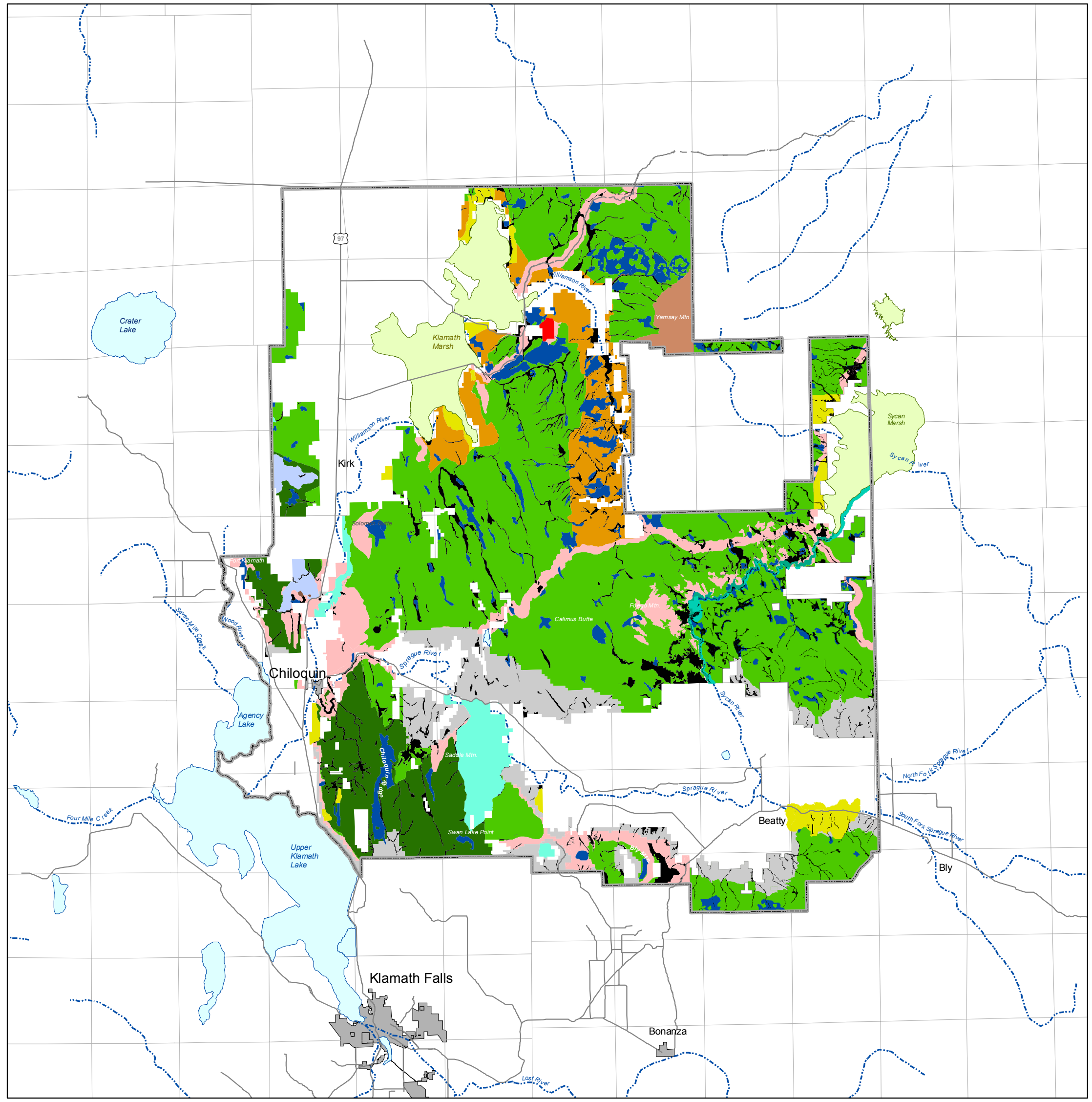
Klamath Reservation

Reservation Boundary
Streams
Highways

Timber Production
Timber Production in Matrix (NWFP)
Bald Eagle Habitat
Big Game Winter Range
Late Successional Reserves (NWFP)
Old Growth
Special Management
Sycan Wild and Scenic River
Upper Williamson Management Area
Riparian Areas
Special Rec.; Yamsay Mtn.
Developed Recreation
Scenic Management
Research Natural Areas

0 2.5 5 10 15 20 Miles

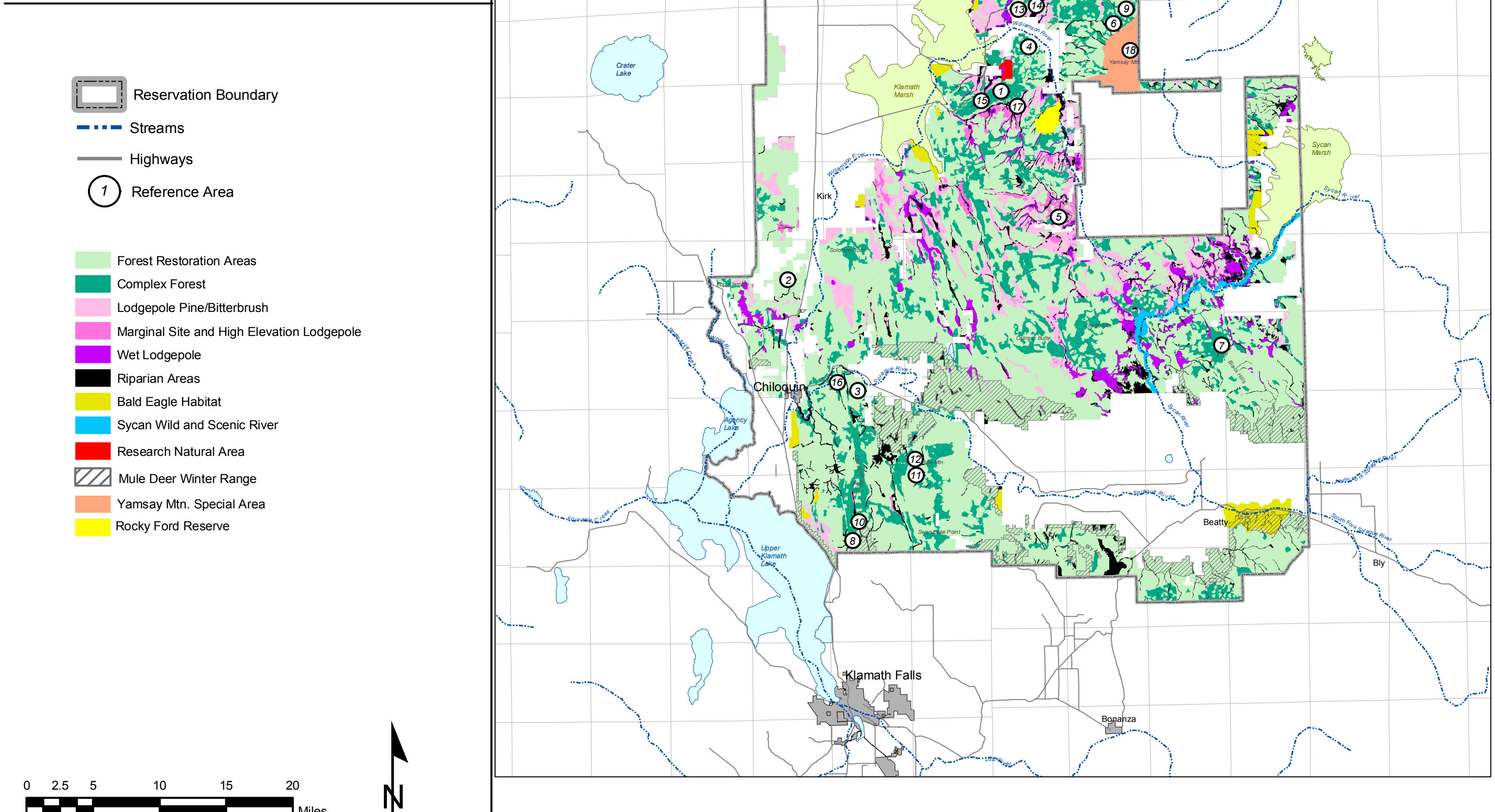
N



Map 9

Proposed Management Emphasis with Management Reference Sites

Klamath Reservation



Map 10

Habitat Types and Inventory Plot Types

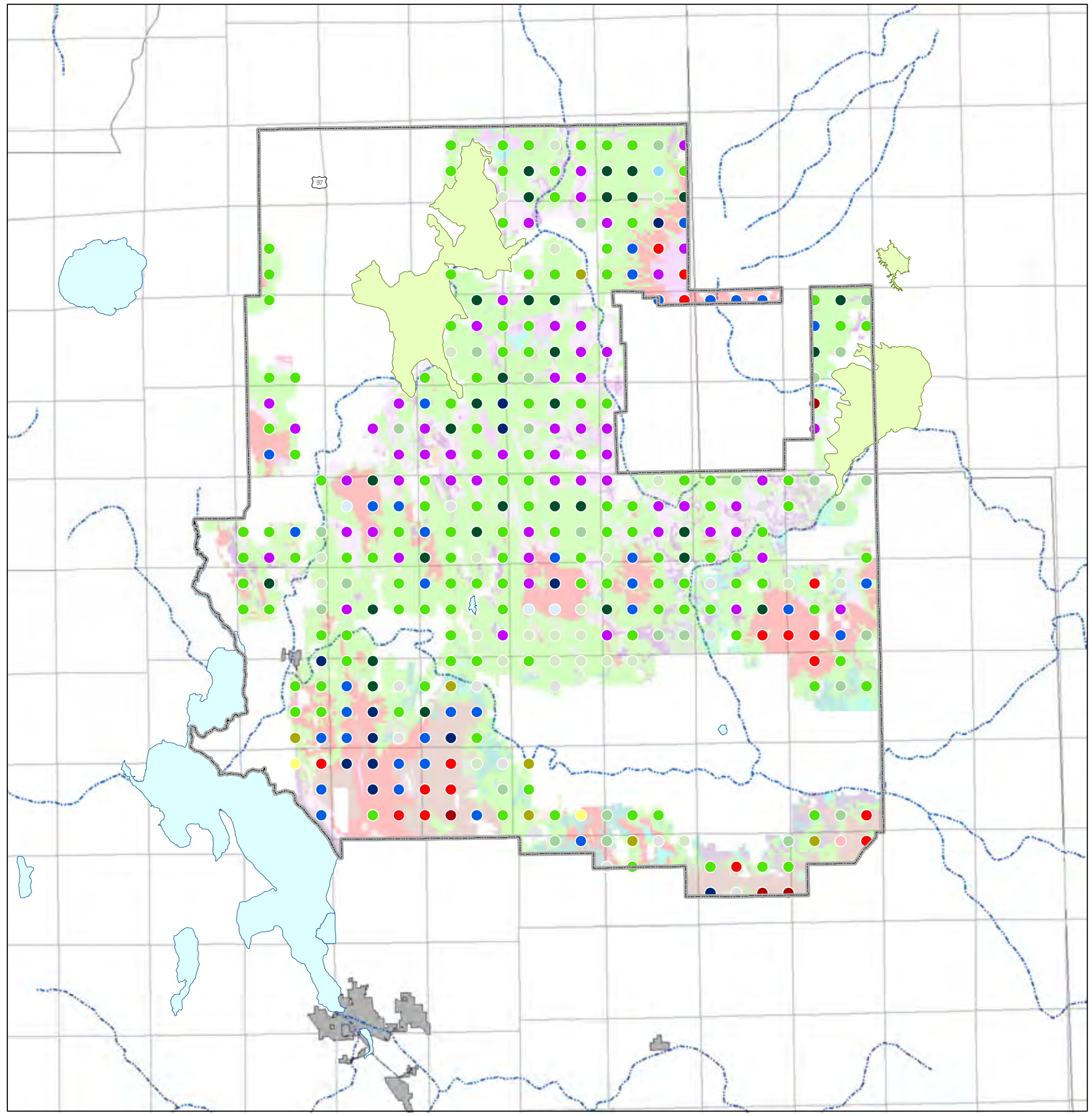
Klamath Reservation

Reservation Boundary
Streams
Highways

- Lodgepole pine
- Mixed Conifer/Snowbrush Low Stock
- Mixed Conifer/Snowbrush Simplified
- Mixed Conifer/Snowbrush Remnant
- Mixed Conifer/Snowbrush Complex
- Ponderosa Pine/Bitterbrush Low Stock
- Ponderosa Pine/Bitterbrush simplified
- Ponderosa Pine/Bitterbrush Remnant
- Ponderosa Pine/Bitterbrush Complex
- Ponderosa Pine/Sagebrush Simplified
- Ponderosa Pine/Sagebrush Remnant
- Moist Mixed Conifer Complex
- Moist Mixed Conifer Remnant
- Moist Mixed Conifer Simplified
- Other

0 2.5 5 10 15 20 Miles

N



Map 11

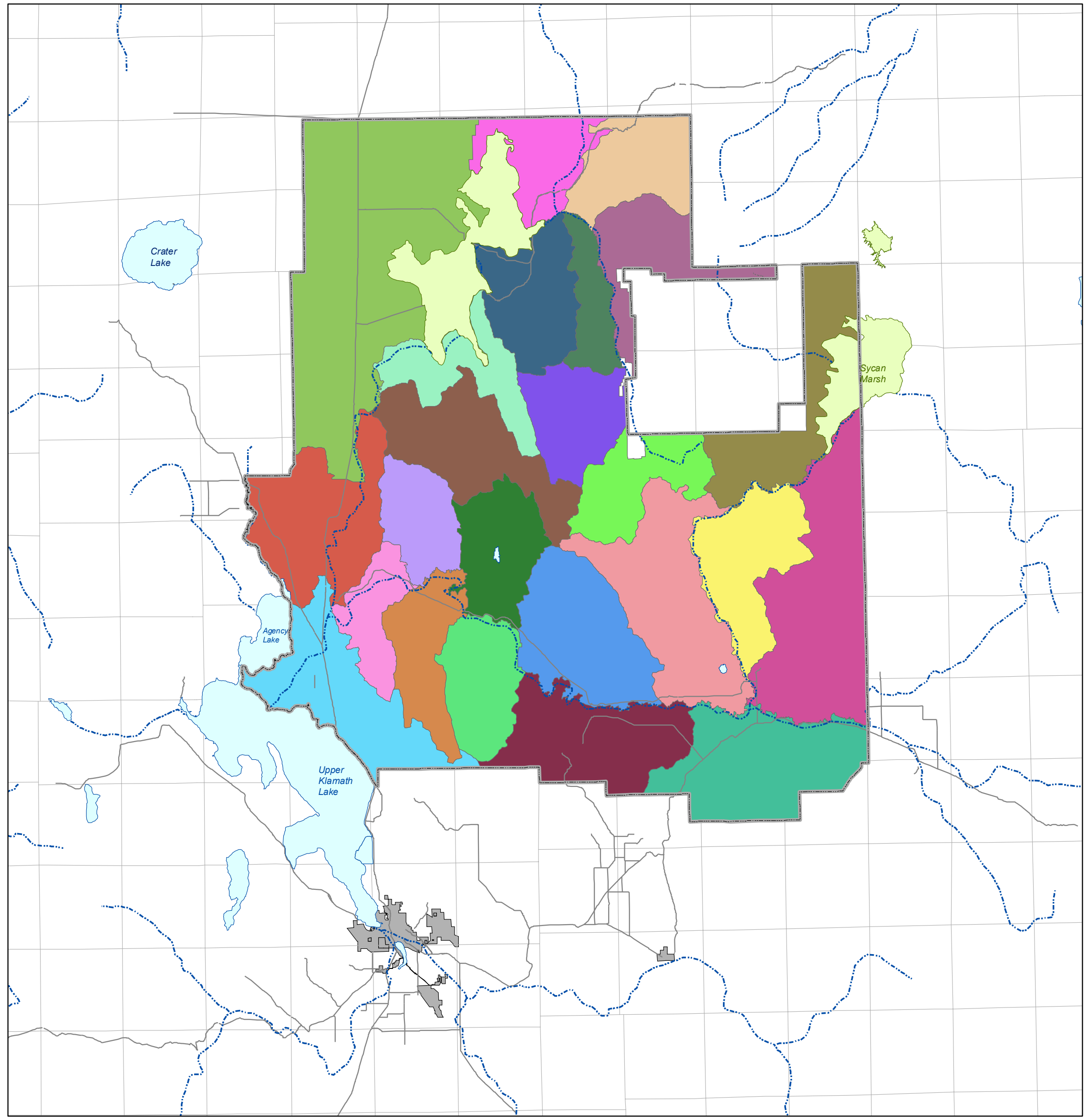
Restoration Units

Klamath Reservation

Reservation Boundary

Streams

Highways



0 2.5 5 10 15 20 Miles

N

Map 12

Rural Population / Wildland Interface Fire Risk areas

Klamath Reservation

Reservation Boundary

Streams

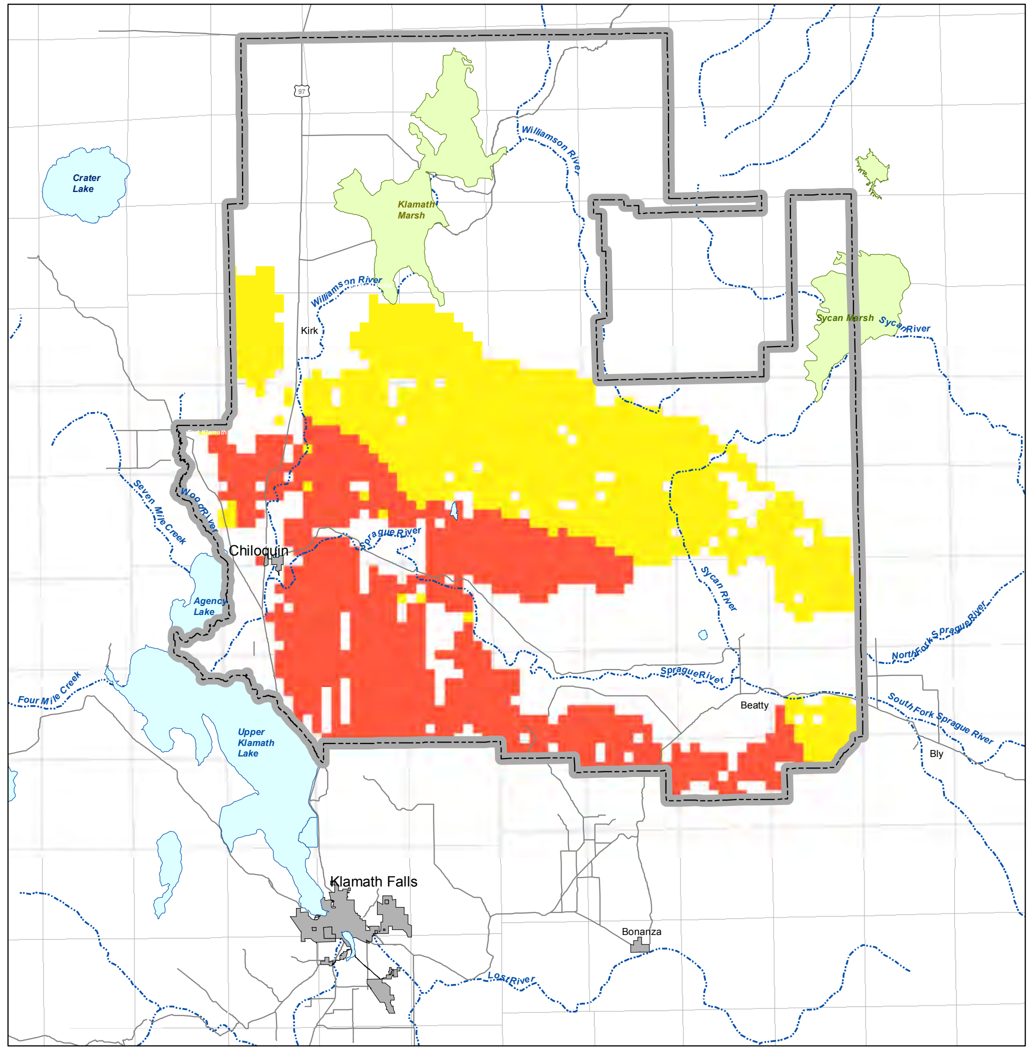
Highways

Moderate

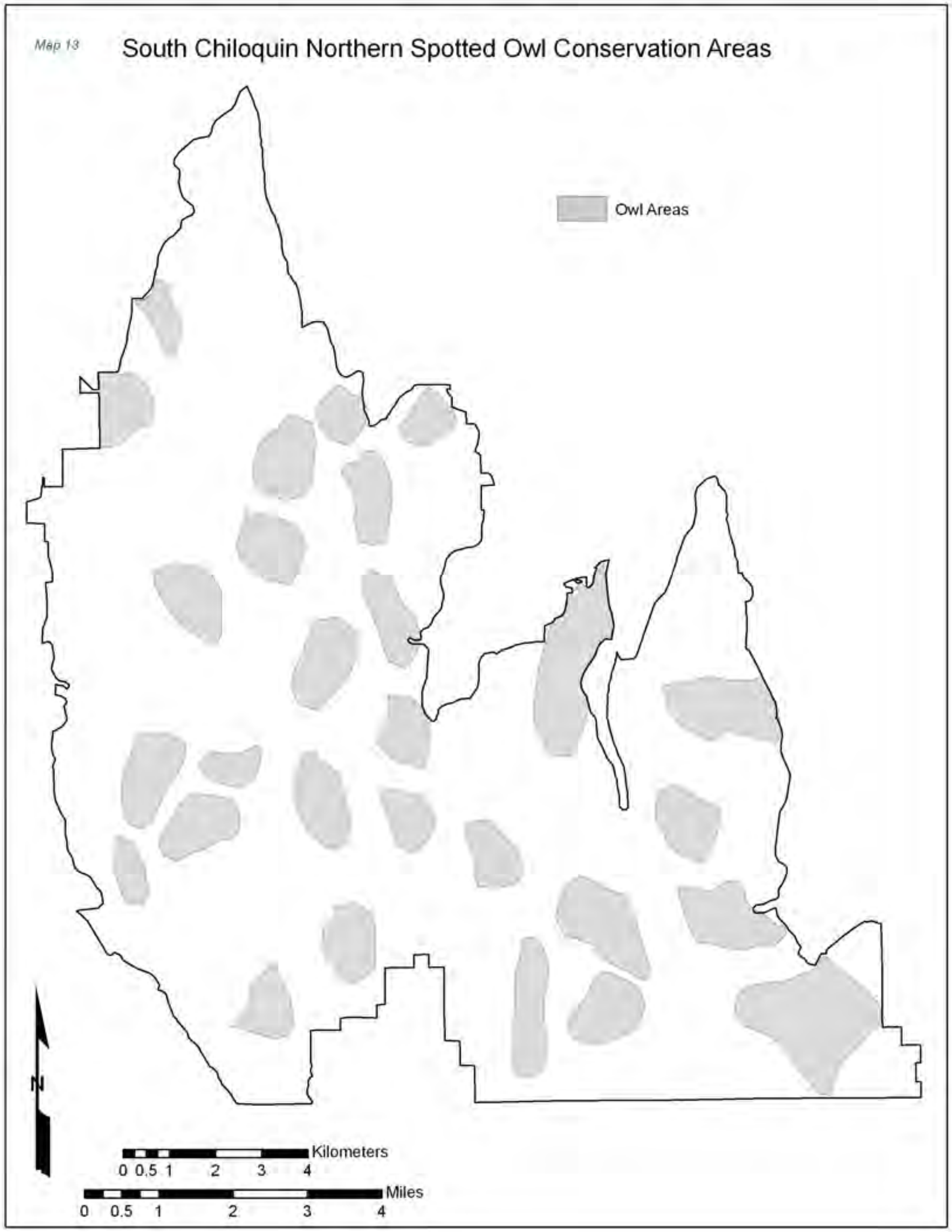
High

0 2.5 5 10 15 20 Miles

N

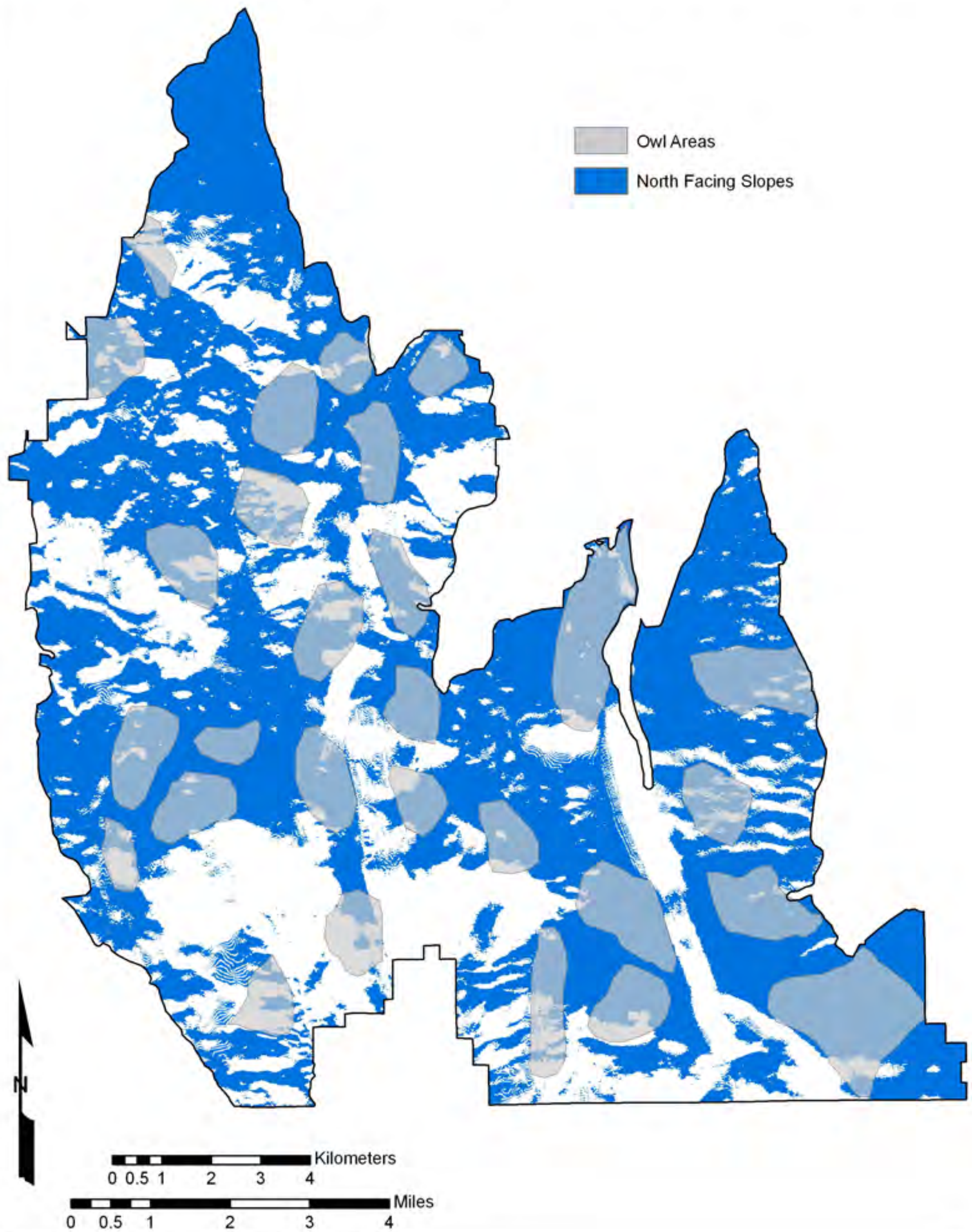


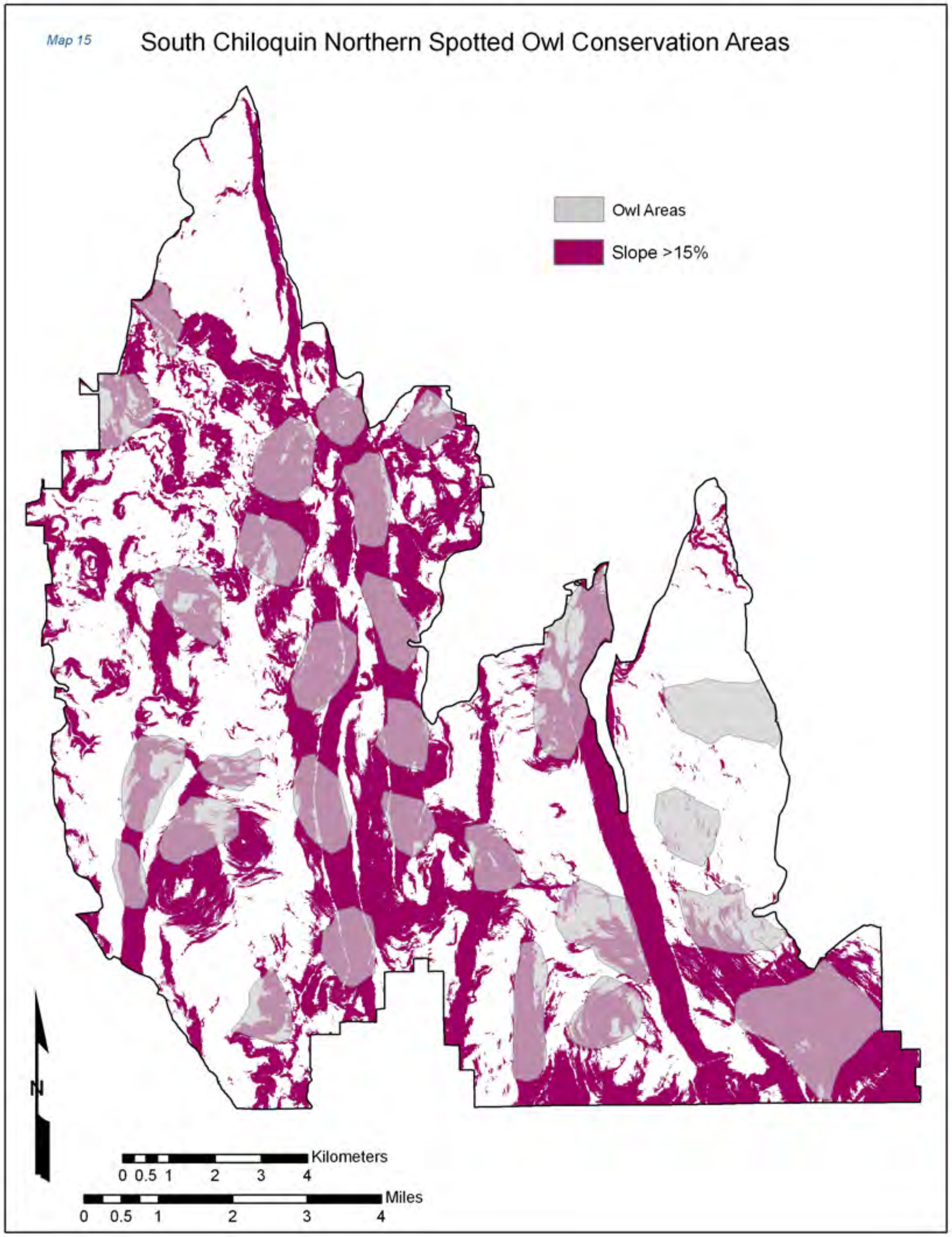
Source: Interior Columbia Basin Ecosystem Management Project. 1997. http://www.icbemp.gov/spatial/disturbance/


Map 13
South Chiloquin Northern Spotted Owl Conservation Areas
Owl Areas
N
Kilometers
0 0.5 1 2 3 4
Miles
0 0.5 1 2 3 4

Map 14

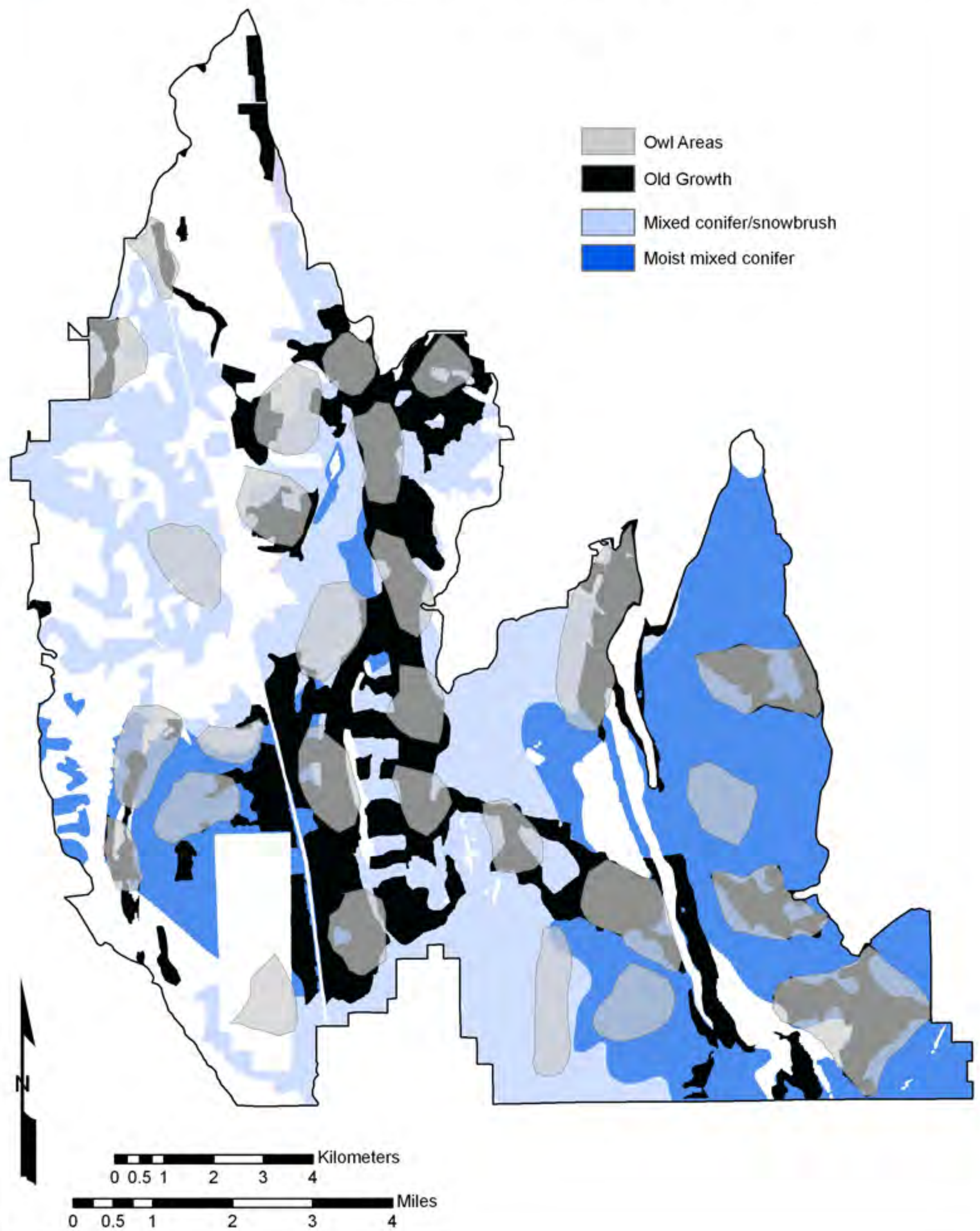
South Chiloquin Northern Spotted Owl Conservation Areas




Map 15
South Chiloquin Northern Spotted Owl Conservation Areas
Owl Areas
Slope >15%
N
Kilometers
0 0.5 1 2 3 4
Miles
0 0.5 1 2 3 4

Map 16

South Chiloquin Northern Spotted Owl Conservation Areas



Appendix B Photos

Goal

Complex Forest

- Large old live trees

Bull Pasture

Boundary Butte

Wildhorse Ridge

Goal

Complex Forest

- Large dead trees

Wildhorse Ridge

Blue Jay Springs

Saddle Mountain

Goal

Complex Forest

- Openings and clumps of smaller trees among the large trees

Blue Jay Springs

Wildhorse Ridge

Bull Pasture

Goal

Complex Forest

▶ *Aspen and willow patches*

Aspen at Black Hills

Aspen reneneration

Aspen mixed with ponderosa pine

Upland willow

Goal

Complex Forest

- Healthy bitterbrush

Blue Jay Springs after controlled burn

Goal

Complex Forest

Shellock Draw

Charlie Knight's cabin

Blue Jay Springs

Problems

- High fuel hazard from a build up in understory trees and brush

Little Yamsay Mountain

Fuego Mountain

Near Sycan River

Problems

▸ *Simplified forest with decadent bitterbrush*

Problems

Pine encroaching meadow

Restoration Harvest Values

Commercial lodgepole pine

Commercial white fir

Commercial ponderosa pine

Wildfire

▶ The Skunk Fire (2002)

photo: U.S. Forest Service, Skunk Fire Environmental Assessment

Wildfire

▶ Bitterbrush, aspen and willow regeneration a year after the Skunk Fire

Wildfire

▶ Toolbox Fire (2002)

Wildfire

- Complex fire burned in the Toolbox Fire (2002)

Appendix C Inventory

Table 1a

2006 Summary -- All Species

622, 238 Acres

Diameter Class	**Trees /acre**	**Avg dbh**	**Avg Height**	**Basal Area /acre**	**Cubic ft /acre**	**Board ft. /acre**	**Total Trees**	**Total Cubic Ft.**	**Total Bd.Ft.**
<1.	78.6	0.2	2.6	0.1	0.0	0.0	48,925,952	0	0
2	98.4	2.1	11.9	2.4	0.0	0.0	61,251,242	0	0
4	79.7	3.8	19.1	6.3	0.0	0.0	49,572,457	0	0
6	43.4	5.9	29.2	8.3	0.0	0.1	27,000,774	12,445	62,224
8	26.9	7.9	40.2	9.2	0.6	3.1	16,710,201	385,788	1,928,938
10	19.0	9.9	50.3	10.2	183.0	882.9	11,851,767	113,850,887	549,373,930
SUB.	**346.0**	**3.4**	**17.9**	**36.5**	**183.6**	**886.1**	**215,312,393**	**114,249,119**	**551,365,092**
12	12.8	11.9	58.0	9.9	227.5	1,092.1	7,969,002	141,546,700	679,546,120
14	8.5	13.9	64.6	9.0	226.9	1,119.9	5,299,601	141,179,580	696,844,336
16	5.0	15.9	71.1	6.9	188.1	951.5	3,108,701	117,067,857	592,059,457
18	3.1	17.9	76.7	5.4	157.3	822.4	1,934,538	97,853,148	511,728,531
19	1.0	10.0	40.9	2.3	68.2	373.5	648,061	42,405,520	232,374,781
SUB.	**30.5**	**13.9**	**62.3**	**33.4**	**867.9**	**4,359.4**	**18,959,903**	**540,052,805**	**2,712,553,225**
21	1.0	10.0	40.9	2.3	68.2	373.5	648,061	42,405,520	232,374,781
22	1.4	21.9	86.7	3.7	122.1	700.5	885,445	75,975,260	435,877,719
24	1.2	23.9	91.5	3.7	127.6	761.3	740,463	79,410,014	473,709,789
26	0.8	25.9	96.4	3.1	109.6	675.1	522,058	68,197,285	420,072,874
28	0.6	27.9	101.2	2.4	90.2	573.5	353,431	56,125,868	356,853,493
30	0.5	30.0	106.1	2.3	87.5	567.2	288,718	54,427,158	352,933,394
SUB.	**5.5**	**23.3**	**87.1**	**17.4**	**605.1**	**3,651.1**	**3,438,176**	**376,541,103**	**2,271,822,050**
32	0.4	31.9	109.2	2.3	93.1	621.9	261,962	57,936,580	386,969,812
34	0.2	34.0	111.7	1.5	61.1	419.7	148,093	38,006,297	261,153,289
36	0.2	35.9	115.1	1.3	52.5	363.2	112,003	32,692,385	225,996,842
38	0.1	37.8	117.3	1.1	46.7	327.1	88,358	29,064,737	203,534,050
40	0.1	39.9	121.4	0.7	30.3	213.3	49,779	18,860,034	132,723,365
42	0.0	41.8	129.0	0.4	19.6	138.0	28,001	12,189,642	85,868,844
44	0.0	44.0	119.4	0.2	8.2	57.3	11,823	5,096,129	35,654,237
46	0.0	45.8	130.5	0.1	6.3	44.6	7,467	3,938,767	27,751,815
48	0.0	47.9	119.2	0.1	4.1	29.4	5,600	2,576,065	18,293,797
50	0.0	50.5	121.9	0.1	2.9	20.6	3,111	1,798,268	12,818,103
52	0.0	51.0	101.0	0.0	0.1	0.4	0	37,334	248,895
54	0.0	53.9	121.0	0.0	1.8	13.3	1,244	1,113,806	8,275,765
56	0.0	55.5	147.0	0.1	2.7	20.1	1,867	1,698,710	12,506,984
58	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
60	0.0	59.6	153.1	0.0	0.8	5.9	622	504,013	3,671,204
62	0.0	62.2	116.1	0.0	1.0	7.4	622	640,905	4,604,561
64	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**1.2**	**35.3**	**113.9**	**8.0**	**331.3**	**2,282.1**	**720,552**	**206,153,672**	**1,420,071,564**
Total	**383.2**	**4.6**	**23.0**	**95.3**	**1,988.0**	**11,178.6**	**238,431,024**	**1,236,996,699**	**6,955,811,931**

Table 1b

2006 Summary -- All Species

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir					**Red fir**			
Seed&Sap	0-10	43.2	4.3	23.5	115.3		0.3	0.0	0.1	0.3
Poles	12-20	4.5	5.4	146.1	742.9		0.0	0.0	0.9	4.7
Sm. Saw	22-30	0.8	2.7	94.3	574.0		0.0	0.0	1.0	5.9
Lg. Saw	32-99	0.1	0.8	31.5	216.4		0.0	0.0	0.0	0.0
Total		48.6	13.2	295.4	1,648.5		0.3	0.1	1.9	10.8
		Incense cedar					**Lodgpole pine**			
Seed&Sap	0-10	3.3	0.3	1.0	4.7		107.6	11.5	72.2	347.6
Poles	12-20	0.3	0.2	4.0	17.5		7.8	8.2	229.5	1,173.8
Sm. Saw	22-30	0.0	0.1	2.9	15.2		0.2	0.6	18.5	108.7
Lg. Saw	32-99	0.0	0.1	3.3	20.0		0.0	0.0	0.4	2.5
Total		3.6	0.8	11.3	57.4		115.7	20.3	320.6	1,632.7
		Sugar pine					**Western white pine**			
Seed&Sap	0-10	11.7	0.9	3.9	19.1		1.1	0.1	0.5	2.4
Poles	12-20	0.8	0.9	22.7	112.8		0.1	0.1	1.8	9.3
Sm. Saw	22-30	0.1	0.5	16.3	97.2		0.0	0.1	2.7	16.9
Lg. Saw	32-99	0.1	0.5	20.1	138.4		0.0	0.0	0.6	4.2
Total		12.7	2.7	62.9	367.6		1.2	0.2	5.7	32.8
		Ponderosa pine					**Douglas-fir**			
Seed&Sap	0-10	167.7	18.2	78.3	376.8		2.7	0.3	1.8	8.9
Poles	12-20	16.9	19.4	498.8	2,515.6		0.6	0.8	22.4	113.9
Sm. Saw	22-30	3.1	10.5	385.5	2,371.1		0.1	0.3	10.1	60.8
Lg. Saw	32-99	0.9	6.1	261.0	1,804.5		0.0	0.2	9.5	65.3
Total		188.5	54.1	1,223.6	7,068.0		3.4	1.6	43.8	248.9
		Mountain hemlock					**Other species**			
Seed&Sap	0-10	1.3	0.1	0.5	2.2		7.3	0.8	1.9	8.8
Poles	12-20	0.1	0.2	4.1	20.3		0.5	0.6	6.0	22.4
Sm. Saw	22-30	0.0	0.1	2.7	16.2		0.1	0.3	3.2	12.7
Lg. Saw	32-99	0.0	0.1	4.3	28.7		0.0	0.1	0.9	4.3
Total		1.5	0.5	11.5	67.5		7.9	1.7	11.9	48.2
		All species combined								
Seed&Sap	0-10	346.0	36.5	183.6	886.1					
Poles	12-20	31.5	35.6	936.2	4,733.3					
Sm. Saw	22-30	4.5	15.2	537.2	3,278.7					
Lg. Saw	32-99	1.2	8.0	331.6	2,284.2					
Total		383.2	95.3	1,988.6	11,182.4					

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Table 2a

Ponderosa Pine, Mixed Conifer Snowbrush, Moist Mixed Conifer

522,047 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.	78.8	0.2	2.4	0.0	0.0	0.0	41,143,568	0	0
2	90.5	2.0	11.4	2.2	0.0	0.0	47,254,650	0	0
4	79.2	3.8	18.5	6.3	0.0	0.0	41,366,482	0	0
6	40.9	5.9	28.1	7.8	0.0	0.1	21,372,082	10,441	52,205
8	25.6	7.9	38.5	8.7	0.7	3.3	13,371,190	344,551	1,722,755
10	18.2	9.9	49.0	9.8	166.7	805.2	9,501,777	86,999,133	420,352,244
SUB.	**333.3**	**3.4**	**17.1**	**34.9**	**167.3**	**808.6**	**174,009,228**	**87,348,904**	**422,127,204**
12	12.6	11.9	57.1	9.7	219.7	1,051.2	6,564,741	114,683,285	548,775,806
14	8.5	13.9	64.0	8.9	224.5	1,103.2	4,431,657	117,199,552	575,922,250
16	5.1	15.9	71.2	7.1	193.0	975.1	2,674,969	100,739,410	509,048,030
18	3.2	17.9	77.2	5.6	162.9	849.2	1,669,506	85,036,236	443,322,312
19	1.1	10.0	41.4	2.4	73.3	401.5	577,906	38,258,214	209,601,871
SUB.	**30.5**	**13.9**	**62.2**	**33.7**	**873.3**	**4,380.2**	**15,918,779**	**455,916,696**	**2,286,670,269**
21	1.1	10.0	41.4	2.4	73.3	401.5	577,906	38,258,214	209,601,871
22	1.6	21.9	87.9	4.1	135.2	777.1	810,217	70,554,652	405,682,724
24	1.4	23.9	92.1	4.3	148.0	883.1	715,726	77,242,074	461,019,706
26	1.0	25.9	97.6	3.5	127.5	786.3	502,209	66,576,654	410,485,556
28	0.6	27.9	102.1	2.8	103.7	659.8	337,764	54,136,274	344,446,611
30	0.5	30.0	107.5	2.6	102.3	664.9	278,773	53,379,306	347,109,050
SUB.	**6.2**	**23.3**	**88.1**	**19.6**	**689.9**	**4,172.7**	**3,222,596**	**360,147,174**	**2,178,345,517**
32	0.5	31.9	110.5	2.8	111.1	743.1	258,935	57,999,422	387,933,126
34	0.3	33.9	112.2	1.7	70.6	485.6	143,041	36,866,959	253,506,023
36	0.2	35.9	115.0	1.4	59.3	410.1	106,498	30,973,049	214,091,475
38	0.2	37.8	118.0	1.3	54.4	381.6	85,094	28,415,018	199,213,135
40	0.1	39.8	121.4	0.8	34.1	240.5	46,984	17,817,464	125,552,304
42	0.1	41.8	129.5	0.5	21.9	154.0	26,102	11,422,388	80,395,238
44	0.0	44.0	118.4	0.2	9.5	66.3	11,485	4,943,785	34,611,716
46	0.0	45.8	130.5	0.2	7.9	55.4	7,831	4,108,510	28,921,404
48	0.0	47.9	125.2	0.1	2.9	20.8	3,132	1,524,377	10,858,578
50	0.0	50.4	126.0	0.1	3.3	23.6	3,132	1,733,196	12,320,309
52	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
54	0.0	53.9	119.9	0.0	2.1	15.7	1,566	1,111,960	8,196,138
56	0.0	55.7	147.9	0.0	2.4	17.3	1,566	1,226,810	9,031,413
58	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
60	0.0	59.6	153.1	0.0	1.0	7.3	522	527,267	3,810,943
62	0.0	62.2	116.1	0.0	1.3	9.1	522	668,220	4,750,628
64	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**1.3**	**35.2**	**114.5**	**9.1**	**381.8**	**2,630.5**	**696,411**	**199,333,206**	**1,373,244,634**
Total	**371.3**	**4.7**	**22.6**	**97.3**	**2,112.4**	**11,992.0**	**193,847,536**	**1,102,745,980**	**6,260,387,624**

Table 2b

Ponderosa Pine, Mixed Conifer Snowbrush, Moist Mixed Conifer

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Red fir**			
Seed&Sap	0-10	53.6	5.2	27.9	136.6	0.1	0.0	0.0	0.0
Poles	12-20	5.4	6.5	176.9	899.5	0.0	0.0	0.0	0.0
Sm. Saw	22-30	1.0	3.2	113.5	692.2	0.0	0.0	0.0	0.0
Lg. Saw	32-99	0.2	1.0	38.7	265.7	0.0	0.0	0.0	0.0
Total		60.1	15.9	357.0	1,994.0	0.1	0.0	0.0	0.0
		Incense cedar				**Lodgepole pine**			
Seed&Sap	0-10	5.1	0.4	1.3	5.8	61.0	6.0	37.8	182.6
Poles	12-20	0.3	0.3	5.0	21.7	3.7	3.7	108.9	557.2
Sm. Saw	22-30	0.1	0.2	3.6	18.9	0.1	0.2	8.2	48.5
Lg. Saw	32-99	0.0	0.2	4.1	24.8	0.0	0.0	0.4	3.0
Total		5.5	1.0	14.1	71.3	64.8	10.0	155.3	791.4
		Sugar pine				**Western white pine**			
Seed&Sap	0-10	14.3	1.0	4.2	20.3	0.7	0.0	0.2	0.9
Poles	12-20	0.9	1.0	25.7	127.8	0.0	0.0	0.8	4.1
Sm. Saw	22-30	0.2	0.6	20.2	120.7	0.0	0.1	2.1	12.5
Lg. Saw	32-99	0.1	0.6	25.0	171.9	0.0	0.0	0.8	5.2
Total		15.5	3.2	75.0	440.7	0.8	0.1	3.8	22.7
		Ponderosa pine				**Douglas-fir**			
Seed&Sap	0-10	187.9	21.2	92.2	444.0	4.3	0.4	2.3	11.1
Poles	12-20	20.2	23.2	597.9	3,016.2	0.8	1.0	27.8	141.4
Sm. Saw	22-30	3.6	12.3	453.9	2,792.5	0.1	0.4	12.6	75.5
Lg. Saw	32-99	1.0	7.0	300.4	2,076.0	0.0	0.3	11.8	81.1
Total		212.7	63.7	1,444.4	8,328.7	5.3	2.0	54.5	309.1
		Mountain hemlock				**Other species**			
Seed&Sap	0-10	0.0	0.0	0.0	0.0	6.3	0.8	1.5	7.3
Poles	12-20	0.0	0.0	0.1	0.3	0.3	0.3	3.6	13.4
Sm. Saw	22-30	0.0	0.0	0.0	0.0	0.1	0.2	2.6	10.4
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.0	0.1	0.6	2.7
Total		0.0	0.0	0.1	0.3	6.7	1.3	8.2	33.8
		All species combined							
Seed&Sap	0-10	333.3	34.9	167.3	808.6				
Poles	12-20	31.6	36.1	946.6	4,781.7				
Sm. Saw	22-30	5.1	17.2	616.6	3,771.2				
Lg. Saw	32-99	1.3	9.1	381.8	2,630.5				
Total		371.3	97.3	2,112.4	11,992.0				

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Table 2c

Ponderosa Pine, Mixed Conifer, Moist Mixed Conifer

Diameter Class	Trees /acre	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Trees /acre	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Trees /acre	Basal Area /acre	Cubic ft /acre	Board ft. /acre
<1.	80.8	0.0	0.0	0.0	78.8	0.0	0.0	0.0	-2.0	0.0	0.0	0.0
2	110.8	2.5	0.0	0.0	90.5	2.2	0.0	0.0	-20.3	-0.2	0.0	0.0
4	64.1	5.3	0.0	0.0	79.2	6.3	0.0	0.0	15.1	1.0	0.0	0.0
6	35.0	6.6	0.0	0.0	40.9	7.8	0.0	0.1	5.9	1.2	0.0	0.1
8	23.0	7.9	0.0	0.0	25.6	8.7	0.7	3.3	2.7	0.9	0.7	3.3
10	16.1	8.6	143.5	690.5	18.2	9.8	166.7	805.2	2.1	1.2	23.2	114.7
SUB.	**329.8**	**30.8**	**143.5**	**690.5**	**333.3**	**34.9**	**167.3**	**808.6**	**3.5**	**4.1**	**23.9**	**118.1**
12	10.7	8.2	178.9	852.0	12.6	9.7	219.7	1,051.2	1.9	1.5	40.8	199.2
14	6.6	6.9	169.1	822.0	8.5	8.9	224.5	1,103.2	1.9	2.0	55.4	281.2
16	4.0	5.5	145.8	733.4	5.1	7.1	193.0	975.1	1.1	1.6	47.2	241.7
18	2.6	4.6	130.7	679.0	3.2	5.6	162.9	849.2	0.6	1.0	32.2	170.2
20	1.8	3.9	117.8	644.4	2.2	4.8	146.6	803.0	0.4	0.9	28.7	158.6
SUB.	**25.7**	**29.1**	**742.4**	**3,730.8**	**31.6**	**36.1**	**946.6**	**4,781.7**	**5.9**	**7.0**	**204.3**	**1,050.9**
									0.0	0.0	0.0	0.0
22	1.5	3.9	128.0	734.7	1.6	4.1	135.2	777.1	0.1	0.2	7.2	42.4
24	1.2	3.8	131.8	787.3	1.4	4.3	148.0	883.1	0.1	0.4	16.1	95.8
26	0.8	2.8	103.0	636.2	1.0	3.5	127.5	786.3	0.2	0.7	24.5	150.1
28	0.6	2.6	99.5	632.8	0.6	2.8	103.7	659.8	0.0	0.1	4.2	27.0
30	0.5	2.5	100.6	652.3	0.5	2.6	102.3	664.9	0.0	0.1	1.7	12.6
SUB.	**4.6**	**15.7**	**562.9**	**3,443.4**	**5.1**	**17.2**	**616.6**	**3,771.2**	**0.5**	**1.5**	**53.7**	**327.8**
32	0.4	2.3	90.7	606.2	0.5	2.8	111.1	743.1	0.1	0.5	20.4	136.9
34	0.3	1.8	73.7	504.7	0.3	1.7	70.6	485.6	0.0	-0.1	-3.1	-19.1
36	0.2	1.3	54.7	377.8	0.2	1.4	59.3	410.1	0.0	0.1	4.6	32.3
38	0.1	1.0	42.6	298.1	0.2	1.3	54.4	381.6	0.0	0.3	11.8	83.5
40	0.1	0.6	28.5	200.0	0.1	0.8	34.1	240.5	0.0	0.1	5.7	40.5
42	0.0	0.4	16.9	118.9	0.1	0.5	21.9	154.0	0.0	0.1	5.0	35.1
44	0.0	0.2	9.5	66.7	0.0	0.2	9.5	66.3	0.0	0.0	0.0	-0.4
46	0.0	0.1	5.5	38.4	0.0	0.2	7.9	55.4	0.0	0.0	2.4	17.0
48	0.0	0.1	2.4	16.7	0.0	0.1	2.9	20.8	0.0	0.0	0.6	4.1
50	0.0	0.1	2.5	17.5	0.0	0.1	3.3	23.6	0.0	0.0	0.9	6.1
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
54	0.0	0.1	3.2	23.1	0.0	0.0	2.1	15.7	0.0	0.0	-1.1	-7.4
56	0.0	0.0	1.3	9.4	0.0	0.0	2.4	17.3	0.0	0.0	1.1	7.9
58	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	1.3	9.0	0.0	0.0	1.0	7.3	0.0	0.0	-0.2	-1.7
62	0.0	0.0	1.3	9.3	0.0	0.0	1.3	9.1	0.0	0.0	0.0	-0.2
64	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB.	**1.2**	**7.9**	**333.9**	**2,295.9**	**1.3**	**9.1**	**381.8**	**2,630.5**	**0.2**	**1.2**	**47.9**	**334.6**
Total	**361.2**	**83.5**	**1,782.6**	**10,160.6**	**371.3**	**97.3**	**2,112.4**	**11,992.0**	**10.1**	**13.7**	**329.7**	**1,831.4**

Table 3a

Ponderosa Pine/Bitterbrush

376,155 Acres

Diameter Class	**Trees /acre**	**Avg dbh**	**Avg Height**	**Basal Area /acre**	**Cubic ft /acre**	**Board ft. /acre**	**Total Trees**	**Total Cubic Ft.**	**Total Bd.Ft.**
<1.	68.5	0.2	2.5	0.0	0.0	0.0	25,773,764	0	0
2.0	86.6	2.1	11.4	2.2	0.0	0.0	32,587,436	0	0
4.0	75.3	3.8	18.3	6.0	0.0	0.0	28,335,004	0	0
6.0	40.7	5.9	27.3	7.7	0.1	0.2	15,295,215	18,808	75,231
8.0	24.2	7.9	37.5	8.3	0.9	4.7	9,115,740	353,586	1,767,929
10.0	17.2	9.9	47.6	9.2	155.1	747.3	6,475,508	58,330,356	281,100,632
SUB.	**312.6**	**3.5**	**17.2**	**33.5**	**156.1**	**752.2**	**117,583,044**	**58,702,749**	**282,943,791**
12.0	12.0	11.9	55.2	9.2	206.3	988.2	4,501,071	77,593,253	371,716,371
14.0	7.6	13.9	62.4	8.0	199.4	976.1	2,858,778	74,986,499	367,164,896
16.0	4.7	15.9	69.2	6.4	174.1	878.4	1,756,644	65,488,586	330,414,552
18.0	2.8	17.9	75.4	4.9	140.4	730.9	1,047,968	52,800,877	274,931,690
19.0	1.0	10.0	40.0	2.1	62.5	341.0	362,425	23,500,284	128,268,855
SUB.	**28.0**	**13.9**	**60.4**	**30.6**	**782.6**	**3,914.6**	**10,526,886**	**294,369,499**	**1,472,496,363**
21.0	1.0	10.0	40.0	2.1	62.5	341.0	362,425	23,500,284	128,268,855
22.0	1.3	21.9	85.9	3.4	112.8	646.9	492,387	42,415,238	243,334,670
24.0	1.2	23.9	90.1	3.8	130.2	776.9	457,028	48,979,143	292,234,820
26.0	0.8	25.9	96.4	2.8	103.8	639.1	290,768	39,026,081	240,400,661
28.0	0.6	27.9	100.8	2.4	90.5	576.9	209,518	34,042,028	217,003,820
30.0	0.5	30.0	105.0	2.3	90.4	586.7	176,041	33,996,889	220,690,139
SUB.	**5.3**	**23.2**	**86.4**	**16.8**	**590.1**	**3,567.5**	**1,988,167**	**221,959,662**	**1,341,932,963**
32.0	0.4	31.9	110.6	2.3	97.3	652.4	159,114	36,581,074	245,403,522
34.0	0.3	33.9	111.9	1.6	67.2	462.0	97,048	25,258,808	173,783,610
36.0	0.2	35.9	115.1	1.2	50.7	350.8	63,194	19,059,774	131,955,174
38.0	0.1	37.7	116.5	0.9	39.2	274.4	44,386	14,752,799	103,216,932
40.0	0.1	39.7	119.9	0.6	26.1	183.6	25,955	9,821,407	69,062,058
42.0	0.0	41.9	129.8	0.4	19.1	134.6	16,551	7,195,845	50,630,463
44.0	0.0	44.1	122.9	0.2	8.4	59.0	6,771	3,140,894	22,193,145
46.0	0.0	45.9	131.6	0.1	6.0	42.5	4,138	2,260,692	15,986,588
48.0	0.0	48.0	119.1	0.0	1.9	13.3	1,505	714,695	5,002,862
50.0	0.0	50.7	115.1	0.0	0.9	6.5	752	346,063	2,445,008
52.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
54.0	0.0	53.3	95.2	0.0	1.4	10.2	752	522,855	3,836,781
56.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
58.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
60.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
62.0	0.0	62.2	116.1	0.0	1.7	12.4	752	650,748	4,664,322
64.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**1.1**	**35.0**	**114.0**	**7.5**	**319.8**	**2,201.7**	**420,541**	**120,305,654**	**828,180,464**
Total	**347.0**	**4.7**	**22.3**	**88.4**	**1,848.5**	**10,436.1**	**130,518,638**	**695,337,564**	**3,925,591,196**

Ponderosa Pine/Bitterbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Incense-cedar**			
Seed&Sap	0-10	7.1	0.6	2.0	9.8	1.5	0.1	0.5	2.2
Poles	12-20	0.5	0.6	16.5	83.3	0.2	0.2	2.5	10.7
Sm. Saw	22-30	0.1	0.2	6.9	40.7	0.0	0.0	0.8	4.4
Lg. Saw	32-99	0.0	0.1	3.8	27.0	0.0	0.0	0.9	5.2
Total		7.7	1.5	29.2	160.8	1.6	0.4	4.7	22.5
		Lodgepole pine				**Sugar pine**			
Seed&Sap	0-10	72.9	7.2	45.1	217.6	5.3	0.4	1.3	6.4
Poles	12-20	4.2	4.3	124.4	637.1	0.3	0.4	8.7	43.3
Sm. Saw	22-30	0.1	0.3	10.1	59.6	0.1	0.2	7.6	45.0
Lg. Saw	32-99	0.0	0.0	0.6	4.1	0.0	0.2	6.9	47.8
Total		77.2	11.8	180.1	918.4	5.7	1.2	24.6	142.5
		Western white pine				**Ponderosa pine**			
Seed&Sap	0-10	0.0	0.0	0.0	0.0	217.2	24.1	105.4	507.5
Poles	12-20	0.0	0.0	0.0	0.0	23.3	26.7	683.8	3,440.4
Sm. Saw	22-30	0.0	0.0	0.0	0.0	4.0	13.6	497.2	3,053.0
Lg. Saw	32-99	0.0	0.0	0.0	0.0	1.1	7.1	306.8	2,114.0
Total		0.0	0.0	0.0	0.0	245.6	71.6	1,593.2	9,114.9
		Douglas-fir				**Other species**			
Seed&Sap	0-10	0.5	0.0	0.0	0.0	8.0	1.0	1.8	8.7
Poles	12-20	0.1	0.2	5.0	25.4	0.3	0.4	4.1	15.3
Sm. Saw	22-30	0.0	0.1	1.9	11.5	0.1	0.2	3.1	12.3
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.0	0.1	0.8	3.5
Total		0.7	0.3	7.0	36.9	8.4	1.6	9.7	39.9
		Combined species							
Seed&Sap	0-10	312.6	33.5	156.1	752.2				
Poles	12-20	29.0	32.7	845.0	4,255.6				
Sm. Saw	22-30	4.3	14.7	527.6	3,226.5				
Lg. Saw	32-99	1.1	7.5	319.8	2,201.7				
Total		347.0	88.4	1,848.5	10,436.1				

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Table 4a

Complex Ponderosa Pine/Bitterbrush

58,005 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.	148.3	0.2	2.0	0.1	0.0	0.0	8,600,053	0	0
2	92.8	2.1	10.9	2.3	0.0	0.0	5,384,720	0	0
4	83.9	3.7	17.9	6.5	0.0	0.0	4,863,835	0	0
6	38.5	5.9	27.3	7.3	0.0	0.0	2,235,629	0	0
8	20.3	7.9	38.1	7.0	0.5	2.3	1,177,792	26,682	133,412
10	11.2	9.9	48.7	6.0	99.7	485.1	651,454	5,783,099	28,138,226
SUB.	**395.0**	**2.6**	**13.1**	**29.1**	**100.2**	**487.4**	**22,913,425**	**5,809,781**	**28,271,637**
12	8.8	11.9	56.7	6.8	156.7	752.9	512,184	9,089,384	43,671,965
14	4.4	14.0	65.6	4.7	122.4	605.5	255,512	7,099,812	35,122,028
16	4.0	16.0	71.6	5.6	155.0	786.8	234,688	8,992,515	45,638,334
18	2.6	17.9	77.7	4.6	137.2	719.5	153,307	7,957,126	41,734,598
19	1.2	10.0	42.1	2.6	82.9	455.4	69,577	4,807,454	26,412,577
SUB.	**21.1**	**14.0**	**62.7**	**24.4**	**654.2**	**3,320.1**	**1,225,269**	**37,946,291**	**192,579,500**
21	1.2	10.0	42.1	2.6	82.9	455.4	69,577	4,807,454	26,412,577
22	2.0	21.9	89.2	5.3	179.3	1,035.5	116,242	10,399,136	60,064,178
24	2.5	23.9	91.8	7.6	267.7	1,602.9	142,518	15,530,259	92,976,215
26	1.6	25.8	98.9	5.6	213.8	1,320.1	90,256	12,401,469	76,572,401
28	1.2	27.9	104.7	5.1	202.8	1,298.9	70,244	11,761,094	75,342,695
30	0.8	30.0	108.7	4.1	164.5	1,076.0	47,796	9,543,563	62,413,380
SUB.	**9.3**	**23.2**	**89.2**	**30.4**	**1,111.0**	**6,788.8**	**536,633**	**64,442,975**	**393,781,444**
32	0.9	32.1	110.8	4.9	201.6	1,353.1	50,638	11,696,128	78,486,566
34	0.8	33.9	112.6	4.7	194.6	1,341.4	43,620	11,290,093	77,807,907
36	0.4	35.8	115.2	3.1	135.2	936.2	26,044	7,842,856	54,304,281
38	0.3	37.8	118.2	2.3	98.4	691.7	16,937	5,708,852	40,122,059
40	0.2	39.7	119.3	1.5	64.8	454.3	10,267	3,758,144	26,351,672
42	0.1	41.9	128.8	1.3	63.1	443.6	8,179	3,662,436	25,731,018
44	0.0	44.0	125.8	0.4	15.2	108.8	2,088	882,256	6,310,944
46	0.0	46.2	134.0	0.3	13.6	96.9	1,392	788,288	5,620,685
48	0.0	47.4	118.1	0.1	5.3	36.9	696	306,846	2,140,385
50	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**2.8**	**35.1**	**114.7**	**18.7**	**791.9**	**5,463.0**	**159,746**	**45,935,320**	**316,881,315**
TOTA	**428.2**	**3.9**	**18.1**	**102.6**	**2,657.3**	**16,059.2**	**24,835,073**	**154,134,366**	**931,513,896**

Table 4b

Complex Ponderosa Pine/Bitterbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Lodgepole pine**			
Seed&Sap	**0-10**	29.2	2.2	7.0	34.7	49.5	3.9	22.7	110.0
Poles	**12-20**	1.5	1.5	38.4	190.2	3.4	3.5	101.4	521.5
Sm. Saw	**22-30**	0.1	0.4	11.6	66.6	0.1	0.2	6.2	37.1
Lg. Saw	**32-99**	0.1	0.6	23.2	163.9	0.0	0.0	0.0	0.0
Total		30.9	4.7	80.3	455.5	53.0	7.6	130.3	668.6
		Sugar pine				**Ponderosa pine**			
Seed&Sap	**0-10**	10.5	1.0	2.9	14.9	303.2	21.5	65.8	320.5
Poles	**12-20**	1.1	1.1	27.7	138.1	16.3	20.8	568.5	2,921.1
Sm. Saw	**22-30**	0.2	0.7	24.1	146.0	7.6	26.4	984.8	6,078.2
Lg. Saw	**32-99**	0.0	0.1	5.2	35.8	2.6	17.8	760.8	5,250.1
Total		11.7	3.0	59.8	334.9	329.8	86.5	2,380.0	14,569.9
		Other species				**All species combined**			
Seed&Sap	**0-10**	2.7	0.5	1.7	7.2	395.0	29.1	100.2	487.4
Poles	**12-20**	0.1	0.1	1.2	4.5	22.3	27.1	737.1	3,775.5
Sm. Saw	**22-30**	0.0	0.1	1.4	5.4	8.1	27.7	1,028.1	6,333.4
Lg. Saw	**32-99**	0.0	0.2	2.7	13.2	2.8	18.7	791.9	5,463.0
Total		2.8	0.9	7.0	30.3	428.2	102.6	2,657.3	16,059.2

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greater. See the stand table for a more accurate representation of these.

Table 5a

Remnant Ponderosa Pine/Bitterbrush

230,263 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.	79.2	0.2	2.4	0.0	0.0	0.0	18,230,843	0	0
2	87.9	2.1	11.5	2.2	0.0	0.0	20,236,664	0	0
4	77.3	3.8	18.2	6.1	0.0	0.0	17,790,350	0	0
6	38.5	5.9	27.3	7.4	0.1	0.4	8,860,520	18,421	92,105
8	25.6	7.9	37.4	8.7	1.2	6.2	5,886,674	283,223	1,427,631
10	18.7	9.9	47.8	10.0	168.7	813.4	4,299,240	38,854,579	187,295,924
SUB.	**327.0**	**3.4**	**16.8**	**34.4**	**170.1**	**820.0**	**75,304,290**	**39,158,526**	**188,815,660**
12	12.4	11.9	55.4	9.6	213.5	1,021.5	2,866,084	49,165,756	235,213,655
14	8.7	13.9	62.6	9.1	227.8	1,115.9	2,002,597	52,460,819	256,950,482
16	5.5	15.9	69.2	7.5	203.5	1,026.0	1,259,078	46,865,428	236,249,838
18	3.4	17.9	75.6	5.9	170.5	888.5	777,368	39,264,447	204,588,676
19	1.2	10.0	39.6	2.6	75.7	412.6	272,401	17,437,817	94,995,001
SUB.	**31.2**	**13.9**	**60.5**	**34.7**	**891.1**	**4,464.5**	**7,177,528**	**205,194,267**	**1,027,997,650**
21	1.2	10.0	39.6	2.6	75.7	412.6	272,401	17,437,817	94,995,001
22	1.6	21.9	85.0	4.1	133.5	764.3	361,052	30,742,413	175,990,011
24	1.3	23.9	89.5	4.1	140.8	838.7	304,638	32,409,517	193,121,578
26	0.9	25.9	95.2	3.2	114.5	704.8	198,717	26,374,324	162,289,362
28	0.6	27.9	99.2	2.5	93.6	595.2	134,243	21,541,104	137,052,538
30	0.5	30.0	104.2	2.7	104.0	674.3	124,803	23,945,049	155,266,341
SUB.	**6.1**	**23.2**	**85.5**	**19.1**	**662.1**	**3,989.9**	**1,395,854**	**152,450,224**	**918,714,831**
32	0.5	31.8	110.6	2.6	107.2	719.3	107,533	24,691,101	165,628,176
34	0.2	33.9	111.8	1.3	56.3	387.2	49,276	12,961,504	89,157,834
36	0.2	36.0	116.3	1.1	47.2	326.7	35,691	10,856,900	75,226,922
38	0.1	37.6	115.6	0.9	38.3	267.5	26,711	8,825,981	61,595,353
40	0.1	39.8	120.1	0.6	25.1	176.8	14,967	5,788,812	40,710,498
42	0.0	41.8	132.7	0.3	13.9	98.2	6,908	3,205,261	22,611,827
44	0.0	44.1	121.3	0.2	8.4	58.7	4,145	1,927,301	13,516,438
46	0.0	45.7	130.3	0.1	6.4	44.9	2,763	1,471,381	10,338,809
48	0.0	48.6	120.1	0.0	1.8	12.4	691	407,566	2,855,261
50	0.0	50.7	115.1	0.0	1.5	10.5	691	343,092	2,417,762
52	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
54	0.0	53.3	95.2	0.0	2.3	16.6	691	522,697	3,822,366
56	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
58	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
60	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
62	0.0	62.2	116.1	0.1	2.8	20.2	691	651,644	4,651,313
64	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**1.1**	**34.8**	**113.7**	**7.3**	**311.2**	**2,139.1**	**250,987**	**71,655,543**	**492,555,583**
Total	**365.4**	**4.7**	**22.3**	**95.5**	**2,034.5**	**11,413.5**	**84,128,429**	**468,460,863**	**2,628,106,751**

Table 5b

Remnant Ponderosa Pine/Bitterbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Incense-cedar**			
Seed&Sap	0-10	4.2	0.3	1.1	5.0	1.8	0.1	0.3	1.2
Poles	12-20	0.5	0.6	16.6	84.6	0.2	0.2	3.0	12.7
Sm. Saw	22-30	0.1	0.2	8.3	49.7	0.0	0.0	0.5	2.3
Lg. Saw	32-99	0.0	0.0	0.4	2.9	0.0	0.0	1.1	6.2
Total		4.7	1.2	26.4	142.3	2.0	0.4	4.8	22.3
		Lodgepole pine				**Sugar pine**			
Seed&Sap	0-10	78.7	7.9	52.7	254.4	2.6	0.2	0.4	2.0
Poles	12-20	4.8	5.0	145.8	749.5	0.1	0.1	2.9	13.9
Sm. Saw	22-30	0.2	0.4	14.2	83.8	0.1	0.2	6.4	36.8
Lg. Saw	32-99	0.0	0.0	1.0	6.7	0.0	0.2	10.0	69.1
Total		83.6	13.3	213.6	1,094.3	2.8	0.8	19.7	121.7
		Western white pine				**Ponderosa pine**			
Seed&Sap	0-10	0.1	0.0	0.0	0.0	230.0	24.8	113.4	546.3
Poles	12-20	0.0	0.0	0.0	0.0	26.2	30.5	784.7	3,953.8
Sm. Saw	22-30	0.0	0.0	0.0	0.0	4.4	15.1	549.4	3,367.9
Lg. Saw	32-99	0.0	0.0	0.0	0.0	1.1	6.9	298.7	2,054.8
Total		0.1	0.0	0.0	0.0	261.6	77.4	1,746.1	9,922.8
		Douglas-fir				**Other species**			
Seed&Sap	0-10	0.9	0.0	0.0	0.0	8.9	1.0	2.3	11.1
Poles	12-20	0.2	0.3	8.2	41.5	0.4	0.5	5.7	21.6
Sm. Saw	22-30	0.0	0.1	3.1	18.8	0.1	0.4	4.7	18.7
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.0	0.0	0.4	2.0
Total		1.1	0.4	11.4	60.3	9.4	1.9	13.1	53.3
		All species combined							
Seed&Sap	0-10	327.0	34.4	170.1	820.0				
Poles	12-20	32.4	37.3	967.0	4,877.5				
Sm. Saw	22-30	4.9	16.5	586.5	3,578.0				
Lg. Saw	32-99	1.1	7.3	311.6	2,141.6				
Total		365.4	95.5	2,035.0	11,417.1				

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Simplified Ponderosa Pine/Bitterbrush

70,309 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.	122.1	0.2	1.6	0.0	0.0	0.0	8,584,307	0	0
2	97.5	2.2	11.8	2.6	0.0	0.0	6,854,565	0	0
4	79.9	3.9	18.9	6.7	0.0	0.0	5,619,025	0	0
6	59.7	5.9	27.3	11.3	0.0	0.0	4,199,416	0	0
8	29.2	7.8	37.3	9.8	0.6	3.1	2,051,406	44,295	217,958
10	21.7	10.0	46.6	11.8	194.8	933.8	1,525,002	13,695,490	65,654,544
SUB.	**410.1**	**3.3**	**16.0**	**42.2**	**195.4**	**936.9**	**28,833,721**	**13,739,785**	**65,872,502**
12	16.0	11.9	54.1	12.3	275.0	1,320.4	1,122,694	19,337,787	92,836,004
14	8.5	13.8	60.5	8.9	219.4	1,067.7	600,509	15,423,685	75,068,919
16	3.7	15.9	67.1	5.1	136.8	689.3	262,534	9,616,865	48,463,994
18	1.7	17.7	71.1	2.9	79.2	406.4	117,275	5,568,473	28,573,578
19	0.3	9.9	37.4	0.6	17.8	97.6	20,460	1,253,609	6,858,643
SUB.	**30.2**	**13.8**	**58.0**	**29.9**	**728.2**	**3,581.4**	**2,123,472**	**51,200,420**	**251,801,137**
21	0.3	9.9	37.4	0.6	17.8	97.6	20,460	1,253,609	6,858,643
22	0.2	21.7	83.3	0.5	18.0	102.8	14,976	1,266,265	7,227,765
24	0.1	23.6	85.9	0.4	14.7	86.6	9,914	1,034,948	6,088,759
26	0.0	25.9	94.6	0.1	3.5	21.4	1,828	244,675	1,504,613
28	0.1	27.4	89.5	0.3	10.5	65.2	5,062	736,838	4,584,147
30	0.1	30.1	84.9	0.3	7.2	43.0	3,586	506,928	3,023,287
SUB.	**0.8**	**23.1**	**79.3**	**2.2**	**71.7**	**416.6**	**55,825**	**5,043,265**	**29,287,214**
32	0.0	32.7	103.0	0.1	2.5	17.1	703	176,476	1,202,284
34	0.1	33.8	105.1	0.4	14.1	95.1	3,937	987,841	6,686,386
36	0.0	36.3	87.0	0.2	4.9	33.3	1,617	345,217	2,341,290
38	0.0	37.0	112.1	0.1	2.8	19.4	562	195,459	1,363,995
40	0.0	39.3	126.6	0.1	3.8	27.1	703	266,471	1,905,374
42	0.0	42.2	121.1	0.2	4.6	32.6	1,406	326,234	2,292,073
44	0.0	43.9	124.1	0.1	4.7	33.5	703	330,452	2,355,352
46	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**0.1**	**36.6**	**107.6**	**1.0**	**37.4**	**258.1**	**9,632**	**2,628,854**	**18,146,753**
Total	**441.2**	**4.0**	**19.1**	**75.4**	**1,032.8**	**5,193.0**	**31,022,581**	**72,611,620**	**365,114,637**

Table 6b

Simplified Ponderosa Pine/Bitterbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Incense-cedar**			
Seed&Sap	**0-10**	3.5	0.2	1.5	7.3	1.9	0.3	1.7	7.8
Poles	**12-20**	0.1	0.1	2.3	11.5	0.2	0.2	3.6	15.8
Sm. Saw	**22-30**	0.0	0.0	0.0	0.0	0.0	0.1	2.9	16.0
Lg. Saw	**32-99**	0.0	0.0	0.0	0.0	0.0	0.1	1.4	7.6
Total		3.5	0.3	3.8	18.8	2.1	0.7	9.6	47.2
		Lodgepole pine				**Sugar pine**			
Seed&Sap	**0-10**	112.6	9.4	50.0	240.2	7.7	0.8	3.2	15.3
Poles	**12-20**	4.0	3.7	104.4	523.9	0.4	0.5	14.4	72.4
Sm. Saw	**22-30**	0.0	0.1	2.4	14.0	0.0	0.0	0.0	0.0
Lg. Saw	**32-99**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		116.6	13.2	156.8	778.1	8.1	1.3	17.5	87.8
		Ponderosa pine				**Other species**			
Seed&Sap	**0-10**	273.1	30.0	138.3	661.7	11.4	1.5	0.8	4.6
Poles	**12-20**	25.6	25.7	619.3	3,047.6	0.2	0.2	2.1	7.6
Sm. Saw	**22-30**	0.5	1.4	48.6	289.0	0.0	0.0	0.0	0.0
Lg. Saw	**32-99**	0.1	0.9	35.7	249.1	0.0	0.1	0.4	1.5
Total		299.2	58.0	841.7	4,247.4	11.7	1.8	3.3	13.7
		All species combined							
Seed&Sap	**0-10**	410.1	42.2	195.4	936.9				
Poles	**12-20**	30.5	30.5	746.1	3,678.9				
Sm. Saw	**22-30**	0.5	1.6	53.9	319.0				
Lg. Saw	**32-99**	0.1	1.0	37.4	258.1				
Total		441.2	75.4	1,032.8	5,193.0				

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Table 7a

Mixed Conifer/Snowbrush

91,402 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic	Total Bd.Ft.
<1.	108.5	0.2	2.8	0.1	0.0	0.0	9,915,015	0	0
2	118.0	2.0	11.6	2.8	0.0	0.0	10,782,877	0	0
4	77.9	3.8	19.6	6.2	0.0	0.0	7,120,856	0	0
6	40.7	5.9	31.4	7.9	0.1	0.3	3,723,078	4,570	27,421
8	29.2	7.9	41.7	9.9	0.4	1.8	2,664,460	31,991	164,524
10	20.9	9.9	52.7	11.3	202.8	984.4	1,914,323	18,532,670	89,976,129
SUB.	**395.2**	**3.1**	**17.2**	**38.2**	**203.2**	**986.5**	**36,120,699**	**18,570,144**	**90,168,073**
12	14.3	11.9	61.3	11.0	256.2	1,220.3	1,304,489	23,419,020	111,537,861
14	10.1	13.9	67.4	10.7	272.1	1,345.5	924,440	24,868,656	122,981,391
16	6.0	15.9	75.0	8.2	227.7	1,151.8	545,944	20,814,063	105,276,824
18	4.1	18.0	81.1	7.2	211.3	1,103.9	371,732	19,315,985	100,898,668
19	1.5	9.9	43.6	3.2	98.7	541.9	134,498	9,020,920	49,526,174
SUB.	**35.9**	**13.9**	**65.7**	**40.3**	**1,066.0**	**5,363.4**	**3,281,103**	**97,438,645**	**490,220,917**
21	1.5	9.9	43.6	3.2	98.7	541.9	134,498	9,020,920	49,526,174
22	2.2	21.9	91.2	5.7	191.1	1,099.3	200,170	17,470,578	100,478,219
24	1.7	23.9	95.2	5.5	185.8	1,102.5	159,862	16,978,836	100,770,705
26	1.3	25.9	98.2	4.7	162.2	996.4	117,086	14,829,060	91,072,953
28	0.9	27.9	104.2	3.7	130.9	829.5	80,160	11,963,608	75,817,959
30	0.8	30.0	110.3	3.8	143.2	927.0	70,288	13,086,938	84,729,654
SUB.	**8.3**	**23.3**	**90.4**	**26.5**	**911.9**	**5,496.6**	**762,064**	**83,349,941**	**502,395,663**
32	0.6	31.7	108.4	3.5	128.3	843.2	57,492	11,723,221	77,070,166
34	0.3	34.0	113.6	1.9	73.8	501.9	27,603	6,742,726	45,874,664
36	0.4	35.8	116.5	2.5	96.5	667.0	32,265	8,821,207	60,965,134
38	0.4	37.9	117.9	2.8	118.7	835.0	32,813	10,853,073	76,320,670
40	0.2	40.0	125.1	1.5	68.4	484.4	15,813	6,254,639	44,275,129
42	0.1	41.6	128.2	0.7	30.1	212.4	6,581	2,753,028	19,413,785
44	0.1	43.9	111.8	0.5	18.8	129.9	4,570	1,719,272	11,873,120
46	0.0	45.7	130.0	0.3	14.0	97.7	2,742	1,277,800	8,929,975
48	0.0	47.8	131.4	0.2	8.2	59.4	1,371	748,582	5,429,279
50	0.0	50.3	129.5	0.3	14.5	103.4	2,102	1,324,415	9,450,967
52	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
54	0.0	54.5	144.1	0.1	6.2	44.9	731	563,036	4,103,950
56	0.0	55.7	147.9	0.3	12.9	94.8	1,371	1,178,172	8,664,910
58	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
60	0.0	59.6	153.1	0.1	5.5	40.2	548	503,625	3,674,360
62	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**2.0**	**36.1**	**115.8**	**14.7**	**595.9**	**4,114.3**	**185,912**	**54,461,882**	**376,055,249**
Total	**441.5**	**4.6**	**23.3**	**119.7**	**2,777.0**	**15,960.8**	**40,349,961**	**253,820,612**	**1,458,849,042**

Table 7b

Mixed Conifer/Snowbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir			
Seed&Sap	0-10	187.6	19.1	109.0	533.6
Poles	12-20	19.0	22.5	612.0	3,117.1
Sm. Saw	22-30	3.4	11.1	375.7	2,278.6
Lg. Saw	32-99	0.6	3.8	145.3	1,000.7
Total		210.5	56.6	1,242.1	6,930.0
		Incense-cedar			
Seed&Sap	0-10	11.0	0.6	2.1	9.2
Poles	12-20	0.2	0.2	3.8	16.1
Sm. Saw	22-30	0.2	0.5	9.9	50.6
Lg. Saw	32-99	0.1	0.6	14.7	88.8
Total		11.4	1.9	30.3	164.8
		Sugar pine			
Seed&Sap	0-10	38.7	2.8	14.6	71.4
Poles	12-20	3.4	3.7	92.9	459.4
Sm. Saw	22-30	0.6	2.1	69.8	418.6
Lg. Saw	32-99	0.3	2.4	99.0	679.4
Total		42.9	11.0	276.3	1,628.7
		Ponderosa pine			
Seed&Sap	0-10	103.6	10.9	48.7	234.2
Poles	12-20	8.9	10.5	273.9	1,389.1
Sm. Saw	22-30	2.2	7.7	288.2	1,787.8
Lg. Saw	32-99	0.9	6.1	267.8	1,872.1
Total		115.6	35.2	878.5	5,283.3
		Mountain hemlock			
Seed&Sap	0-10	0.0	0.0	0.0	0.0
Poles	12-20	0.0	0.0	0.4	1.8
Sm. Saw	22-30	0.0	0.0	0.0	0.0
Lg. Saw	32-99	0.0	0.0	0.0	0.0
Total		0.0	0.0	0.4	1.8
		All species combined			
Seed&Sap	0-10	395.2	38.2	203.2	986.5
Poles	12-20	37.4	43.4	1,164.7	5,905.3
Sm. Saw	22-30	6.9	23.4	813.2	4,954.8
Lg. Saw	32-99	2.0	14.7	595.9	4,114.3
Total		441.5	119.7	2,777.0	15,960.8

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		Red fir			
Seed&Sap	0-10	0.4	0.0	0.0	0.0
Poles	12-20	0.0	0.0	0.0	0.0
Sm. Saw	22-30	0.0	0.0	0.0	0.0
Lg. Saw	32-99	0.0	0.0	0.0	0.0
Total		0.4	0.0	0.0	0.0
		Lodgepole pine			
Seed&Sap	0-10	33.5	2.8	16.1	77.0
Poles	12-20	2.0	1.9	52.6	266.3
Sm. Saw	22-30	0.0	0.1	2.5	15.4
Lg. Saw	32-99	0.0	0.0	0.0	0.0
Total		35.5	4.8	71.2	358.7
		Western white pine			
Seed&Sap	0-10	3.9	0.2	1.0	4.9
Poles	12-20	0.1	0.1	4.4	22.5
Sm. Saw	22-30	0.1	0.3	11.3	68.4
Lg. Saw	32-99	0.0	0.1	4.2	28.5
Total		4.2	0.7	21.0	124.3
		Douglas-fir			
Seed&Sap	0-10	15.1	1.8	11.3	54.8
Poles	12-20	3.6	4.3	122.9	625.6
Sm. Saw	22-30	0.5	1.6	54.9	331.2
Lg. Saw	32-99	0.2	1.6	64.8	444.7
Total		19.3	9.3	254.0	1,456.3
		Other species			
Seed&Sap	0-10	1.5	0.1	0.3	1.3
Poles	12-20	0.2	0.2	1.9	7.3
Sm. Saw	22-30	0.0	0.1	0.9	4.2
Lg. Saw	32-99	0.0	0.0	0.0	0.0
Total		1.7	0.3	3.1	12.9

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Complex Mixed Conifer/Snowbrush

21,093 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.	259.4	0.1	1.9	0.1	0.0	0.0	5,470,828	0	0
2	171.2	2.0	11.2	3.9	0.0	0.0	3,610,784	0	0
4	120.4	3.8	20.1	9.8	0.0	0.0	2,539,956	0	0
6	59.0	5.9	31.6	11.4	0.0	0.0	1,244,044	0	0
8	37.9	7.9	44.0	12.9	0.4	2.0	799,277	8,226	42,186
10	22.3	9.8	55.0	11.8	213.3	1,049.9	469,383	4,499,770	22,145,541
SUB.	**670.1**	**2.5**	**14.3**	**49.9**	**213.7**	**1,051.9**	**14,134,272**	**4,507,996**	**22,187,727**
12	9.6	11.9	67.0	7.5	183.6	879.1	203,294	3,872,464	18,542,856
14	7.1	14.1	72.9	7.7	206.9	1,033.4	149,402	4,363,720	21,797,506
16	5.9	15.9	81.9	8.2	243.6	1,251.1	124,849	5,139,099	26,389,452
18	5.4	18.0	86.8	9.5	294.8	1,552.1	113,333	6,217,795	32,738,445
19	2.0	10.0	46.5	4.4	143.9	798.8	43,146	3,034,544	16,849,088
SUB.	**30.1**	**14.0**	**71.0**	**37.3**	**1,072.8**	**5,514.5**	**634,024**	**22,627,621**	**116,317,349**
21	2.0	10.0	46.5	4.4	143.9	798.8	43,146	3,034,544	16,849,088
22	2.5	22.0	95.7	6.6	225.8	1,305.1	52,500	4,762,167	27,528,474
24	2.0	23.8	102.9	6.1	213.1	1,270.7	41,532	4,494,707	26,802,875
26	1.2	25.7	104.3	4.4	139.7	861.1	25,755	2,945,848	18,163,182
28	2.0	27.9	108.5	8.3	293.4	1,863.5	41,216	6,189,319	39,306,806
30	1.6	29.9	114.5	8.0	311.2	2,012.3	34,297	6,564,774	42,445,444
SUB.	**11.3**	**23.2**	**95.4**	**37.7**	**1,327.0**	**8,111.5**	**238,446**	**27,991,360**	**171,095,870**
32	0.9	31.8	115.4	5.0	196.5	1,302.9	19,258	4,144,775	27,482,070
34	0.6	34.1	118.4	3.9	153.5	1,045.1	12,972	3,237,565	22,044,294
36	0.6	35.7	118.1	4.4	175.0	1,203.1	13,225	3,690,853	25,376,988
38	0.7	37.8	117.8	5.6	236.8	1,661.5	15,145	4,995,244	35,046,020
40	0.3	39.7	121.2	2.5	109.7	768.8	6,117	2,313,058	16,216,298
42	0.1	41.8	130.0	0.9	40.1	282.4	1,919	846,673	5,956,663
44	0.1	43.3	123.7	0.6	26.9	186.6	1,308	567,191	3,935,954
46	0.1	45.3	139.3	0.7	31.2	222.7	1,266	658,945	4,697,411
48	0.1	47.7	131.3	0.8	35.9	258.0	1,392	757,661	5,441,994
50	0.0	49.2	130.1	0.4	18.9	135.4	696	399,080	2,855,992
52	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
54	0.0	54.4	144.1	0.5	26.7	194.7	717	562,128	4,106,807
56	0.0	55.3	157.1	0.5	24.8	181.1	675	522,685	3,819,942
58	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
60	0.0	59.6	153.1	0.5	25.6	185.9	591	538,926	3,921,189
62	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**3.6**	**36.5**	**119.6**	**26.4**	**1,101.5**	**7,628.3**	**75,260**	**23,234,572**	**160,903,732**
Total	**715.0**	**3.6**	**18.9**	**151.3**	**3,715.1**	**22,306.2**	**15,081,980**	**78,361,550**	**470,504,677**

Complex Mixed Conifer/Snowbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Incense-cedar**			
Seed&Sap	0-10	268.3	26.5	125.0	619.1	16.1	1.0	3.9	17.5
Poles	12-20	18.3	24.7	723.0	3,765.9	0.0	0.0	0.0	0.0
Sm. Saw	22-30	4.8	16.5	546.1	3,334.9	0.0	0.0	0.0	0.0
Lg. Saw	32-99	1.0	6.9	283.2	1,961.3	0.1	0.7	16.1	94.8
Total		292.4	74.6	1,677.3	9,681.3	16.2	1.7	20.0	112.3
		Lodgepole pine				**Sugar pine**			
Seed&Sap	0-10	13.4	1.2	6.0	29.3	131.4	5.1	12.5	62.8
Poles	12-20	0.9	1.0	31.8	165.2	2.4	3.0	83.5	427.0
Sm. Saw	22-30	0.0	0.0	0.0	0.0	1.0	4.1	144.8	899.5
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.8	6.0	245.8	1,699.7
Total		14.3	2.2	37.8	194.5	135.5	18.1	486.6	3,089.0
		Ponderosa pine				**Douglas-fir**			
Seed&Sap	0-10	190.9	11.5	42.9	209.7	48.8	4.6	23.4	113.5
Poles	12-20	5.4	7.1	206.5	1,077.8	4.9	5.6	168.7	864.6
Sm. Saw	22-30	2.4	8.6	346.1	2,183.4	1.1	4.1	146.2	894.9
Lg. Saw	32-99	1.2	8.4	371.0	2,589.6	0.5	4.4	185.4	1,282.8
Total		199.9	35.7	966.4	6,060.5	55.3	18.7	523.8	3,155.7
		Other species				**All species combined**			
Seed&Sap	0-10	1.2	0.0	0.0	0.0	670.1	49.9	213.7	1,051.9
Poles	12-20	0.3	0.2	3.1	12.8	32.1	41.7	1,216.6	6,313.3
Sm. Saw	22-30	0.0	0.0	0.0	0.0	9.3	33.3	1,183.2	7,312.7
Lg. Saw	32-99	0.0	0.0	0.0	0.0	3.6	26.4	1,101.5	7,628.3
Total		1.5	0.2	3.1	12.8	715.0	151.3	3,715.1	22,306.2

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greater. See the stand table for a more accurate representation of these.

Table 9a

Remnant Mixed Conifer/Snowbrush

63,278 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.	115.0	0.3	2.8	0.1	0.0	0.0	7,275,451	0	0
2	110.2	2.0	11.7	2.6	0.0	0.0	6,973,425	0	0
4	70.6	3.8	19.4	5.5	0.0	0.0	4,469,009	0	0
6	36.9	5.9	31.7	7.1	0.0	0.0	2,332,301	0	0
8	25.8	7.9	41.8	8.8	0.4	2.1	1,631,876	25,944	132,884
10	22.2	10.0	52.1	12.0	215.3	1,041.7	1,402,304	13,620,590	65,916,693
SUB.	**380.6**	**3.0**	**16.8**	**36.2**	**215.7**	**1,043.7**	**24,084,366**	**13,646,533**	**66,043,249**
12	16.9	11.9	60.8	13.0	301.6	1,438.3	1,067,183	19,084,012	91,012,747
14	12.1	13.9	66.2	12.8	321.6	1,587.1	768,638	20,350,838	100,428,514
16	6.5	15.8	72.9	8.9	241.2	1,213.1	411,307	15,261,388	76,762,542
18	3.9	18.0	78.6	6.9	197.6	1,028.5	247,797	12,506,264	65,081,423
19	1.4	9.9	42.3	3.0	91.6	500.8	87,798	5,798,796	31,689,622
SUB.	**40.8**	**13.9**	**64.2**	**44.6**	**1,153.7**	**5,767.8**	**2,582,723**	**73,001,297**	**364,974,848**
21	1.4	9.9	42.3	3.0	91.6	500.8	87,798	5,798,796	31,689,622
22	2.4	21.8	89.7	6.2	207.7	1,193.3	151,867	13,144,106	75,509,637
24	1.8	24.0	92.5	5.7	190.4	1,128.2	114,407	12,046,866	71,390,240
26	1.4	26.0	96.3	5.3	184.5	1,131.4	90,361	11,677,322	71,592,729
28	0.7	27.9	100.1	2.9	99.8	631.5	42,586	6,313,246	39,960,057
30	0.6	30.0	106.4	2.7	100.1	649.3	35,246	6,334,761	41,086,405
SUB.	**8.3**	**23.3**	**87.9**	**25.7**	**874.2**	**5,234.5**	**522,265**	**55,315,096**	**331,228,691**
							0	0	0
32	0.6	31.7	104.5	3.3	118.6	775.3	38,220	7,505,404	49,059,433
34	0.3	34.1	110.6	1.6	61.7	420.7	16,136	3,906,151	26,621,055
36	0.3	35.9	115.7	1.9	73.2	508.0	16,769	4,630,051	32,145,224
38	0.3	38.0	118.3	2.1	90.0	634.3	17,085	5,695,653	40,137,235
40	0.1	40.2	127.6	1.3	59.9	426.3	9,302	3,788,454	26,975,411
42	0.1	41.5	127.3	0.7	30.9	218.1	4,746	1,955,923	13,800,932
44	0.1	44.1	108.0	0.6	19.4	132.8	3,417	1,225,695	8,403,318
46	0.0	45.9	122.3	0.3	10.1	68.9	1,455	638,475	4,359,854
48	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
50	0.0	50.8	129.2	0.3	14.6	104.2	1,392	925,124	6,593,568
52	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
54	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
56	0.0	56.0	139.1	0.2	10.1	74.8	696	641,006	4,733,194
58	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**1.7**	**35.8**	**113.1**	**12.3**	**488.5**	**3,363.5**	**109,344**	**30,911,303**	**212,835,553**
Total	**431.4**	**4.6**	**23.4**	**118.8**	**2,732.0**	**15,409.5**	**27,298,762**	**172,874,230**	**975,082,341**

Table 9b

Remnant Mixed Conifer/Snowbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Red fir**			
Seed&Sap	0-10	184.5	18.5	111.6	544.9	0.5	0.0	0.0	0.0
Poles	12-20	20.5	23.2	616.6	3,113.9	0.0	0.0	0.0	0.0
Sm. Saw	22-30	3.3	10.6	362.9	2,193.8	0.0	0.0	0.0	0.0
Lg. Saw	32-99	0.5	3.1	111.2	762.9	0.0	0.0	0.0	0.0
Total		208.7	55.4	1,202.4	6,615.5	0.5	0.0	0.0	0.0
		Incense-cedar				**Lodgepole pine**			
Seed&Sap	0-10	11.8	0.5	1.5	6.9	44.7	3.6	21.4	102.1
Poles	12-20	0.3	0.3	5.4	23.3	2.6	2.4	65.2	328.7
Sm. Saw	22-30	0.2	0.7	14.3	73.1	0.0	0.1	3.6	22.2
Lg. Saw	32-99	0.1	0.6	15.8	96.5	0.0	0.0	0.0	0.0
Total		12.4	2.1	37.0	199.8	47.4	6.1	90.2	452.9
		Sugar pine				**Western white pine**			
Seed&Sap	0-10	26.0	2.3	16.5	80.2	7.7	0.3	1.5	7.0
Poles	12-20	4.1	4.4	106.3	521.2	0.2	0.2	6.4	32.4
Sm. Saw	22-30	0.5	1.7	52.7	307.1	0.1	0.4	16.4	98.9
Lg. Saw	32-99	0.2	1.5	59.5	403.4	0.0	0.1	6.2	41.3
Total		30.8	9.8	235.0	1,311.9	8.0	1.0	30.4	179.6
		Ponderosa pine				**Douglas-fir**			
Seed&Sap	0-10	93.3	10.0	54.5	261.6	10.2	1.0	8.1	39.1
Poles	12-20	10.9	12.6	323.2	1,630.9	3.6	4.2	120.0	609.3
Sm. Saw	22-30	2.4	8.2	300.9	1,853.6	0.3	0.9	30.3	178.8
Lg. Saw	32-99	0.8	6.1	263.3	1,840.7	0.1	0.9	32.5	218.7
Total		107.4	36.9	942.0	5,586.8	14.2	7.1	191.0	1,046.0
		Mountain hemlock				**Other species**			
Seed&Sap	0-10	0.0	0.0	0.0	0.0	1.8	0.1	0.5	1.9
Poles	12-20	0.0	0.0	0.6	2.6	0.1	0.1	1.6	6.2
Sm. Saw	22-30	0.0	0.0	0.0	0.0	0.0	0.1	1.4	6.1
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		0.0	0.0	0.6	2.6	2.0	0.3	3.5	14.2
		All species combined							
Seed&Sap	0-10	380.6	36.2	215.7	1,043.7				
Poles	12-20	42.2	47.6	1,245.3	6,268.6				
Sm. Saw	22-30	6.9	22.8	782.5	4,733.6				
Lg. Saw	32-99	1.7	12.3	488.5	3,363.5				
Total		431.4	118.8	2,732.0	15,409.5				

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Table 10a

Moist Mixed Conifer

38,670 Acres

Diameter Class		Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.		101.6	0.3	3.2	0.1	0.0	0.0	3,928,717	0	0
	2	84.5	1.9	10.6	1.9	0.0	0.0	3,266,996	0	0
	4	92.7	3.8	18.7	7.4	0.0	0.0	3,584,245	0	0
	6	39.6	5.9	29.9	7.5	0.0	0.0	1,530,868	0	0
	8	27.1	7.9	40.4	9.2	0.1	0.2	1,048,885	1,934	7,734
	10	20.3	9.9	51.1	10.9	171.8	836.6	785,156	6,644,279	32,351,322
SUB.		**365.8**	**3.3**	**17.1**	**37.1**	**171.9**	**836.8**	**14,144,867**	**6,646,213**	**32,359,056**
	12	13.5	11.9	59.1	10.4	238.3	1,141.9	523,940	9,215,834	44,157,273
	14	11.1	13.8	66.1	11.6	293.4	1,443.2	428,657	11,346,165	55,808,544
	16	6.9	15.8	75.0	9.4	265.8	1,346.7	265,740	10,279,259	52,076,889
	18	4.3	17.9	79.4	7.4	220.6	1,144.7	165,044	8,530,989	44,265,549
	19	1.8	9.9	43.4	3.8	123.1	683.5	68,021	4,761,630	26,430,945
SUB.		**37.5**	**13.9**	**64.6**	**42.6**	**1,141.3**	**5,760.0**	**1,451,401**	**44,133,878**	**222,739,200**
	21	1.8	9.9	43.4	3.8	123.1	683.5	68,021	4,761,630	26,430,945
	22	2.4	22.0	92.3	6.2	220.0	1,283.2	90,952	8,508,947	49,621,344
	24	2.0	23.9	95.7	6.3	230.3	1,389.5	78,229	8,905,701	53,731,965
	26	1.8	25.9	104.0	6.7	252.3	1,573.9	70,418	9,757,601	60,862,713
	28	1.0	28.0	105.0	4.3	172.4	1,100.1	38,979	6,667,868	42,540,867
	30	0.8	29.8	114.9	3.7	146.4	960.9	29,428	5,660,901	37,158,003
SUB.		**9.7**	**23.2**	**92.6**	**30.9**	**1,144.6**	**6,991.1**	**376,027**	**44,262,649**	**270,345,837**
	32	0.9	32.0	114.6	4.9	204.0	1,383.3	33,875	7,889,453	53,492,211
	34	0.3	33.6	112.9	2.0	88.0	610.3	12,297	3,402,187	23,600,301
	36	0.2	35.7	111.1	1.6	68.4	469.0	9,087	2,643,481	18,136,230
	38	0.1	38.0	124.4	1.2	47.4	333.9	5,646	1,834,505	12,911,913
	40	0.1	39.4	108.5	0.5	17.1	116.0	2,436	662,030	4,485,720
	42	0.1	41.8	130.9	0.6	28.4	199.5	2,398	1,098,228	7,714,665
	44	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
	46	0.0	45.4	132.1	0.2	10.7	76.7	812	412,609	2,965,989
	48	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.		**1.7**	**34.1**	**115.2**	**11.0**	**464.0**	**3,188.7**	**66,551**	**17,942,107**	**123,307,029**
Total		**414.8**	**4.9**	**24.0**	**121.6**	**2,921.7**	**16,776.7**	**16,038,808**	**112,983,686**	**648,754,989**

Moist Mixed Conifer

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Incense-cedar**			
Seed&Sap	0-10	164.6	18.8	99.7	488.4	18.3	2.2	7.9	36.0
Poles	12-20	22.7	27.9	764.7	3,889.2	2.3	2.1	34.4	147.1
Sm. Saw	22-30	4.5	15.5	582.2	3,590.4	0.2	0.8	17.7	94.8
Lg. Saw	32-99	0.6	3.5	138.5	938.1	0.1	0.5	12.0	71.8
Total		192.4	65.8	1,585.1	8,906.1	21.0	5.6	71.9	349.6
		Lodgepole pine				**Sugar pine**			
Seed&Sap	0-10	8.9	0.4	5.3	25.1	29.7	1.7	5.7	28.5
Poles	12-20	1.5	1.4	44.8	228.2	0.9	1.1	29.5	154.3
Sm. Saw	22-30	0.0	0.0	0.0	0.0	0.2	0.7	24.4	146.3
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.1	0.6	25.6	179.8
Total		10.4	1.7	50.1	253.3	30.9	4.0	85.2	509.0
		Ponderosa pine				**Douglas-fir**			
Seed&Sap	0-10	138.3	13.6	50.3	243.9	4.7	0.2	2.9	14.2
Poles	12-20	11.2	13.0	365.7	1,893.8	0.5	0.8	24.0	125.0
Sm. Saw	22-30	2.9	9.7	383.4	2,394.6	0.1	0.4	13.8	81.5
Lg. Saw	32-99	1.0	6.4	287.9	1,999.0	0.0	0.0	0.0	0.0
Total		153.4	42.8	1,087.3	6,531.2	5.3	1.4	40.6	220.7
		Other species				**All species combined**			
Seed&Sap	0-10	1.3	0.1	0.2	0.6	365.8	37.1	171.9	836.8
Poles	12-20	0.2	0.1	1.4	6.1	39.3	46.4	1,264.4	6,443.6
Sm. Saw	22-30	0.0	0.0	0.0	0.0	8.0	27.1	1,021.5	6,307.6
Lg. Saw	32-99	0.0	0.0	0.0	0.0	1.7	11.0	464.0	3,188.7
Total		1.4	0.2	1.5	6.7	414.8	121.6	2,921.7	16,776.7

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greater. See the stand table for a more accurate representation of these.

Complex Moist Mixed Conifer

7,031 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic Ft.	Total Bd.Ft.
<1.	107.0	0.1	2.2	0.0	0.0	0.0	752,169	0	0
2.0	86.7	2.1	11.3	2.2	0.0	0.0	609,897	0	0
4.0	62.7	3.9	19.9	5.3	0.0	0.0	440,823	0	0
6.0	44.7	5.9	31.0	8.4	0.0	0.0	314,251	0	0
8.0	30.3	7.9	41.6	10.3	1.0	5.0	212,976	7,312	35,155
10.0	22.1	9.9	52.0	11.8	170.4	826.8	155,280	1,198,364	5,813,231
SUB.	**353.5**	**3.3**	**17.7**	**38.1**	**171.5**	**831.8**	**2,485,395**	**1,205,676**	**5,848,386**
12.0	10.4	11.6	67.9	7.6	191.8	933.0	72,771	1,348,616	6,559,923
14.0	7.5	14.0	71.3	8.1	218.9	1,083.1	53,070	1,538,945	7,615,276
16.0	8.6	15.9	77.6	12.0	342.2	1,741.2	60,593	2,405,727	12,242,377
18.0	5.2	17.9	84.5	9.1	283.5	1,486.6	36,603	1,993,148	10,452,285
19.0	3.0	10.0	46.3	6.6	221.0	1,238.1	21,156.3	1,554,026.8	8,704,729.6
SUB.	**34.7**	**13.9**	**69.5**	**43.4**	**1,257.4**	**6,482.0**	**244,193.7**	**8,840,463.0**	**45,574,590.5**
21.0	3.0	10.0	46.3	6.6	221.0	1,238.1	21,156.3	1,554,026.8	8,704,729.6
22.0	4.8	21.9	97.5	12.5	468.9	2,746.7	33,678	3,296,555	19,312,048
24.0	3.4	23.6	101.5	10.4	398.1	2,404.2	24,137	2,798,900	16,903,930
26.0	4.3	25.9	108.0	15.7	600.4	3,758.2	30,254	4,221,131	26,423,904
28.0	3.3	28.1	113.1	14.1	604.5	3,907.7	22,984	4,250,380	27,475,039
30.0	3.1	29.9	116.8	15.3	626.2	4,138.4	22,070	4,402,883	29,097,090
SUB.	**21.9**	**23.2**	**97.2**	**74.6**	**2,919.1**	**18,193.3**	**154,281.2**	**20,523,875.7**	**127,916,740.8**
32.0	2.7	32.0	116.9	14.8	650.6	4,420.6	18,731	4,574,087	31,081,239
34.0	0.4	33.8	110.1	2.4	108.7	753.8	2,700	764,270	5,299,968
36.0	0.7	35.9	110.7	4.8	212.7	1,482.5	4,774	1,495,423	10,423,458
38.0	0.3	37.9	127.7	2.7	99.0	698.9	2,447	696,210	4,913,966
40.0	0.1	39.1	109.1	0.8	19.4	135.2	710	136,472	950,591
42.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**4.2**	**33.4**	**116.0**	**25.6**	**1,090.4**	**7,491.0**	**29,361**	**7,666,462**	**52,669,221**
TOTA	**414.3**	**5.7**	**28.2**	**181.6**	**5,438.3**	**32,997.9**	**2,913,232**	**38,236,476**	**232,008,235**

Table 11b

Complex Moist Mixed Conifer

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Lodgepole pine**			
Seed&Sap	0-10	282.9	31.8	143.8	698.4	7.9	0.6	11.5	54.4
Poles	12-20	30.2	40.4	1,164.9	6,047.5	3.5	2.7	89.7	445.0
Sm. Saw	22-30	13.3	48.2	1,890.0	11,823.8	0.0	0.0	0.0	0.0
Lg. Saw	32-99	2.0	12.5	500.9	3,407.8	0.0	0.0	0.0	0.0
Total		328.4	132.9	3,699.6	21,977.4	11.5	3.4	101.2	499.4
		Sugar pine				**Ponderosa pine**			
Seed&Sap	0-10	0.0	0.0	0.0	0.0	62.6	5.6	16.2	79.0
Poles	12-20	0.0	0.0	0.0	0.0	4.0	6.8	223.8	1,227.5
Sm. Saw	22-30	0.3	0.7	26.3	154.8	5.4	19.1	781.8	4,976.4
Lg. Saw	32-99	0.0	0.0	0.0	0.0	2.2	13.1	589.5	4,083.2
Total		0.3	0.7	26.3	154.8	74.2	44.7	1,611.3	10,366.2
		All species combined							
Seed&Sap	0-10								
Poles	12-20	353.5	38.1	171.5	831.8				
Sm. Saw	22-30	37.7	49.9	1,478.4	7,720.0				
Lg. Saw	32-99	18.9	68.1	2,698.0	16,955.1				
Total		4.2	25.6	1,090.4	7,491.0				
TOTAL		414.3	181.6	5,438.3	32,997.9				

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greate See the stand table for a more accurate representation of these.

Remnant Moist Mixed Conifer

29,881 Acres

Diameter Class	**Trees /acre**	**Avg dbh**	**Avg Height**	**Basal Area /acre**	**Cubic ft /acre**	**Board ft. /acre**	**Total Trees**	**Total Cubic Ft.**	**Total Bd.Ft.**
<1.	205.9	0.3	2.3	0.2	0.0	0.0	6,152,080	0	0
2	87.9	1.9	10.5	1.9	0.0	0.0	2,626,510	0	0
4	107.3	3.8	18.5	8.5	0.0	0.0	3,206,261	0	0
6	40.2	5.9	29.4	7.6	0.0	0.0	1,202,411	0	0
8	28.1	7.9	40.3	9.6	0.0	0.0	838,580	0	0
10	20.2	9.9	51.1	10.8	177.2	863.2	604,851	5,293,718	25,793,279
SUB.	**489.6**	**2.6**	**13.8**	**38.6**	**177.2**	**863.2**	**14,630,664**	**5,293,718**	**25,793,279**
12	13.4	11.9	58.8	10.3	239.1	1,149.9	400,316	7,143,949	34,360,162
14	11.6	13.8	66.1	12.0	306.5	1,510.7	345,275	9,157,929	45,141,227
16	6.5	15.8	74.7	8.9	250.7	1,269.1	193,569	7,489,971	37,921,977
18	4.1	17.8	78.1	7.1	207.8	1,075.3	121,914	6,210,168	32,131,039
19	1.5	9.9	42.1	3.3	104.9	580.0	45,524	3,134,816	17,329,486
SUB.	**37.0**	**13.9**	**64.0**	**41.6**	**1,109.0**	**5,585.0**	**1,106,598**	**33,136,834**	**166,883,891**
21	1.5	9.9	42.1	3.3	104.9	580.0	45,524	3,134,816	17,329,486
22	1.7	22.1	87.9	4.6	156.9	913.0	51,844	4,688,329	27,281,353
24	1.8	24.1	92.6	5.5	197.6	1,191.8	52,292	5,903,589	35,612,176
26	1.2	25.9	99.1	4.4	165.1	1,023.2	36,276	4,932,158	30,574,239
28	0.5	27.8	93.6	2.2	78.7	491.7	15,478	2,351,934	14,692,488
30	0.1	29.2	90.1	0.4	8.1	45.8	2,420	242,036	1,368,550
SUB.	**6.8**	**23.2**	**84.2**	**20.4**	**711.3**	**4,245.5**	**203,833**	**21,252,861**	**126,858,291**
32	0.4	32.0	110.7	2.4	92.3	623.5	12,938	2,759,212	18,630,804
34	0.3	33.5	113.9	2.0	88.1	611.2	9,592	2,632,516	18,263,267
36	0.1	35.5	112.0	0.9	36.3	242.8	4,094	1,084,680	7,255,107
38	0.1	38.0	122.3	0.7	30.5	214.1	2,510	910,474	6,397,522
40	0.1	39.6	108.1	0.5	17.7	118.8	1,703	528,595	3,549,863
42	0.1	41.8	130.9	0.8	38.4	269.9	2,510	1,147,729	8,064,882
44	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
46	0.0	45.4	132.1	0.3	14.5	103.8	837	431,780	3,101,648
48	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0
SUB.	**1.1**	**34.7**	**114.5**	**7.6**	**317.8**	**2,184.1**	**34,214**	**9,494,688**	**65,263,092**
Total	**534.6**	**3.8**	**18.6**	**108.1**	**2,315.1**	**12,877.6**	**15,975,279**	**69,178,400**	**384,795,566**

Table 12b

Remnant Moist Mixed Conifer

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Incense-cedar**			
Seed&Sap	0-10	193.8	16.3	92.6	453.5	29.6	2.7	9.1	41.4
Poles	12-20	20.0	24.0	654.9	3311.9	2.5	2.2	36.7	158.1
Sm. Saw	22-30	2.2	7.0	241.9	1447.8	0.3	1.1	24.0	128.6
Lg. Saw	32-99	0.2	1.3	46.6	310.2	0.1	0.6	16.2	97.4
Total		216.2	48.6	1036.0	5523.5	32.5	6.7	86.0	425.5
		Lodgepole pine				**Sugar pine**			
Seed&Sap	0-10	6.6	0.3	3.9	18.6	43.8	2.4	7.7	38.7
Poles	12-20	1.0	1.0	33.9	176.2	1.2	1.4	40.1	209.5
Sm. Saw	22-30	0.0	0.0	0.0	0.0	0.2	0.7	25.3	152.1
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.1	0.8	34.8	244.0
Total		7.6	1.4	37.8	194.8	45.3	5.3	107.8	644.3
		Western white pine				**Ponderosa Pine**			
Seed&Sap	0-10	1.0	0.0	0.0	0.0	210.3	16.6	60.0	291.6
Poles	12-20	0.0	0.0	0.0	0.0	13.2	15.0	416.1	2141.4
Sm. Saw	22-30	0.0	0.0	0.0	0.0	2.4	7.7	296.6	1827.0
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.7	4.9	220.8	1536.6
Total		1.0	0.0	0.0	0.0	226.7	44.3	993.4	5796.6
TOTAL									
		Douglas-fir				**Mountain hemlock**			
Seed&Sap	0-10	3.6	0.3	3.9	19.3	1.0	0.0	0.0	0.0
Poles	12-20	0.7	1.1	32.5	169.7	0.0	0.0	0.0	0.0
Sm. Saw	22-30	0.2	0.5	18.7	110.6	0.0	0.0	0.0	0.0
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		4.5	1.9	55.2	299.5	1.0	0.0	0.0	0.0
		Other species				**All Species Combined**			
Seed&Sap	0-10	1.7	0.1	0.2	0.8	491.5	38.7	177.4	864.0
Poles	12-20	0.2	0.2	1.9	8.2	38.8	45.0	1216.1	6175.0
Sm. Saw	22-30	0.0	0.0	0.0	0.0	5.3	17.1	606.5	3666.1
Lg. Saw	32-99	0.0	0.0	0.0	0.0	1.2	7.6	318.3	2188.2
Total		1.9	0.3	2.1	9.1	536.7	108.4	2318.3	12893.4
TOTAL									

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greater. See the stand table for a more accurate representation of these.

Table 13a

Lodgepole pine/bitterbrush

56,247 Acres

Diameter Class	Trees /acre	Avg dbh	Avg Height	Basal Area /acre	Cubic ft /acre	Board ft. /acre	Total Trees	Total Cubic feet	Total Bd.Ft.
<1.	68.1	0.6	5.8	0.1	0.0	0.0	3,830,421	0	0
2	156.0	2.1	13.8	4.2	0.0	0.0	8,773,913	0	0
4	98.9	3.7	22.0	7.6	0.0	0.0	5,565,247	0	0
6	55.5	5.8	33.4	10.4	0.0	0.0	3,124,465	0	0
8	32.5	7.9	46.4	11.1	0.0	0.0	1,826,621	0	0
10	22.3	9.8	55.2	11.8	252.3	1,213.9	1,255,883	14,189,431	68,278,233
SUB.	**433.4**	**3.6**	**21.5**	**45.3**	**252.3**	**1,213.9**	**24,376,550**	**14,189,431**	**68,278,233**
12	14.0	11.9	63.5	10.9	273.9	1,333.4	788,639	15,406,616	74,999,750
14	9.6	13.9	70.3	10.2	284.7	1,440.6	540,871	16,014,646	81,029,428
16	4.9	15.8	73.4	6.7	197.8	1,013.5	274,598	11,122,844	57,006,335
18	3.1	17.9	78.0	5.4	163.0	877.3	175,322	9,168,823	49,345,493
20	1.8	19.8	79.6	3.8	114.9	636.9	100,120	6,464,468	35,823,714
SUB.	**33.4**	**14.0**	**69.1**	**37.0**	**1,034.3**	**5,301.6**	**1,879,494**	**58,177,397**	**298,199,095**
22	0.7	21.9	86.6	1.9	61.0	350.4	40,610	3,428,817	19,708,949
24	0.3	23.8	89.7	0.9	29.3	176.1	16,480	1,649,725	9,905,097
26	0.2	25.9	94.4	0.7	26.4	162.4	11,306	1,484,358	9,134,513
28	0.2	28.0	93.7	0.9	33.9	215.1	12,431	1,906,773	12,098,730
30	0.1	29.9	91.9	0.5	18.8	119.0	6,075	1,059,693	6,693,393
SUB.	**1.5**	**24.2**	**89.6**	**5.0**	**169.4**	**1,023.0**	**86,845**	**9,528,804**	**57,540,681**
32	0.1	32.7	95.7	0.3	12.4	81.2	3,262	696,900	4,567,256
34	0.1	34.5	112.0	0.3	13.8	94.8	2,812	775,646	5,332,216
36	0.0	35.5	114.1	0.2	10.3	70.5	1,969	578,782	3,965,414
38	0.0	37.8	115.8	0.2	7.5	51.9	1,406	422,415	2,919,219
40	0.0	40.1	112.2	0.4	14.7	101.5	2,306	827,393	5,709,071
42	0.0	41.7	124.5	0.2	9.8	68.5	1,237	550,096	3,852,920
44	0.0	0.0	0.0	0.0	0.0	0.0	0		
SUB.	**0.2**	**36.2**	**109.9**	**1.7**	**68.5**	**468.4**	**12,937**	**3,851,795**	**26,346,095**
Total	**468.6**	**4.4**	**25.2**	**88.9**	**1,524.5**	**8,007.0**	**26,355,882**	**85,746,864**	**450,369,729**

Table 13b

Lodgepole Pine/Bitterbrush

		Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre	Trees /acre	BA /acre	Cubic ft /acre	Board ft /acre
		White fir				**Lodgepole pine**			
Seed&Sap	0-10	7.7	0.7	6.0	29.0	334.0	37.3	217.7	1,048.9
Poles	12-20	0.2	0.3	9.1	47.6	28.7	31.5	893.5	4,597.3
Sm. Saw	22-30	0.0	0.1	3.0	17.2	0.8	2.3	73.6	435.3
Lg. Saw	32-99	0.0	0.1	4.0	27.6	0.0	0.0	0.0	0.0
Total		7.9	1.2	22.1	121.4	363.5	71.1	1,184.8	6,081.5
		Sugar pine				**Ponderosa pine**			
Seed&Sap	0-10	4.5	0.8	4.4	21.9	87.2	6.5	24.2	114.2
Poles	12-20	0.6	0.8	20.6	103.7	4.0	4.4	111.1	553.0
Sm. Saw	22-30	0.0	0.0	0.0	0.0	0.7	2.6	92.8	570.5
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.2	1.6	64.5	440.8
Total		5.1	1.6	25.1	125.6	92.1	15.0	292.6	1,678.5
		Other species				**All species combined**			
Seed&Sap	0-10	0.0	0.0	0.0	0.0	433.4	45.3	252.3	1,213.9
Poles	12-20	0.0	0.0	0.0	0.0	33.4	37.0	1,034.3	5,301.6
Sm. Saw	22-30	0.0	0.0	0.0	0.0	1.5	5.0	169.4	1,023.0
Lg. Saw	32-99	0.0	0.0	0.0	0.0	0.2	1.7	68.5	468.4
Total		0.0	0.0	0.0	0.0	468.6	88.9	1,524.5	8,007.0

Note: Trees <22" are counted in the 12-20" class, thus this table slightly underestimates the number of trees 21" and greater. See the stand table for a more accurate representation of these.

Historic Klamath Reservation Forest Recoverable Oven-Dry Weight Of Biomass Per Tree[1,2,3,4,5]

Table 14

Species	DBH	Height	Pounds
Ponderosa Pine	3	14	15
	5	22	46
	7	32	125
	9	41	250
	11	50	250
	13	57	320
	15	63	420
	17	72	550
	19	78	700
Lodgepole Pine	3	15	13
	5	24	50
	7	34	130
	9	44	170
	11	54	170
	13	61	210
	15	67	270
	17	74	340
	19	78	400
Douglas-Fir	3	16	20
	5	25	66
	7	36	170
	9	47	200
	11	58	220
	13	65	250
	15	73	310
	17	79	375
	19	85	450
White Fir	3	16	17
	5	25	54
	7	36	140
	9	47	210
	11	58	240
	13	65	300
	15	73	390
	17	79	490
	19	85	600

[1]Reduced by 10% for waste.
[2]Total tree for 7 inch and smaller dbh classes.
[3]Top above 5 inches dib (6 inches for PP) and limbs for 9 inch and larger dbh classes.
[4]30% of 9 inch dbh trees and 4% of 11 inch and larger trees are recovered as biomass.
[5]Average bark content: PP = 19%, LP = 9%, DF = 16%, and WF = 17%.

Sources:
Wood Weight--"Wood Handbook," Ag Handbook No. 72, 1974.
Stem Volume--"Estimating Merchantable Volume and Stem Residue in Four Timber Species," INT-196, 1977, by James L. Faurot.
Top & Limb Volume--"Handbook for Predicting Slash Weight of Western Conifers," INT-37, 1977, by James K. Brown, J.A. Kendall Snell, and David L. Bunnell.

Table 15

White fir

DIA. CLASS	TREES /AC	AVG DBH	AVG HGT	BA /AC	CUBIC CU/AC	BOARD BD/AC	Odw /tree	total odw 1000s	total odw pounds
<1.	16.114	0.27	3	0.013	0	0			
2	14.633	1.94	11.3	0.325	0	0	17	129,853	249
4	10.34	3.84	21	0.847	0	0	54	291,464	558
6	5.574	5.92	34.9	1.075	0	0	140	407,348	780
8	4.043	7.88	45.8	1.376	0.06	0.3	210	443,194	849
10	2.868	9.91	56.2	1.541	27.85	136.2	240	359,303	688
SUB.	53.571	3.09	18.1	5.178	27.91	136.6		0	0
								0	0
12	1.885	11.82	62.7	1.439	33.21	157.7	300	295,191	566
14	1.427	13.87	70	1.5	38.81	191.9	390	290,509	557
16	0.903	15.89	76.9	1.245	34.86	176.2	490	230,969	442
18	0.695	17.9	82.1	1.216	35.91	186.6	600	217,674	417
20	0.511	19.92	87.5	1.107	34.1	187	720	192,054	368
SUB.	5.422	14.58	71.8	6.508	176.88	899.5		0	0
								0	0
22	0.315	21.87	91.8	0.822	28.1	162.1	840	138,121	265
24	0.258	23.87	96.3	0.802	28.49	169.9		0	0
26	0.183	25.89	101.9	0.67	23.3	144.7		0	0
28	0.123	27.89	102.2	0.523	18.02	113.7		0	0
30	0.085	29.97	114.1	0.416	15.58	101.5		0	0
SUB.	0.964	24.65	98.2	3.234	113.48	692		0	0
								0	0
32	0.065	31.7	112.3	0.354	13.53	89.6		0	0
34	0.024	33.8	115	0.149	5.83	39.9		0	0
36	0.028	35.84	115.1	0.195	7.6	53		0	0
38	0.019	37.78	113	0.15	5.64	39.7		0	0
40	0.009	39.94	121.8	0.076	2.95	21.1		0	0
42	0.001	41.34	135	0.012	0.44	3.3		0	0
44	0.004	43.65	106.1	0.04	1.25	8.9		0	0
46	0	0	0	0	0	0		0	0
48	0.001	47.5	118.1	0.017	0.61	4.3		0	0
50	0.001	49.25	130.1	0.018	0.8	5.7		0	0
52	0	0	0	0	0	0		0	0
SUB.	0.152	34.71	114.1	1.012	38.66	265.5		0	0
								0	0
TOTAL	60.11	4.55	24.5	15.931	356.93	1993.5		0	0

---	**Incense cedar**								
								0	0
DIA.	TREES	AVG	AVG	BA	CUBIC	BOARD			
CLASS	/AC	DBH	HGT	/AC	CU/AC	BD/AC			
								0	0
<1.	2.127	0.34	3	0.002	0	0		0	0
2	1.232	1.81	9.5	0.025	0	0	15	9,647	18
4	0.928	3.7	16.8	0.07	0	0	46	22,283	43
6	0.325	5.8	29.4	0.06	0	0	125	21,206	41
8	0.242	8.04	38.3	0.086	0	0	250	31,581	61
10	0.216	9.9	45.2	0.116	1.28	5.8	250	28,188	54
SUB.	5.071	2.44	12.3	0.36	1.28	5.8		0	0
								0	0
12	0.179	11.88	48.9	0.138	2.09	8.9	320	29,900	57
14	0.09	13.94	54.4	0.095	1.63	6.9	420	19,732	38
16	0.012	15.56	58.7	0.015	0.27	1.2	550	3,445	7
18	0.028	17.76	64.2	0.049	0.93	4.2	700	10,231	20
20	0.004	19.48	62.3	0.007	0.1	0.5	430	898	2
SUB.	0.312	13.23	52.4	0.305	5.02	21.7		0	0
								0	0
22	0.015	22.1	76	0.039	0.79	3.9		0	0
24	0.007	23.5	72.4	0.021	0.32	1.6		0	0
26	0.017	25.69	85.5	0.06	1.3	6.9		0	0
28	0.005	27.43	82.8	0.019	0.43	2.3		0	0
30	0.007	29.49	88	0.035	0.77	4.2		0	0
SUB.	0.05	25.06	81	0.174	3.62	18.9		0	0
								0	0
32	0.004	32.02	86.4	0.021	0.46	2.6		0	0
34	0.008	33.95	94.6	0.051	1.22	7		0	0
36	0.004	35.59	97.3	0.027	0.64	3.7		0	0
38	0.003	37.49	99.5	0.021	0.54	3.3		0	0
40	0.001	39.8	89.5	0.012	0.3	1.9		0	0
42	0	0	0	0	0	0		0	0
44	0.001	43.9	110.6	0.015	0.45	2.9		0	0
46	0.001	45.44	119.1	0.016	0.51	3.3		0	0
48	0	0	0	0	0	0		0	0
50	0	0	0	0	0	0		0	0
SUB.	0.023	36.04	96.5	0.163	4.12	24.7		0	0
								0	0
TOTA	5.456	3.4	15.6	1.002	14.04	71.3		0	0

---	**Lodgepole pine**								
								0	0
DIA.	TREES	AVG	AVG	BA	CUBIC	BOARD			
CLASS	/AC	DBH	HGT	/AC	CU/AC	BD/AC			
								0	0
<1.	13.404	0.23	2.7	0.008	0	0		0	0
2	19.781	2.04	13.6	0.478	0	0	13	134,234	257
4	13.267	3.73	22.6	1.029	0	0	50	346,269	663
6	7.233	5.9	35.4	1.384	0.01	0	130	490,831	940
8	4.219	7.86	48.7	1.429	0.37	1.8	170	374,394	717
10	3.085	9.86	59.1	1.641	37.43	180.7	170	273,763	524
SUB.	60.989	3.26	20.5	5.968	37.81	182.6		0	0
								0	0
12	1.815	11.79	65.9	1.378	36.3	176.8	210	198,960	381
14	1.079	13.81	73.9	1.125	33.41	170.8	270	152,074	291
16	0.479	15.82	78.4	0.655	20.6	107	340	85,013	163
18	0.212	17.88	82.5	0.371	11.99	65.2	400	44,266	85
20	0.096	19.87	90.6	0.206	6.58	37.4	240	12,027	23
SUB.	3.681	13.47	71.5	3.734	108.88	557.2		0	0
								0	0
22	0.049	21.73	88.6	0.127	3.98	22.9		0	0
24	0.021	23.94	91.9	0.067	2.4	14.5		0	0
26	0.014	26.08	103.5	0.051	1.8	11.1		0	0
28	0	0	0	0	0	0		0	0
30	0	0	0	0	0	0		0	0
SUB.	0.085	23	91.8	0.246	8.18	48.5		0	0
								0	0
32	0	0	0	0	0	0		0	0
34	0	0	0	0	0	0		0	0
36	0	0	0	0	0	0		0	0
38	0.001	38.17	105.4	0.011	0.44	3		0	0
40	0	0	0	0	0	0		0	0
42	0	0	0	0	0	0		0	0
SUB.	0.001	38.17	105.4	0.011	0.44	3		0	0
								0	0
TOTAL	64.756	3.87	23.5	9.959	155.31	791.3		0	0

--- **Sugar pine**

								0	0
DIA.	TREES	AVG	AVG	BA	CUBIC	BOARD			
CLASS	/AC	DBH	HGT	/AC	CU/AC	BD/AC			
								0	0
<1.	5.583	0.18	1.9	0.003	0	0		0	0
2	4.037	1.97	10.4	0.092	0	0	15	31,610	61
4	2.475	3.74	18.1	0.193	0	0	46	59,430	114
6	1.042	5.83	25.9	0.195	0	0	125	67,991	130
8	0.701	7.97	36	0.244	0	0	250	91,481	175
10	0.469	9.92	47.9	0.253	4.15	20.3	250	61,205	117
SUB.	14.306	2.42	12	0.98	4.15	20.3		0	0
								0	0
12	0.422	11.91	56.7	0.327	7.24	34.1	320	70,491	135
14	0.233	14.03	62	0.25	5.98	29.1	420	51,083	98
16	0.101	15.8	67.6	0.138	3.52	17.5	550	28,997	56
18	0.088	18.01	75.3	0.156	4.46	22.9	700	32,155	62
20	0.07	19.72	81.4	0.149	4.48	24.3	430	15,712	30
SUB.	0.914	14.07	63	1.021	25.69	127.8		0	0
								0	0
22	0.046	21.98	86.3	0.12	3.8	21.4		0	0
24	0.045	23.64	87.9	0.139	4.43	25.6		0	0
26	0.029	26.07	87.5	0.107	3.4	20.3		0	0
28	0.019	27.75	99.8	0.078	2.72	16.7		0	0
30	0.034	30.02	104.7	0.165	5.83	36.8		0	0
SUB.	0.172	25.3	92	0.608	20.18	120.7		0	0
								0	0
32	0.009	31.51	97.7	0.05	1.75	11.1		0	0
34	0.008	34.04	106.9	0.052	2.09	14.2		0	0
36	0.018	35.9	112.5	0.124	4.83	33		0	0
38	0.014	37.62	115.9	0.106	4.28	29.5		0	0
40	0.011	39.84	120.8	0.094	4	27.7		0	0
42	0.003	41.26	121.4	0.025	1.02	7.2		0	0
44	0.005	43.97	120.2	0.049	2.04	14.1		0	0
46	0.006	45.95	124.7	0.069	2.97	21		0	0
48	0	0	0	0	0	0		0	0
50	0.001	50.77	121.1	0.02	0.84	5.9		0	0
52	0	0	0	0	0	0		0	0
54	0.001	54.49	144.1	0.023	1.12	8.2		0	0
56	0	0	0	0	0	0		0	0
SUB.	0.076	38.14	114.4	0.611	24.95	171.8		0	0
								0	0
TOTAL	15.468	3.54	16.4	3.22	74.97	440.6		0	0

---	**Western white pine**								
								0	0
DIA.	TREES	AVG	AVG	BA	CUBIC	BOARD			
CLASS	/AC	DBH	HGT	/AC	CU/AC	BD/AC			
								0	0
<1.	0.395	0.12	3.8	0	0	0		0	0
2	0.066	2.69	15.4	0.003	0	0	15	517	1
4	0.213	3.56	20.8	0.015	0	0	46	5,115	10
6	0.026	5.62	30.7	0.005	0	0	125	1,697	3
8	0.027	8.08	43.2	0.01	0	0	250	3,524	7
10	0.014	9.94	68.1	0.007	0.19	0.9	250	1,827	4
SUB.	0.741	2	13.3	0.039	0.19	0.9		0	0
								0	0
12	0.014	11.34	77.2	0.01	0.3	1.4	320	2,339	4
14	0.007	14.38	83.4	0.008	0.26	1.4	420	1,535	3
16	0.004	15.98	103.3	0.005	0.21	1.1	550	1,148	2
18	0	0	0	0	0	0	700	0	0
20	0	20.9	108.4	0.001	0.04	0.2	430	0	0
SUB.	0.025	13.05	83.3	0.024	0.81	4.1		0	0
								0	0
22	0.014	21.7	94.3	0.036	1.32	7.6		0	0
24	0	23	90.7	0.001	0.02	0.1		0	0
26	0.004	26.66	137.2	0.014	0.73	4.7		0	0
28	0	0	0	0	0	0		0	0
30	0	0	0	0	0	0		0	0
SUB.	0.018	22.73	103.1	0.051	2.07	12.5		0	0
								0	0
32	0.001	32.8	111.3	0.008	0.33	2.2		0	0
34	0	33	111.3	0.001	0.02	0.1		0	0
36	0.001	36.42	110.6	0.01	0.43	2.9		0	0
38	0	0	0	0	0	0		0	0
40	0	0	0	0	0	0		0	0
SUB.	0.003	34.61	111	0.018	0.78	5.2		0	0
								0	0
TOTAL	0.787	2.95	17.9	0.133	3.84	22.7		0	0

--- **Ponderosa pine**

DIA. CLASS	TREES /AC	AVG DBH	AVG HGT	BA /AC	CUBIC CU/AC	BOARD BD/AC			
								0	0
<1.	37.94	0.19	1.9	0.018	0	0		0	0
2	47.583	2.11	10.7	1.232	0	0	15	372,575	714
4	50.986	3.76	16.9	4.029	0	0	46	1,224,276	2,345
6	24.997	5.88	24.9	4.762	0	0	125	1,631,054	3,125
8	15.428	7.89	34.5	5.267	0.21	1.1	250	2,013,354	3,857
10	10.988	9.92	45	5.921	91.97	442.9	250	1,433,934	2,747
SUB.	187.922	3.6	16.5	21.229	92.18	444		0	0
								0	0
12	7.94	11.91	54	6.155	135.58	649.2	320	1,326,298	2,541
14	5.348	13.87	60.3	5.622	136.45	664	420	1,172,496	2,246
16	3.374	15.89	68.7	4.65	124.71	628.6	550	968,675	1,856
18	2.05	17.9	75.3	3.585	103.68	539.9	700	749,070	1,435
20	1.457	19.93	81.3	3.159	97.39	533.8	430	327,038	627
SUB.	20.169	14.28	62.3	23.172	597.81	3015.6		0	0
								0	0
22	1.066	21.9	87.6	2.792	94.33	544.4		0	0
24	0.978	23.88	92.5	3.043	107.8	647.6		0	0
26	0.692	25.87	97.8	2.529	95.24	589.3		0	0
28	0.476	27.92	101.9	2.026	78.95	504.8		0	0
30	0.394	29.98	106.3	1.932	77.41	505.4		0	0
SUB.	3.607	24.88	94.8	12.322	453.74	2791.6		0	0
								0	0
32	0.406	31.92	110.6	2.258	92.77	623.2		0	0
34	0.226	33.94	112.8	1.421	59.89	414		0	0
36	0.141	35.89	117	0.988	43.42	301.8		0	0
38	0.122	37.83	119.1	0.951	42.17	296.6		0	0
40	0.068	39.82	123.5	0.586	26.65	188.6		0	0
42	0.044	41.9	129.8	0.421	19.42	136.7		0	0
44	0.011	44.18	123.2	0.117	5.17	36.6		0	0
46	0.007	45.76	136.4	0.078	3.88	27.4		0	0
48	0.003	47.91	120.1	0.035	1.57	11.2		0	0
50	0.003	50.78	126.4	0.039	1.67	12		0	0
52	0	0	0	0	0	0		0	0
54	0.001	53.3	95.3	0.021	1	7.5		0	0
56	0.001	56	139.1	0.024	1.28	9.4		0	0
58	0	0	0	0	0	0		0	0
60	0	0	0	0	0	0		0	0
62	0.001	62.24	116.1	0.029	1.28	9.1		0	0
64	0	0	0	0	0	0		0	0
SUB.	1.034	34.95	115	6.969	300.17	2074.2		0	0
								0	0
TOTAL	212.732	5.13	22.6	63.691	1443.9	8325.5		0	0

---	Douglas-fir								
DIA.	TREES	AVG	AVG	BA	CUBIC	BOARD			
CLASS	/AC	DBH	HGT	/AC	CU/AC	BD/AC			
								0	0
<1.	1.666	0.16	2.1	0.001	0	0		0	0
2	1.254	1.75	10.4	0.023	0	0	20	13,092	25
4	0.474	3.92	19.4	0.04	0	0	66	16,330	31
6	0.406	6.04	28.1	0.082	0.01	0.1	170	36,028	69
8	0.327	7.79	41.9	0.109	0.01	0.1	200	34,139	65
10	0.188	10.15	56	0.106	2.27	11	220	21,590	41
SUB.	4.315	2.6	14.2	0.36	2.29	11.1		0	0
								0	0
12	0.19	11.99	69.1	0.149	3.87	18.6	250	24,795	48
14	0.258	13.85	73.6	0.27	7.43	37.2	310	41,750	80
16	0.201	15.79	79.7	0.274	8.02	40.6	375	39,346	75
18	0.102	17.85	84.3	0.177	5.45	28.5	450	23,960	46
20	0.043	19.77	90.8	0.092	3	16.5	290	6,509	12
SUB.	0.794	14.73	76.4	0.962	27.77	141.4		0	0
								0	0
22	0.027	21.9	93.9	0.071	2.15	12.1		0	0
24	0.033	24.01	96.2	0.103	3.28	18.9		0	0
26	0.007	25.41	112.5	0.026	0.99	6		0	0
28	0.024	27.95	111.1	0.101	3.51	21.8		0	0
30	0.014	30.02	117.8	0.067	2.62	16.7		0	0
SUB.	0.104	25.23	102.9	0.367	12.55	75.5		0	0
								0	0
32	0.011	32.09	110.8	0.06	2.21	14.1		0	0
34	0.005	33.99	124.1	0.035	1.38	9.2		0	0
36	0.008	35.57	127.7	0.057	2.09	14.2		0	0
38	0.004	37.75	132	0.032	1.3	9		0	0
40	0	0	0	0	0	0		0	0
42	0.002	41.45	130.9	0.023	0.98	6.8		0	0
44	0.001	44.23	117.1	0.015	0.55	3.7		0	0
46	0.001	45.3	140.4	0.012	0.51	3.6		0	0
48	0.001	48.22	142.7	0.017	0.74	5.3		0	0
50	0	0	0	0	0	0		0	0
52	0	0	0	0	0	0		0	0
54	0	0	0	0	0	0		0	0
56	0.001	55.41	157.1	0.023	1.07	7.8		0	0
58	0	0	0	0	0	0		0	0
60	0.001	59.64	153.1	0.022	1.01	7.3		0	0
62	0	0	0	0	0	0		0	0
64	0	0	0	0	0	0		0	0
SUB.	0.037	37.47	125.3	0.296	11.82	81.1		0	0
								0	0
TOTAL	5.251	5.13	26.2	1.985	54.42	309		0	0

---	**Mountain hemlock**							
DIA. CLASS	TREES /AC	AVG DBH	AVG HGT	BA /AC	CUBIC CU/AC	BOARD BD/AC		
							0	0
<1.	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
SUB.	0	0	0	0	0	0	0	0
							0	0
12	0	0	0	0	0	0	0	0
14	0.004	14.09	69.5	0.004	0.08	0.3	0	0
16	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
SUB.	0.004	14.09	69.5	0.004	0.08	0.3	0	0
							0	0
22	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0
SUB.	0	0	0	0	0	0	0	0
							0	0
32	0	0	0	0	0	0	0	0
SUB.	0	0	0	0	0	0	0	0
							0	0
TOTA	0.004	14.09	69.5	0.004	0.08	0.3	0	0

---	**Other species**								
								0	0
DIA.	TREES	AVG	AVG	BA	CUBIC	BOARD			
CLASS	/AC	DBH	HGT	/AC	CU/AC	BD/AC			
								0	0
<1.	1.596	0.32	4.3	0.001	0	0		0	0
2	1.844	1.68	8.9	0.032	0	0	15	14,439	28
4	0.555	4.21	17	0.055	0	0	46	13,327	26
6	1.335	5.86	20.8	0.252	0	0	125	87,109	167
8	0.623	7.94	24.8	0.215	0	0	250	81,302	156
10	0.374	9.9	28	0.201	1.52	7.3	250	48,807	94
SUB.	6.328	3.54	13.7	0.757	1.52	7.3		0	0
								0	0
12	0.131	11.78	32.8	0.1	1.09	4.5	320	21,882	42
14	0.043	14.06	33.5	0.046	0.43	1.5	420	9,427	18
16	0.05	15.87	35.3	0.068	0.76	2.7	550	14,355	28
18	0.022	17.61	38	0.036	0.44	1.6	700	8,039	15
20	0.032	20.18	40.2	0.071	0.84	3	430	7,183	14
SUB.	0.277	14.28	34.6	0.321	3.56	13.4		0	0
								0	0
22	0.02	21.89	41.7	0.052	0.64	2.5		0	0
24	0.028	24.13	43.7	0.089	1.17	4.7		0	0
26	0.016	25.81	44.9	0.057	0.75	3.1		0	0
28	0	27.1	46.4	0.001	0.01	0.1		0	0
30	0	0	0	0	0	0		0	0
SUB.	0.064	23.86	43.4	0.199	2.57	10.4		0	0
								0	0
32	0	0	0	0	0	0		0	0
34	0.001	34.34	51.8	0.009	0.11	0.5		0	0
36	0.004	35.65	50.7	0.029	0.29	1.3		0	0
38	0	0	0	0	0	0		0	0
40	0.001	40.53	55.8	0.013	0.18	0.9		0	0
42	0	0	0	0	0	0		0	0
44	0	0	0	0	0	0		0	0
SUB.	0.007	36.38	51.9	0.05	0.57	2.7		0	0
								0	0
TOTAL	6.676	4.22	14.8	1.327	8.22	33.8		0	0
							Grand Total	**17,594,652**	**33,706**

Appendix D Harvest

Volume/Acre by Species (board feet)

	white fir	lodgepole pine	Douglas-fir	ponderosa pine	harvest vol/acre	acres	harvest
Mixed Conifer Complex	7,555	204	542	0	8,301	21,093	175,092,993
Mixed Conifer Remnant	5,700	491	207	0	6,398	63,278	404,855,357
Moist Mixed Conifer Complex	16,600	597	0	0	17,197	7,031	120,911,006
Moist Mixed Conifer Remnant	4,000	225	56	705	4,986	24,608	122,696,864
Ponderosa Pine Complex	306	741	0	410	1,457	58,005	84,507,808
Ponderosa Pine Remnant	126	1,236	52	1,200	2,614	230,263	601,999,990
Ponderosa Pine Simplified	25	900	0	482	1,407	70,309	98,897,146
					Total	**474,588**	**1,608,961,164**

Total Volume by Species (board feet)

	white fir	lodgepole pine	Douglas-fir	ponderosa pine	harvest
Mixed Conifer Complex	159,357,615	4,302,972	11,432,406	0	175,092,993
Mixed Conifer Remnant	360,687,017	31,069,706	13,098,634	0	404,855,357
Moist Mixed Conifer Complex	116,713,538	4,197,469	0	0	120,911,006
Moist Mixed Conifer Remnant	98,433,104	5,536,862	1,378,063	17,348,835	122,696,864
Ponderosa Pine Complex	17,743,797	42,981,870	0	23,782,141	84,507,808
Ponderosa Pine Remnant	29,105,263	284,605,258	11,973,684	276,315,785	601,999,990
Ponderosa Pine Simplified	1,729,610	63,278,424	0	33,889,112	98,897,146
Total	**783,769,944**	**435,972,561**	**37,882,787**	**351,335,872**	**1,608,961,164**

Net of large white fir left as snags

Mixed Conifer Complex

<u>Removal</u>						
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**	
0-20	white fir	240.0	40.0	880.0	4,555.0	
	lodgepole pine	11.0	2.3	39.9	204.0	
	Douglas-fir	21.0	5.4	106.5	542.0	
	Subtotal	**272.0**	**47.8**	**1,026.4**	**5,301.0**	
20+	white fir	5.0	25.0	800.0	4,500.0	3,000*
	Subtotal	**5.0**	**25.0**	**800.0**	**4,500.0**	
Total		**277.0**	**72.8**	**1,826.4**	**9,801.0**	**9,100***

<u>Residual</u>					
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**
0-20	white fir	0.0	0.0	0.0	0.0
	sugar pine	64.0	11.0	137.0	685.0
	Douglas-fir	21.0	6.0	125.0	636.0
	incense cedar	11.0	1.0	7.0	33.0
	ponderosa pine	107.0	20.0	261.0	1,337.0
	Subtotal	**203.0**	**38.0**	**530.0**	**771.0**
20+	white fir	0.0	0.0	0.0	0.0
	sugar pine	2.0	12.0	454.0	3,020.0
	Douglas-fir	2.0	9.0	344.0	2,255.0
	incense cedar	0.0	1.0	17.0	104.0
	ponderosa pine	5.0	18.0	772.0	5,126.0
	Subtotal	**9.0**	**40.0**	**1,587.0**	**10,505.0**
Total		**212.0**	**78.0**	**2,117.0**	**11,276.0**
Grand Total (Rem. + Res.)		**489.0**	**150.8**		

Mixed Conifer Remnant

<u>Removal</u>						
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**	
0-20	white fir	180.7	44.1	800.0	4,020.0	
	lodgepole pine	39.0	7.0	98.3	490.6	
	Douglas-fir	2.9	1.6	40.5	207.1	
	Subtotal	222.7	52.7	938.9	**4,717.7**	
20+	white fir	4.2	15.0	543.0	3,400.0	1,700*
Total		**226.9**	**67.7**	**1,481.9**	**8,117.7**	**6,417***

<u>Residual</u>					
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**
0-20	white fir	0.0	0.0	0.0	0.0
	sugar pine	22.5	7.4	142.5	699.8
	Douglas-fir	6.8	3.7	94.5	483.0
	incense cedar	9.3	0.9	7.5	33.7
	western white pine	5.8	0.5	8.7	45.1
	ponderosa pine	78.1	23.7	412.0	2,075.0
	Subtotal	**122.5**	**36.3**	**665.2**	**3,336.6**
20+	white fir	0.0	0.0	0.0	0.0
	sugar pine	0.8	3.6	129.3	818.9
	Douglas-fir	0.5	2.1	73.8	463.0
	incense cedar	0.3	1.4	31.8	179.5
	western white pine	0.2	0.6	24.3	153.2
	ponderosa pine	3.4	15.0	595.3	3,885.8
	Subtotal	**5.2**	**22.7**	**854.5**	**5,500.4**
Total		**127.7**	**59.0**	**1,519.6**	**8,837.0**
Grand Total (Rem. + Res.)		**354.5**	**126.6**		

Moist Mixed Conifer Complex

Removal						
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**	
0-20	white fir	260.0	70.0	1,056.6	5,425.6	
	lodgepole pine	10.7	3.6	117.8	597.3	
	Subtotal	**270.7**	**73.6**	**1,174.4**	**6,022.9**	
20+	white fir	13.0	55.0	21,000.0	13,300.0	11,200*
	Subtotal	**13.0**	**55.0**	**2,100.0**	**13,300.0**	
Total		**283.7**	**128.6**	**3,274.4**	**19,322.9**	**17,322***
Residual						
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**	
0-20	white fir	20.0	5.0	200.0	800.0	
	ponderosa pine	53.5	15.0	226.2	1,226.4	
	Subtotal	**73.5**	**20.0**	**426.2**	**2,026.4**	
20+	white fir	2.0	10.0	400.0	2,200.0	
	ponderosa pine	8.0	34.0	1,452.7	9,568.9	
	Subtotal	**10.0**	**44.0**	**1,852.7**	**11,768.9**	
Total		**83.5**	**64.0**	**2,278.9**	**13,795.3**	
Grand Total (Rem. + Res.)		**367.2**	**192.6**			

Moist Mixed Conifer Remnant

Removal					
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**
0-20	white fir	130.0	40.0	800.0	4,000.0
	lodgepole pine	5.5	1.5	43.0	224.6
	Douglas-fir	1.2	0.4	10.5	55.5
	ponderosa pine	50.0	10.0	150.0	700.0
	Subtotal	**186.7**	**51.9**	**1,003.5**	**4,980.1**
20+	white fir		0.0	0.0	0.0
Total		**186.7**	**51.9**	**1,003.5**	**4,980.1**
Residual					
0-20	white fir	18.0	5.0	80.0	400.0
	sugar pine	31.1	4.5	56.1	290.9
	Douglas-fir	2.8	1.0	24.5	129.4
	incense cedar	23.6	5.6	57.7	256.6
	ponderosa pine	103.0	24.2	420.0	2,000.0
	Subtotal	**178.5**	**40.3**	**638.4**	**3,076.9**
20+	white fir	1.6	6.6	239.0	2,500.0
	sugar pine	0.4	1.6	66.6	436.9
	Douglas-fir	0.3	0.8	28.2	165.9
	incense cedar	0.4	1.8	42.5	241.8
	ponderosa pine	3.4	13.7	563.9	3,662.3
	Subtotal	**6.0**	**24.5**	**940.2**	**7,006.9**
Total		**184.5**	**64.8**	**1,578.6**	**10,083.8**
Grand Total (Rem. + Res.)		**371.2**	**116.7**		

Ponderosa Pine Complex

Removal					
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**
0-20	white fir	25.9	4.2	55.1	273.5
	lodgepole pine	37.3	7.9	137.1	700.4
	ponderosa pine	137.3	15.0	110.6	410.5
	Subtotal	**200.5**	**27.1**	**329.8**	**1,383.4**
20+					
	white fir	0.1	0.2	55.1	32.4
	lodgepole pine	0.3	0.2	6.7	40.6
	Subtotal	**0.4**	**0.4**	**61.9**	**72.9**
Total		**200.9**	**31.5**	**391.6**	**1,457.3**
Residual					
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**
0-20	white fir	0.0	0.0	0.0	0.0
	sugar pine	8.9	2.3	34.4	171.0
	ponderosa pine	78.4	26.7	650.9	2705.1
	Subtotal	**82.3**	**29.0**	**542.2**	**2838.1**
20+	white fir	0.1	0.8	31.2	211.5
	sugar pine	0.2	0.9	0.9	201.1
	ponderosa pine	10.5	45.3	1,792.3	11,629.2
	Subtotal	**10.8**	**47.0**	**1,824.4**	**12,041.8**
Total		**93.1**	**76.0**	**2,366.7**	**14,815.9**
Grand Total (Rem. + Res.)		**294.0**	**105.4**		

Ponderosa Pine Remnant

Removal					
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**
0-20	white fir	4.5	1.0	19.4	99.4
	lodgepole pine	69.3	13.6	223.3	1,136.1
	Douglas-fir	0.3	0.4	10.1	51.8
	ponderosa pine	130.0	26.0	350.5	1205.7
	Subtotal	**206.1**	**44.0**	**687.2**	**2,464.9**
20+	white fir	0.1	0.1	1.2	26.9
	lodgepole pine	0.2	0.5	16.6	99.9
	Subtotal	**0.2**	**0.6**	**17.8**	**126.8**
Total		**206.6**	**44.0**	**705.0**	**2,591.7**
Residual					
DBH Class	**Species**	**TPA**	**BA**	**Cubic Ft.**	**Bd. Ft.**
0-20	white fir	0.0	0.0	0.0	0.0
	Douglas-fir	0.0	0.0	0.0	0.0
	sugar pine	2.5	0.4	4.7	22.7
	ponderosa pine	69.2	29.7	730.0	4,234.4
	Subtotal	**71.7**	**30.1**	**734.7**	**4,257.1**
20+	white fir	0.1	0.2	7.4	46.4
	sugar pine	0.1	0.5	18.6	119.6
	Douglas-fir	0.0	0.1	3.4	20.6
	ponderosa pine	5.9	25.2	908.8	5,800.9
	Subtotal	**6.1**	**26.0**	**938.1**	**5,987.5**
Total		**77.8**	**56.1**	**1,672.8**	**10,244..6**
Grand Total (Rem. + Res.)		**283.4**	**99.1**		

Ponderosa Pine Simplified

Removal

DBH Class	Species	TPA	BA	Cubic Ft.	Bd. Ft.
0-20	white fir	2.5	0.4	4.9	24.6
	lodgepole pine	85.1	14.6	181.0	900.0
	ponderosa pine	132.2	22.8	97.1	482.0
Total		**219.8**	**37.8**	**283.0**	**1,406.6**

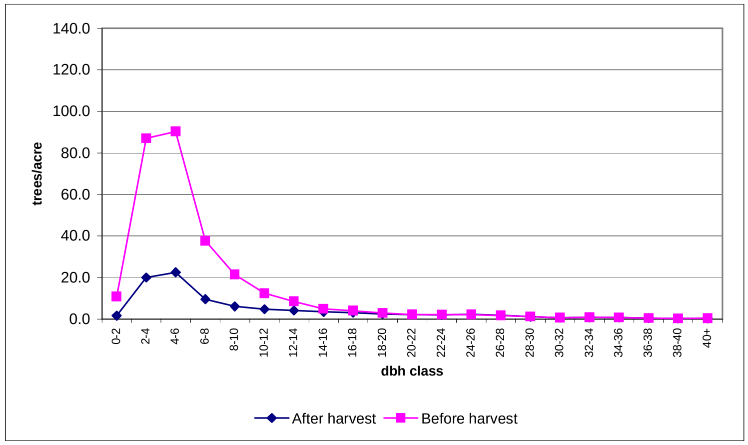
Residual

DBH Class	Species	TPA	BA	Cubic Ft.	Bd. Ft.
0-20	ponderosa pine	93.8	41.6	808.7	3,976.0
20+	ponderosa pine	0.6	2.5	90.6	574.3
Total		**94.4**	**44.1**	**899.3**	**4,550.3**
Grand Total (Rem. + Res.)		**314.2**	**81.9**		

*** Net of large white fir left as snags**

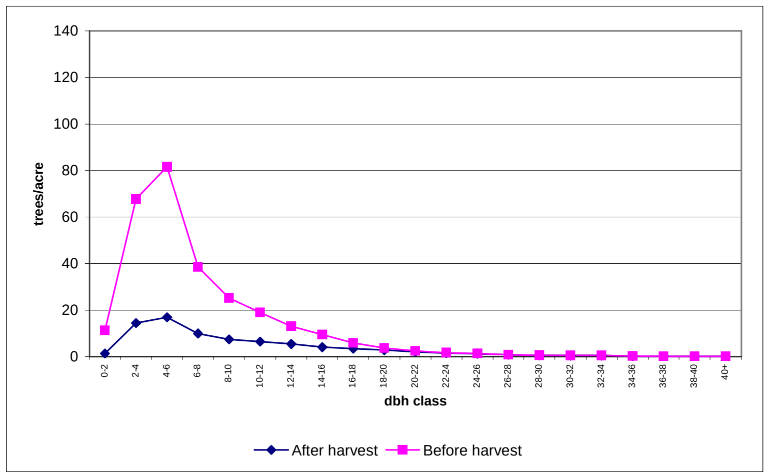
DBH Class	before trees/acre	before BA/acre	after trees/acre	after BA/acre
0-2	10.9	0.0	1.7	0.0
2-4	87.1	3.0	20.0	0.7
4-6	90.4	7.3	22.5	1.8
6-8	37.7	7.2	9.6	1.8
8-10	21.5	7.4	6.1	2.1
10-12	12.4	6.7	4.8	2.6
12-14	8.6	6.5	4.2	3.2
14-16	5.0	5.1	3.5	3.6
16-18	4.1	5.4	3.1	4.1
18-20	2.9	5.0	2.5	4.3
20-22	2.3	5.0	2.1	4.7
22-24	2.1	5.6	2.0	5.3
24-26	2.2	6.9	2.3	7.1
26-28	1.8	6.3	1.8	6.4
28-30	1.3	5.7	1.2	5.3
30-32	0.7	3.6	0.7	3.5
32-34	0.9	4.9	0.9	5.0
34-36	0.8	5.2	0.8	5.1
36-38	0.5	3.3	0.5	3.4
38-40	0.3	2.1	0.3	2.2
40+	0.4	4.3	0.4	4.1
Total	**293.8**	**106.6**	**91.0**	**76.3**

Ponderosa Pine/bitterbrush Complex



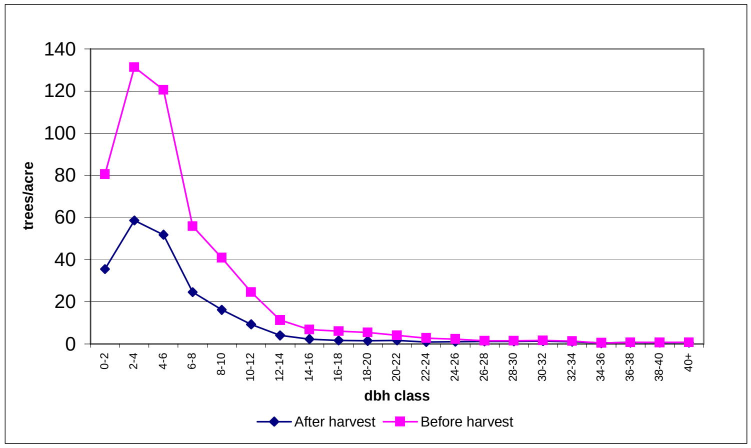
DBH Class	before trees/acre	before BA/acre	after trees/acre	BA/acre
0-2	11.3	0.0	1.4	0.0
2-4	67.7	1.9	14.5	0.4
4-6	81.6	6.5	17.0	1.4
6-8	38.5	6.9	10.0	1.8
8-10	25.2	8.8	7.5	2.6
10-12	19.0	10.2	6.5	3.5
12-14	13.1	10.5	5.5	4.4
14-16	9.5	10.1	4.1	4.3
16-18	5.9	7.5	3.5	4.5
18-20	3.7	6.4	2.9	5.0
20-22	2.5	5.3	2.1	4.4
22-24	1.7	4.4	1.6	4.1
24-26	1.4	4.4	1.3	4.2
26-28	0.9	3.3	0.9	3.3
28-30	0.6	2.6	0.6	2.6
30-32	0.5	2.5	0.5	2.5
32-34	0.5	2.9	0.5	2.9
34-36	0.2	1.5	0.2	1.5
36-38	0.1	1.0	0.1	1.0
38-40	0.1	1.1	0.1	1.1
40+	0.2	1.1	0.2	1.5
Total	**284.5**	**99.2**	**81.1**	**56.9**

Ponderosa Pine/bitterbrush Remnant



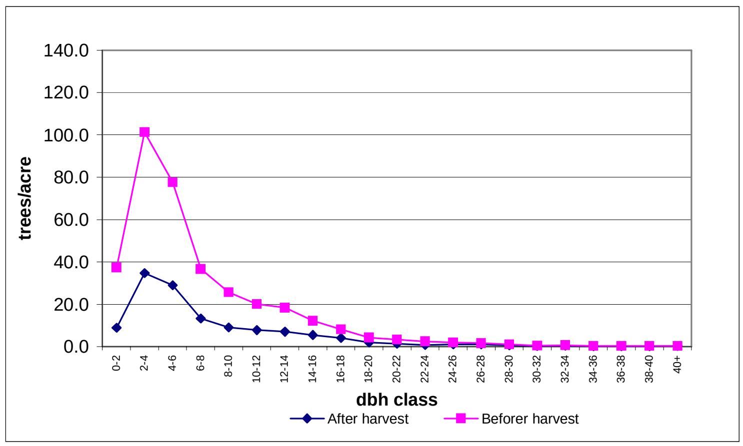
DBH Class	before trees/acre	before BA/acre	after trees/acre	after BA/acre
0-2	80.5	0.0	35.5	0.0
2-4	131.4	3.4	58.6	1.5
4-6	120.6	9.5	51.8	4.1
6-8	55.8	10.4	24.6	4.6
8-10	40.9	13.9	16.2	5.5
10-12	24.6	13.2	9.3	5.0
12-14	11.3	8.8	4.0	3.1
14-16	6.8	7.1	2.3	2.4
16-18	6.0	7.9	1.6	2.1
18-20	5.5	9.4	1.4	2.4
20-22	4.1	9.0	1.6	3.5
22-24	2.8	3.0	0.9	2.3
24-26	2.3	4.1	1.1	3.1
26-28	1.5	5.3	1.2	4.0
28-30	1.5	6.3	1.2	4.7
30-32	1.6	7.5	1.3	5.6
32-34	1.3	7.2	1.1	5.4
34-36	0.5	3.1	0.4	2.3
36-38	0.8	5.4	0.7	4.1
38-40	0.7	5.7	0.6	4.3
40+	0.8	8.6	0.7	6.5
Total	**501.3**	**148.8**	**216.0**	**76.4**

Mixed Conifer Complex



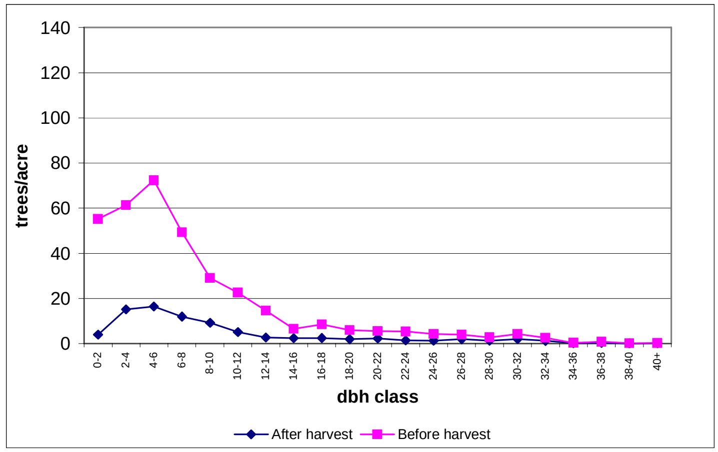
DBH Class	before trees/acre	before BA/acre	after trees/acre	after BA/acre
0-2	37.4	0.0	8.9	0.0
2-4	101.3	2.6	34.7	0.9
4-6	77.6	6.2	29.0	2.3
6-8	36.6	6.9	13.3	2.5
8-10	25.7	9.1	9.0	3.2
10-12	20.1	10.8	7.8	4.2
12-14	18.4	14.2	7.0	5.4
14-16	12.2	12.9	5.5	5.8
16-18	8.2	11.4	4.1	5.7
18-20	4.3	7.5	2.0	3.5
20-22	3.3	7.1	1.3	2.8
22-24	2.5	3.0	0.8	2.0
24-26	2.0	5.0	1.1	3.4
26-28	1.6	5.7	1.1	3.8
28-30	1.0	4.2	0.7	2.8
30-32	0.5	2.2	0.3	1.5
32-34	0.7	3.9	0.5	2.6
34-36	0.3	1.7	0.2	1.1
36-38	0.3	1.8	0.2	1.2
38-40	0.3	2.2	0.2	1.5
40+	0.2	3.9	0.3	2.6
Total	**354.5**	**122.4**	**127.8**	**58.8**

Mixed Conifer Remnant



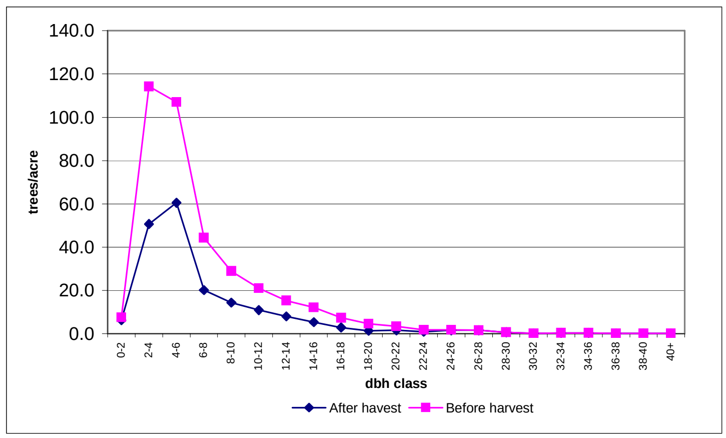
DBH Class	before trees/acre	before BA/acre	after trees/acre	after BA/acre
0-2	55.2	0.0	4.0	0.0
2-4	61.3	1.6	15.2	0.4
4-6	72.3	6.6	16.4	1.5
6-8	49.3	9.9	12.0	2.4
8-10	29.0	10.4	9.2	3.3
10-12	22.6	11.1	5.1	2.5
12-14	14.6	11.4	2.7	2.1
14-16	6.5	7.0	2.4	2.6
16-18	8.5	11.9	2.5	3.5
18-20	6.0	10.5	2.0	3.5
20-22	5.5	12.0	2.3	5.0
22-24	5.4	7.6	1.4	3.6
24-26	4.3	8.7	1.3	4.2
26-28	4.0	15.0	1.9	7.2
28-30	2.8	12.0	1.3	5.8
30-32	4.3	21.2	2.1	10.2
32-34	2.6	14.6	1.2	7.0
34-36	0.4	2.2	0.2	1.1
36-38	0.8	5.6	0.4	2.7
38-40	0.2	1.7	0.1	0.8
40+	0.3	2.4	0.1	1.2
Total	**355.9**	**183.3**	**83.9**	**70.5**

Moist Mixed Conifer Complex



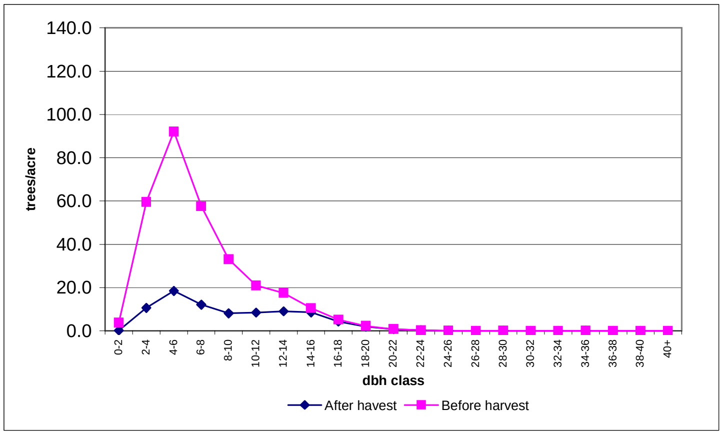
DBH Class	before trees/acre	before BA/acre	after trees/acre	after BA/acre
0-2	7.6	0.0	6.3	0.0
2-4	114.2	2.9	50.7	1.3
4-6	107.1	9.4	60.5	5.3
6-8	44.3	8.3	20.2	3.8
8-10	28.9	10.0	14.4	5.0
10-12	21.0	11.4	10.9	5.9
12-14	15.3	11.7	8.0	6.1
14-16	12.1	12.8	5.3	5.6
16-18	7.4	10.0	2.9	3.9
18-20	4.6	8.2	1.4	2.5
20-22	3.5	7.4	1.6	3.4
22-24	1.8	4.6	0.9	2.3
24-26	1.8	5.5	1.6	4.9
26-28	1.6	5.7	1.6	5.7
28-30	0.7	2.7	0.7	2.7
30-32	0.2	1.1	0.2	1.1
32-34	0.4	2.2	0.4	2.2
34-36	0.4	2.3	0.4	2.3
36-38	0.1	1.0	0.1	1.0
38-40	0.1	0.6	0.1	0.6
40+	0.1	0.9	0.2	1.7
Total	**373.2**	**133.3**	**188.4**	**67.3**

Moist Mixed Conifer Remnant



DBH Class	before trees/acre	before BA/acre	after trees/acre	after BA/acre
0-2	3.8	0.0	0.2	0.0
2-4	59.6	2.1	10.6	0.4
4-6	92.1	7.0	18.4	1.4
6-8	57.5	10.5	12.1	2.2
8-10	33.1	11.0	8.1	2.7
10-12	21.0	12.4	8.5	5.0
12-14	17.5	16.1	9.0	8.3
14-16	10.5	10.9	8.6	8.9
16-18	5.2	7.1	4.4	6.0
18-20	2.3	4.0	2.0	3.5
20-22	0.8	1.7	0.8	1.6
22-24	0.3	0.8	0.3	0.8
24-26	0.1	0.4	0.1	0.3
26-28	0.0	0.2	0.0	0.2
28-30	0.1	0.3	0.1	0.3
30-32	0.0	0.1	0.0	0.1
32-34	0.0	0.1	0.0	0.1
34-36	0.1	0.3	0.1	0.3
36-38	0.0	0.1	0.0	0.1
38-40	0.0	0.1	0.0	0.1
40+	0.0	0.4	0.0	0.4
Total	**304.1**	**85.6**	**83.3**	**42.7**

Simplified Ponderosa Pine



Appendix E Peer Review

John Gordon
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September 23, 2003

To: Allan Foreman, Chairman
Klamath Tribes

From: John Gordon
Forest Management Plan Review Team

Cc: K. Norman Johnson, Jerry Franklin

Subject: Klamath Management Plan (KMP) Peer Review

This and the appended reports will constitute the written portion of the review carried out between September 2 and 6, 2003, by John Beuter, Norm Christensen, Hal Salwasser and myself. I was very pleased to be involved in this exciting, long term effort, as were, I am sure, the other reviewers.

This team, at the invitation of the authors of the KMP and the Klamath Tribes read and discussed the written plan and appendices, visited 12 field sites on the proposed Klamath Forest, and presented results to the KMP authors and Klamath staff, and finally to the Klamath Tribal Council. Each team member prepared a brief written report. This report contains an overview of our estimation of the strengths of the KMP and our suggestions for improvement, including my own.

OVERALL FINDING

The KMP is still a work in progress, but is at a stage when its overall quality and suitability can be fairly assessed. Indeed, it is at the best stage for review, when overall direction and method are clear, but suggestions can still be used.

The plan passes review with flying colors.

It is a sensitive, strongly field based, fine grained extension of, and improvement upon, the Sustainability Strategy and reflects the Management Principles developed by the Tribes (comments on these are included in the individual reports).

SPECIFIC STRENGTHS

1. Sensitivity to the Tribal vision for its forests reflected in the Sustainability Strategy; KMP pursues the overall restoration vision in specific terms appropriate to the ecology of the forest.
2. Natural history and human use history have been extensively researched, new material has been brought to light, and this has been effectively used in the plan.

3. Ecological trends in vegetation, habitat and wildlife populations have be carefully examined and used as the basis for the plan, along with the Tribal vision.
4. Desired future trajectories for the various delineated forest types and conditions have been carefully worked out and applied to harvest schedules and restoration prescriptions. These are well described in text, numbers and photos. The photos included in the plan are especially effective.
5. An Operations Section (document III) lays out a plausible approach to practical realization of the plan's objectives.
6. Long term condition of the forest and its sub-units remains the guiding vision for all plan objectives; short-term problems and expediencies are considered appropriately, but always remain subservient to the long term.
7. The forest is appropriately zoned into ecological/operational units using the best scientific evidence available, and effective standards and guidelines are presented for their use.
8. Monitoring and adaptive research of the kind supported by IFMAT I are organically incorporated into the plan.
9. The creation of demonstration areas in each significant forest type and condition are to be established so that Tribal members, staff, contractors and publics can see the current and desired future of each significant forest component.

SUGGESTIONS

1. IFMAT I proposes that resource management activities within a Tribal organization should have a single director to provide integration among natural resource and related cultural plans and activities. This structure should be supported by ongoing Tribal public involvement that keeps Tribal members closely apprised of management plans and activities.
2. A fuller treatment of integration of KMP with other Tribal plans and planning activities would support future integration of objectives and operations across Tribal activities.
3. The plan will create comparisons between treated and untreated areas in each major forest component, and this should be further flagged and described in the KMP.
4. A detailed financial and business plan should be added so that ecological and economic considerations can be effectively meshed.
5. Sections on forest soils and genecology should briefly discuss the likely effects of planned activities on soil properties, productivity and conservation and on the genetic structure and evolution of major species.
6. More information will be needed, as the plan unfolds, on the dynamics of meadow communities and hardwood woodlands.
7. Grazing, especially by the growing elk population and domestic livestock, needs fuller treatment as to its management and impacts.
8. A more detailed transportation plan should be developed over the first years of plan implementation.
9. Adaptive management trials should go forward even if it isn't possible to create replicated and randomized trials though the use of closely watched single trials that include an a priori hypothesis and careful observation.

I believe that these considerations can add strength to an already excellent plan. Please don't hesitate to call on me if I can be of additional help. Many additional comments are provided in the individual statements of the other reviewers, and I will be happy to provide the "raw materials" of the review (notes, comments on documents) if you would like to have them.

INDIVIDUAL REPORTS

John Beuter

UMPQUA-TUALATIN, INC.

Forests and Forestry

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September 23, 2003

MEMO TO: John Gordon

FROM: John Beuter

SUBJECT: Notes from review of the Klamath Reservation Forest

Following is a summary of my observations based on reviewing the planning documents for the proposed Klamath Reservation Forest (KRF) and interaction with planners, tribal forestry staff and our review team on field visits, September 4-5, 2003.

1. Excellence - With the notable omission of a clear business plan (to be discussed below), the plan sets a standard of excellence for the process and substance of planning for forest restoration on a large property. The plan is specific to the KRF property and tribal objectives, but would be pertinent to any entity that owned the KRF or similar property, and wished to manage it for the same objectives. The elements of excellence include the following:

   a. Science-informed regarding ecological structure and processes, with specific reference to trees, wildlife needs and wildfire risk. Top-tier scientists were involved in or were consulted in the planning process, which included also extensive review of the literature pertinent to issues on the KRF.

   b. Experience-informed regarding site-specific input from locally-experienced field foresters and other natural resource specialists about what works (has worked) and doesn't work (hasn't worked) on the ground.

   c. Peer-reviewed (science & experience) by top-tier scientists, with findings that the plan specifically identifies, describes and pictures (by use of photos) key components of the forest and classifies them as exemplars of the restoration vision, or areas needing attention in order to attain the restoration vision. For components needing attention, prescriptions are well thought out and presented, allowing for easy verification, modification (where needed) and implementation in the field.

d. **Adaptable** in terms of scope, timing, process and substance. Prescriptions are not intended to mechanical in nature, i.e. to be broadcast mindlessly across thousands of acres of a component of the forest. The prescriptions reflect the best knowledge and judgment at this point in time. Implementation at any point in time is intended to set a standard of excellence for a specific situation, and provide a basis for acquiring new knowledge that may be useful for modifying prescriptions and ratcheting up the standard of excellence over time.

2. **A business plan** is needed to complete the plan. Without finances and financial management the restoration plan cannot be implemented. At present, the plan includes a net cost (after accounting for cash flow from sale of timber) of $4.5-5 million per year to implement restoration activities. In my judgment, it will take $10-15 million per year to manage the forest (including restoration activities), some of which might be offset by cash flow from the sale of timber. Costs are likely to toward the higher end of the range in the early years. The business plan should be detailed for the first 10 years, showing year-by-year:
    a. **Priorities for restoration activities** should be set based on ecological risk and economic opportunity, including accounting for anticipated costs and revenues as well as restoration accomplishments.
    b. **Organizational overhead** needs to be accounted for, including costs for personnel, office management, vehicles and other equipment; costs for planning, consultation, public involvement, monitoring, etc.
    c. **Cost-effectiveness** of proposed activities should be analyzed to the extent possible to minimize operational costs and eliminate activities where benefits are not likely to exceed the costs.
    d. **Net cost per year** can be estimated from a-c above. This is the amount that must be raised from sources external to forest operations in order for the plan to be implemented.

3. **Random comments:**
    a. **Grazing:** Concern was expressed in the plan and in review comments about forage for wildlife, particularly bitterbrush and aspen. In the recommended prescriptions for inducing the growth of forage it wasn't clear that the impact of livestock grazing on its availability for wildlife was considered. Existing grazing allotments need to be explicitly accounted for, and evaluated as to compatibility with restoration objectives.
    b. **Roads:** Existing road density is implied to be a problem that needs attention. That may well be, but cannot be known for sure without a transportation plan compatible with the restoration objectives. Existing roads do not appear to be an environmental problem, and maintenance costs are relatively low. In my opinion, roads are not a high priority for expenditures beyond routine maintenance at this time, except for <u>specific</u> needs and problems that need to be addressed to foster restoration objectives.
    c. **Adjacent ownerships and inholdings** should be addressed regarding impact and risks to restoration activities, and opportunities for cooperation to reduce risks and enhance restoration across the broader landscape.

4. Perspective: Care should be taken in discussing restoration prescriptions to avoid giving the impression that they are to be (or should be) applied mechanically and instantly across the entire component of the forest to which they pertain. Prescriptions are intended to be adaptable to differing situations encountered on the ground and to knowledge acquired over time (see 1d above).

5. Confidence: Given the observations of excellence cited above the plan should be presented and defended with constructive assertiveness and confidence, leaving the impression that this plan sets a new standard of excellence for process and substance. Although it may be appropriate to seek comment and suggestions beyond the review team, the rules of engagement should be set to avoid endless debate and standing to disrupt or delay use of the plan as a means to establish the intent and credibility of the Tribes in re-acquiring their land base. The key to confidence is to assert that even if the Tribes were unsuccessful in re-acquiring the KRF, this is the best plan for the Forest Service to follow, assuming they have similar restoration objectives.

6. Best interest of the Tribes should be the main criterion for setting restoration priorities and fine-tuning the implementation of the plan. Sometimes the discussion of the review team seem to me to be more about designing a research forest, than planning for an operational forest intended to provide sustainable cultural, social and economic benefits to the Tribes. Scientific advisers need to be sensitive to the potential costs to the Tribes (monetary and opportunity costs, both short-term and long-term) of recommendations for reserves, controls and other restrictions of opportunity and choice. The plan already constrains overall choice to those activities and practices that foster restoration of ecological values and resources that are culturally important to the Tribes. Given that, every effort should be made to enhance monetary value by minimizing costs and preserving options for monetary enhancement. Examples discussed by the review team were to provide for active management for timber production (enhanced growth) of lodgepole pine and the monarch tree understory of naturally occurring white fir. While these alternatives may seem inappropriate to pure scientifically-defined forest restoration, they should be considered in the context of the constraints already imposed by overall restoration plan and, at the margin, deciding what's best for the Tribes.

Hal Salwasser

General

The Klamath Forest Plan draft (August 15, 2003 version) proposes a bold, innovative and compelling plan for restoring resiliency and productivity of Klamath Basin pine and mixed conifer forests while generating and sustaining cultural, social, environmental and economic benefits for the tribes. Several hundred thousand of acres of forest on the Klamath Reservation are currently at moderate to high risk to drought stress, insects, or uncharacteristically intense fire. Thousands of other acres are functioning at far less than their productive capacity for desired resource values, e.g., mule deer and culturally important plants. Further ecological and economic losses will occur if restoration is not initiated, exemplified by continued low deer numbers and recent fires. The Klamath Forest Plan has potential to demonstrate a new model for restoration forestry on federal forestlands in addition to the reservation. The proposal to replace unlimited planning with adaptive management to learn and improve through well-designed action and monitoring is excellent.

Administrative and Policy Considerations

Consider tying the final Forest plan more directly to the tribes' vision for overall cultural, economic, social and environmental sustainability, not just to forest sustainability; use all parts of the Klamath Tribes Vision in the sustainability strategy (page 13) to guide plan.

Consider modifying the two principles on page 2 of the draft plan to address "what for" and "for whom" questions about the management plan: to restore and sustain the tribes' cultural, economic and social vitality.

Consider modifications to Principles for the Management of the Klamath Tribal Forestlands:

- ✓ Consider training and employment of tribal members as principles for forest management.
- ✓ Consider revitalization of tribal culture and economy as forest management principles. Ecological restoration could be designed with economic and cultural revitalization in mind.
- ✓ Consider modifying forest management principle 12 to include traditional ecological knowledge and local experience of professional resource managers as well as best available science as bases for decisions.
- ✓ Consider modifying the decision-making and administrative appeal processes to more fully reflect tribal culture and dispute resolution processes rather than mirror dysfunctional federal appeal and judicial review processes currently in place for federal resource agencies. Allowing for challenge to decisions is good but dispute resolution should have the purpose of learning and improving decisions. Consider making the Klamath Forest Review Board or tribal judicial review the final arbiter of disputes to maintain tribal sovereignty.

Brief and involve the Fremont-Winema Forest Supervisor and Chiloquin District Ranger on the plan soon and as it evolves.

Wildlife

The August 15, 2003 draft uses a "regulated forest" approach to conservation of wildlife habitats, i.e., standards for cover:forage ratios, snag standards, and riparian reserves. This approach is not necessary for the ecosystem restoration strategy being proposed. The draft Plan aims to restore more naturally diverse and resilient forest conditions over the entire area of the reservation, including restoration of vibrant aspen and riparian communities. Thus, it aims to restore ecosystem conditions and processes similar to those that all native species evolved with; they should all benefit from the restored conditions.

The regulated forest approach to wildlife conservation was developed to serve federal, state and private forest plans that aimed to change forests from naturally diverse and resilient forests to highly regulated, simpler ecosystems. Many wildlife and fish species can be negatively impacted by unmitigated regulated forest management actions such as clear cutting followed by planting closely spaced trees for the primary purpose of growing wood, removing snags and down wood habitats, simplifying tree species diversity, age and size classes, and changing riparian areas through heavy grazing. Therefore, special management provisions are commonly put into regulated forest plans to protect sufficient habitat conditions to retain most, if not all, native species in the plan area. These special provisions range from state forest practice act rules to federal forest plan standards and guidelines to standards required by various certification schemes for forest sustainability.

The proposed Klamath Forest Plan starts with a 180^{o} different objective: to restore and sustain a naturally diverse forest and its ecological processes. Thus, the tools and provisions suited for previous and currently existing forest plans, e.g., the Winema NF Plan and NWFP, may not needed and could actually present unnecessary encumbrances to effective and timely restoration under the proposed plan.

Species associated with complex forests, riparian and aspen communities, and mule deer should all benefit immensely from planned restoration of complex forests with abundant under story shrubs and herbs. No additional standards for old-forest associated species or deer should be needed given the habitat diversity and productivity that will ensue if planned restoration work occurs in Pine-PUTR, mixed conifer, aspen and riparian areas. For deer, focus on forage more than cover. Cover does only 2 things: it reduces energy loss to heat and cold or it protects animals from predators (human included). Only forage can "grow" deer and forage has been the most significant factor in mule deer declines since before I studied the herds in 1970s. The most important forage for population growth and big bucks is spring-summer forage, while does are in their third trimester and lactating and while males are bulking up for rut and winter. A diverse assortment of grasses, forbs and shrubs at stand and landscape scales is desired. Forage is in lousy shape in nearly all sites we visited and can be improved only by creating more early seral conditions and getting more sunlight below the forest canopy.

To articulate and assess the impacts – positive, negative and neutral — of the plan for "indicator," "key-stone," or "focal" species, groups of species, and key habitats, use inventories and maps of current habitat conditions together with the same for future conditions at decadal intervals with wildlife habitat relationships models as interpretive tools and for monitoring. These indicator, keystone, or focal species, groups, and habitats could include:

- ✓ federal and state listed species at risk of extinction,
- ✓ mule deer,
- ✓ elk,
- ✓ bitterbrush,
- ✓ aspen,
- ✓ willows or riparian areas,
- ✓ snag and down wood associated species,
- ✓ complex late seral forests restored to resiliency and the species associated with them, and
- ✓ other culturally significant plants and animals.

Avoid hard numeric targets and aim instead for general conditions and ranges that can be measured at reasonable costs. For example, make the 21" limit on tree harvest a general and not a hard and fast rule. Focus more on the composition and distribution of big trees left after thinning and their replacement cohorts of smaller trees. Don't aim for "perfect" or precise solutions rather favor a little sloppiness.

Watch out for elk impacts on deer; elk displace deer behaviorally and they eat some of the same plants.

How will livestock grazing be managed to allow for shrub and herbaceous forage productivity?

How will hunting pressure on deer be managed to allow herd response to new vegetation?

What about fish? There is little about them in the August 15, 2003 draft.

Globally replace "coarse woody debris" wherever it is mentioned in the text with "coarse wood" or "large wood habitats."

Globally replace references to "forest health" or "healthy forests" in the text with "forest resiliency:" resiliency to fire, insects, droughts, or invasives is the desired outcome and is what health and diversity provide.
Miscellaneous

Explore alternative governance models as intermediates on the path to full reservation restoration:

- ✓ Forest Service maintains responsibility but follows tribal management plan and "tests" the tribes' principles for dispute resolution.

- ✓ Set up new reservation as a trust along lines of Valles Caldera in NM

Pay close attention to costs in all activities.

Consider modification to the IFMAT II Criteria for tribal forest plans to articulate closer linkage of forest management to cultural and economic goals of tribes. I have provided some suggested edits to Norm Johnson.

Norm Christensen

This plan is both thorough and thoughtful. The goals are well thought and clearly articulated, and the management plan is completely consistent with those goals. That said, I would like to comment on five areas where I believe the plan can be improved.

1. The long-term context for management. For the most part, the plan focuses on what might be termed immediate goals such as restoration of forest complexity, reducing fire risk and improving wildlife habitat. It is not entirely clear how individual stands and the landscape will be managed in the long term. Put another way, once stands are restored to some condition, then what? It may be useful to speak of "desired future conditions," but forest management is, at its core, change management—we are actually managing future trajectories. Management interventions will set in motion new patterns of change that will, in turn, shape future forests values and risks. Thinning from below will most certainly diminish fire risk in many stands, however, thought must be given to the change that will ensue when such thinning is complete. Without a subsequent program to manage fuel re-growth, forests will return to flammable conditions in a matter of a decade or two. In the mixed-conifer forests, this pattern of change may be the basis for an economically and ecologically sustainable silviculture that leaves the "big old trees" and harvests the ingrowth on a 30-50 year rotation. A similar strategy might be employed in the simple and complex ponderosa pine types, but it is not likely to be costly from an economic standpoint. In these stands, a prescribed fire program may be the preferred alternative. In any case, this is a risk management process; forests will change such that risks

of wildfire will be changing constantly in time. Such risks might best be managed in the context of a landscape-level management plan.

2. Mixed and moist mixed conifer forests. In the original InterForest evaluation it was suggested that restoration in the complex mixed conifer forests was not a high priority. However, it is clear that fire protection over the past decades has resulted in ingrowth of shade tolerant species (e.g., white fir) in these stands and that this ingrowth provides a very direct and immediate threat to the very large trees. We recommend that these stands be given a very high priority for restoration in order to protect their important ecological values. Restoration in these stands will provide additional economic benefits to offset the very real costs for restoration in the simplified ponderosa pine types.

3. Landscape-level planning. This area provides a terrific opportunity to implement management that is cognizant of landscape-level processes and spatial relationships among stands. This may be an important tool for managing future risks associated with forest change. Fire, as well as many other disturbances, is a landscape phenomenon. For the most part, the chance of an individual stand burning is determined by the patterns of fire across the landscape and the characteristics of adjacent stands. There is abundant opportunity to break the area into management compartments within which stands can be management in such a way as to minimize the risk of landscape-level disturbances. Such landscape-level management is clearly relevant to the health of wildlife populations as well.

4. Biological Diversity. This plan is clearly aimed at increasing the biological diversity of the entire reservation. That said, it is not possible to monitor each and every species to ensure success in this area. The attention given to game wildlife and at-risk species is entirely appropriate. More attention could be given to the behavior of species that may play a role in key ecosystem processes. Most important here is bitterbrush. It is clear that our understanding of the biology of this species is still somewhat limited, particularly in regards to its response to different kinds and intensities of disturbance. Its health is certainly important to browsing animals such as the mule deer. As a nitrogen fixing shrub, its regrowth following fire and cutting may be important to the maintenance of productivity on a variety of sites slated for restoration.

5. Adaptive management. This is one of the finest management plans I have seen. That said, it is likely that case that particular practices or recommendations will produce undesirable. This plan is very clear in its advocacy of adaptive management and includes important provisions for such management. In the context of adaptive management, some intensive research will be necessary of course. Nevertheless, the priority should be the development of a suite of relatively simple, cost effective indices—a “dashboard”—of ecosystem health that are directly relevant to the central goals of this plan and can be implemented by line managers.