TERRESTRIAL HABITAT—BROAD SCALE OVERVIEW

The Arapaho and Roosevelt National Forests and Pawnee National Grassland extend across the Front Range of the Rocky Mountains and the High Plains of northeastern Colorado. Vegetative regions range from alpine tundra at the highest elevations to subalpine forest, upper and lower montane forests, and finally to short-grass prairie at the lowest elevations. Flora is central to the discussion of terrestrial habitat.

MOUNTAINS

ECOLOGICAL SECTION

Within Province M331, the Arapaho and Roosevelt National Forests are entirely in the Northern Parks and Ranges Section, M331I. This area covers about 18,000 square miles, or 17.6 percent of the province and 0.5 percent of the United States. The section is generally characterized as mountains with broad plains. Elevations range from 5,575 to 14,410 feet and there are many rivers and streams, (USDA Forest Service 1994).

ARAPAHO AND ROOSEVELT NATIONAL FORESTS

The Range of Natural Variation (RNV) is defined as the spectrum of conditions possible in ecosystem composition, structure and function considering both temporal and spatial factors (Kaufmann, et al. 1994). Comparison of existing conditions with the RNV is considered a useful indicator of the health and balance of an ecosystem. Many elements of composition, structure and function are discussed in the following sections; however, the RNV has not been ascertained for most elements, and useful comparisons are limited. In certain sections where data exist estimates of RNV and conclusions based on it are used to judge, to the extent possible, what conditions existed prior to human influence. In one situation, approximations of RNV from similar, nearby forest ecosystems are presented. The sections that discuss and compare RNV include vegetation structure (for late seral forest types, including old-growth forests), habitat effectiveness and interior forests.

Composition of Ground Cover

Forest vegetation dominates this mountainous area, but many other associated species of plants grow within each major cover type. Within these more obvious, existing vegetation cover types are habitat types that are distinguished on the basis of understory vegetation. Habitat types indicate the potential natural vegetation, or association of plants, that will occur in the absence of disturbance. Lodgepole pine forests, for example, are most prevalent but a substantial portion of them would become dominated by subalpine fir and Engelmann spruce in the absence of major disturbances such as fire, windstorms, insects, disease or logging. Similarly, certain existing ponderosa pine forests are actually Douglas-fir habitat types and will eventually be dominated by Douglas-fir trees in the continued absence of fire and other disturbances. Habitat types and plant

associations have been described, and predictions of future conditions are possible assuming the presence or absence of disturbances (Hess and Alexander 1986, Johnston 1987). While habitat types have not been mapped, it is important to be aware of the differences between what exists now and what may exist in the future given disturbance or the lack of it.

The following specific *Forest Plan* direction assures, along with more general direction, adequate early and late forest structural stages including old growth for terrestrial wildlife:

- Chapter One, Section One: Forestwide management emphasis goals 3 and 8 and objectives 2 and 12 for biodiversity, ecosystem health and sustainability
- Chapter One, Section Two: Operational goals, standards and guidelines 34, 41, 43, 62, 66, 92, 93, 116-122
- Chapter Two and Three: Geographic and management area direction that emphasizes wildlife habitat

Table 3.49 Existing Land Cover of the Arapaho and Roosevelt National Forests

Major Vegetation and Nonvegetation Cover	Acres (Approximate)	Percent
FORESTED		
Lodgepole pine	501,000	39
Engelmann spruce and subalpine fir	248,000	19
Ponderosa pine	137,000	11
Douglas-fir	57,000	4
Aspen	44,000	3
Limber, bristlecone, pinyon pine, juniper	8,000	1
Narrowleaf cottonwood and blue spruce	1,000	<1
SUBTOTAL	996,000	77

Major Vegetation and Nonvegetation Cover	Acres (Approximate)	Percent
NONFORESTED		
Grasses and forbs	144,000	11
Shrubs	68,000	5
Rock, ice, and other nonvegetation	67,000	5
Lakes and ponds	14,000	2
SUBTOTAL	293,000	23
TOTAL	1,289,000	100

Environmental Consequences—Ground Cover Composition

The existing acreages shown above are expected to change little over time with any alternative. No conversions of one vegetation type to another will occur; however shifts in seral and climax species within habitats will vary among the six alternatives. Such shifts would, however, be within the range of natural variation (RNV) where change is slow and probably detectable only over centuries.

Management under the two possible budget levels is likely to affect the ground cover. Aspen, which is presently suppressed by late successional conifers, will increase as a seral component where harvest and burning of conifers occur, especially where overstory is removed in lodgepole pine and spruce-fir forests that have aspen as a major seral species. Conifers will eventually establish dominance again. Alternative I is estimated to result in the most aspen, followed by Alternatives C, A, B, H, and E, respectively, based on changes from late- to early-structural stages due to timber management and fire occurrence in decade 1 (Tables 3.59 through 3.64) and on the amount of planned aspen regeneration for wildlife habitat improvement (See the Supplemental Tables at the end of this document). The increase in aspen will occur primarily in lodgepole pine forests.

Where management and other disturbances are absent the lodgepole pine cover will become dominated by subalpine fir and Engelmann spruce. This will occur in subalpine fir habitat types where lodgepole pine is presently a major seral species, but where succession is at the point of overstory establishment by fir and spruce and the lodgepole pine canopy is fading. This slow, natural progression to fir and spruce will likely be highest in Alternative E followed by H, A, B, C and I, respectively, based on the relative amounts of remaining late successional lodgepole pine in decade 5 (Tables 3.59 through 3.64).

Existing ponderosa pine canopies will decrease in some areas if fire suppression and lack of vegetation treatment continue to allow Douglas-fir trees to succeed into dominance. Retention of ponderosa pine dominance will be greatest in Alternative H followed by B, A, C, I and E,

respectively, based on planned acres of harvest and fuel treatment over five decades in these conifer types.

Young ponderosa pine trees will increase in some areas if fire suppression continues to allow their regeneration around dry grassland openings; a small shift from nonforested to forested area would result. Maintenance of existing openings and discouragement of invading ponderosa pine will be greatest in Alternative H, followed by A, then by C, E and I which are equal, and last by B, based on planned acres of reduced conifer encroachment.

Shrubs will gain in dominance on grass-forb-shrublands if fire suppression continues in these areas. Young ponderosa pine trees will succeed in invading openings under the six alternatives in much the same way as described in the foregoing paragraph.

Areas of nonvegetation are expected to change little, if any, by alternative.

Patterns of Vegetation

The arrangement and distribution of vegetation vary considerably across the Forests, and particularly with elevation. Alpine tundra occurs at the highest elevations and consists of low shrubs, cushion plants, forbs, sedges, lichens and mosses. The alpine tundra region is found from about 11,000 feet to the tops of the peaks some of which exceed 14,000 feet. In the ARNF tundra occurs primarily along the Continental Divide. This region has short, cool summers and long, cold winters. Snow may cover the ground all year in some areas, not at all in others. Strong winds, variable moisture, and a 45-day growing season create a harsh environment. Vegetation includes hairgrass, buttercup, sedges, grasses, willows, and cushion plants. Scattered krummholz of spruce and fir are found at the lower boundary of this region.

Subalpine forests of Engelmann spruce, subalpine fir, limber pine and bristlecone pine occur just below alpine areas at elevations from 9,000 to 11,000 feet. Wet meadows and bogs are common. This region is cool in summer and cold in winter. Temperatures below zero degrees Fahrenheit are frequent and may extend for long periods of time. The growing season is less than 90 days. Precipitation is 25 to 30 inches annually. The principal vegetation series are willow-birch and sedge-grass meadows on the valley floors, with limber pine, lodgepole pine, aspen, Engelmann spruce, and subalpine fir on the slopes and ridgetops.

Lodgepole pine forests grow on both sides of the Continental Divide below the subalpine forests in the upper montane region from roughly 8,000 to 9,000 feet. The growing season is less than 90 days and precipitation is 25 to 30 inches per year. Willows, alder, birch, grasses, and sedges cover the valley floors. The valley walls and ridge tops host fairly dense stands of aspen, ponderosa pine, Douglas-fir, limber pine, and lodgepole pine.

Ponderosa pine and Douglas-fir forests, shrublands and grasslands predominate at the lower elevations of the National Forests east of the Continental Divide. This lower montane forest region occupies an elevational range from 6,000 to 8,000 feet, with a growing season of about 100 days and precipitation averages of 20 to25 inches per year. Sagebrush and grasses are

intermixed in the eastern portion; ponderosa pine and grasses predominate in the central portion; and stands of Douglas-fir and ponderosa pine are found in the western portion. Low moisture levels produce park-like stands of widely spaced trees with a grass/shrub understory.

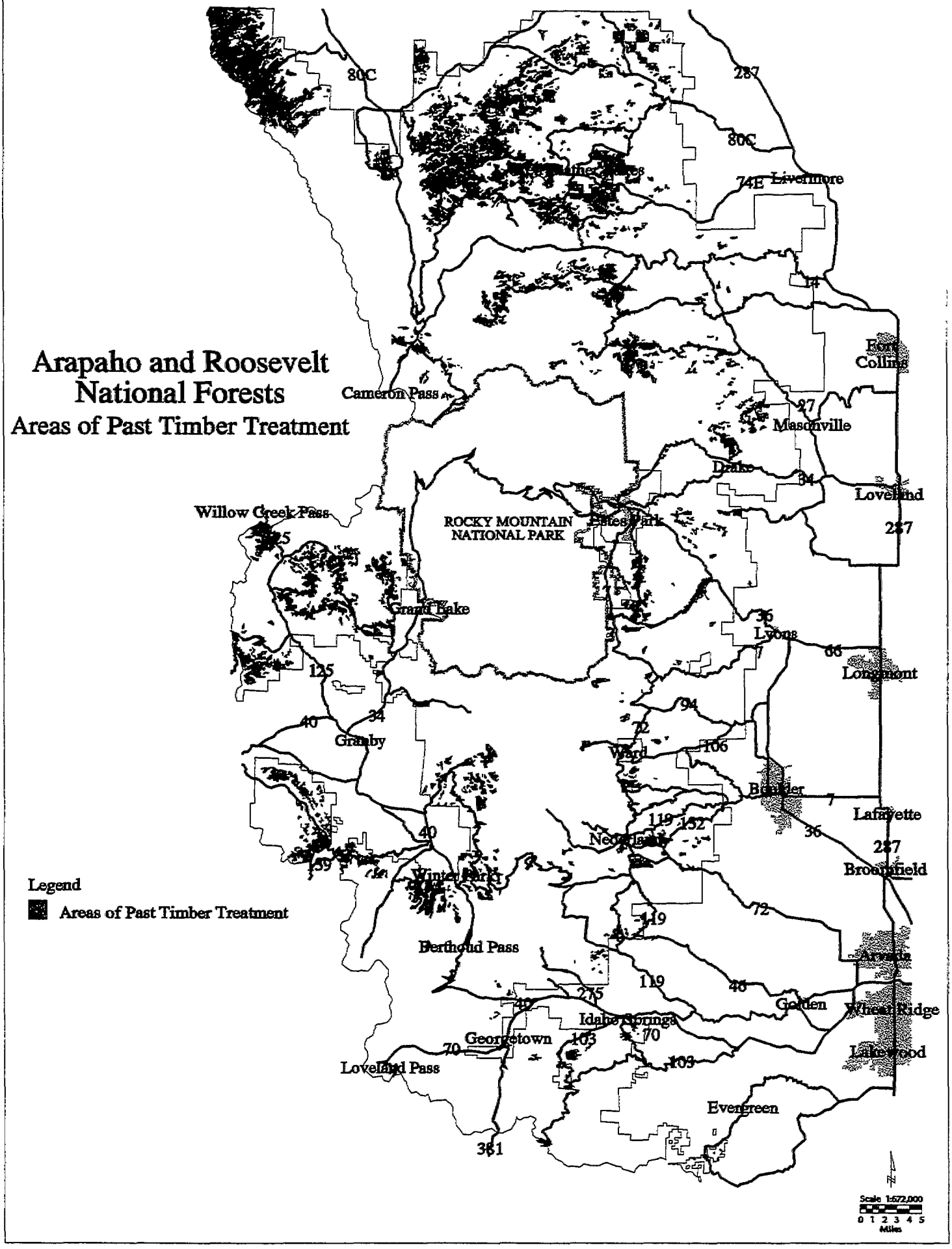
Patterns of vegetation vary considerably within and between these forest types. High-elevation spruce-fir forests are most uniform and connected except where logging has occurred and sites are becoming re-established to trees. Medium- elevation lodgepole pine forests vary from highly uniform and connected to generally patchy and broken where recent logging or fires have occurred and sites are becoming re-established to trees. Low elevation ponderosa pine and Douglas-fir forests are mostly patchy and broken due to human development, logging and insect epidemics. Forested corridors are discussed further in the wildlife section of this chapter.

Aspen is a major seral component in portions of the spruce-fir and lodgepole pine forests and in limited areas occurs as a major climax species, especially in the northwestern part of the Arapaho National Forest and the northern Roosevelt National Forest. Blue spruce occurs in high-elevation riparian areas and narrowleaf cottonwood occurs in low-elevation riparian areas. Rocky Mountain juniper occurs in dry foothills on the eastern edge of the Roosevelt National Forest (Hess and Alexander 1986). Shrublands of willow species are common in moist, medium- to high-elevation openings. Species such as sagebrush, mountain mahogany, rabbitbrush, bitterbrush, skunkbush, gooseberry and raspberry occur at dry, medium- to low-elevation openings and within juniper and ponderosa pine forests. Grasses and grasslike plants dominate a wide variety of openings from foothills to alpine, from dry to wet environments.

Environmental Consequences—Vegetation Patterns

Patterns associated with vegetation composition are expected to change little with any of the six alternatives. However, changes in structure discussed in the next section, will create different patterns. Altered patterns of structure are likely to result from vegetation treatments, which will vary by alternative and will occur primarily within areas classified as "suitable and available" for timber management (see *the timber suitability map* included with this document). Treatments and resulting changes from existing structural patterns will generally be in accessible areas where timber management has occurred in the past, as shown in Figure 3.10. The sizes of created openings will generally be larger than those created by humans in the past, and should more closely mimic the results of natural events in both size and shape.

Figure 3.10


Arapaho and Roosevelt National Forests
Areas of Past Timber Treatment
Legend
Areas of Past Timber Treatment
80C
287
74E
Livermore
Fort Collins
Cameron Pass
Masonville
Drake
Loveland
Willow Creek Pass
ROCKY MOUNTAIN NATIONAL PARK
Estes Park
Grand Lake
Lyons
Longmont
125
Granby
Ward
Boulder
Lafayette
Broomfield
Winter Park
Berthoud Pass
Arvada
Golden
Wheat Ridge
Idaho Springs
Georgetown
Lakewood
Loveland Pass
Evergreen
361
Scale 1:672,000
0 1 2 3 4 5
Miles

Structure of Vegetation

Within the Arapaho and Roosevelt National Forests, 2 percent of forested vegetation is early successional grass-forb and shrub-seedling, and 59 percent is late successional mature and old-growth stages (Table 3.50). Within individual forest types the amounts per structural stage vary (Table 3.51).

Table 3.50 Structure of All Forested Vegetation, ARNF, 1997

Vegetation Cover	Acres (Approximate)	Percent of Total
Grass-forb	9,000	1
Shrub-seedling	10,600	1
Sapling-pole	344,300	36
Late successional		
Mature	470,600	50
Old Growth	108,900	12
TOTAL	943,400	100

Table 3.51 Forest Structural Stages of All Conifer Types, ARNF, 1997

Forest Type/ Structural Stage	Acres (Approximate)	Percent of Type Subtotal	Percent of Forests Total
Lodgepole pine			
Grass-forb	5,300	1	1
Shrub-seedling	8,000	1	1
Sapling-pole	254,300	51	25
Late successional -Mature	195,800	39	19
Late successional -Old Growth	38,000	8	4
SUBTOTAL	501,400	100	50

Forest Type/ Structural Stage	Acres (Approximate)	Percent of Type Subtotal	Percent of Forests Total
Spruce/Fir			
Grass-forb	1,800	1	<1
Shrub-seedling	1,500	<1	<1
Sapling-pole	54,100	21	5
Late successional - Mature	121,400	49	12
Late successional - Old Growth	69,200	28	7
SUBTOTAL	248,000	100	25
Ponderosa pine			
Grass-forb	1,500	1	<1
Shrub-seedling	800	<1	<1
Sapling-pole	19,300	14	2
Late successional-Mature	113,800	84	11
Late successional-Old Growth	1,300	1	<1
SUBTOTAL	136,700	100	14
Douglas-fir			
Grass-forb	400	1	<1
Shrub-seedling	300	<1	<1
Sapling-pole	16,600	29	2
Late successional - Mature	39,600	69	4
Late successional-Old Growth	400	1	<1
SUBTOTAL	57,300	100	6

Forest Type/ Structural Stage	Acres (Approximate)	Percent of Type Subtotal	Percent of Forests Total
Aspen			
Grass-forb	300	<1	<1
Shrub-seedling	600	1	<1
Sapling-pole	35,500	83	3
Late successional-Mature	7,200	16	1
Late successional-Old Growth	0	0	0
SUBTOTAL	43,600	100	4
Limber, bristlecone, pinyon pines, cottonwood, blue spruce and juniper			
Grass-forb	100	1	<1
Shrub-seedling	0	0	<1
Sapling-pole	6,800	71	1
Late successional-Mature	2,300	25	<1
Late successional-Old Growth	300	3	<1
SUBTOTAL	9,500	100	1
TOTAL	996,500		100

The range of natural variation (RNV) is not known for vegetation structure, but two scenarios can be conjectured. The first is based on estimates of RNV made for a 28,000 acre area within the adjacent Routt National Forest and summarized in Table 3.52, but it is uncertain whether these estimates are appropriate for larger scales such as the Arapaho and Roosevelt National Forests.

Table 3.52 Estimated RNV Percent by Seral Stage in a 28,000 Acre Area, Routt National Forest vs Existing Conditions on the ARNF[a]

Estimated RNV percent by seral stage, Routt NF			
Forest Type	**Early**	**Intermediate**	**Late**
Lodgepole pine	20-50	20-50	30-70
Spruce-fir	0-20	10-20	50-70

ARNF existing percent by seral stage			
Forest Type	**Early**	**Intermediate**	**Late**
Lodgepole pine	2-3[b]	50-51[b]	47
Spruce-fir	1	21	77

[a] Source: USDA Forest Service (1994a).

[b] Rounding to the nearest percent causes slight differences between percentage amounts from separate, single structural stage categories (Table 3.51) versus a structural stage category for both grass-forb with shrub-seedling stages combined (Table 3.68). Hence, the one percent range for these lodgepole pine seral stages.

Assuming the RNV estimates at the relatively small scale of 28,000 acres are meaningful to compare with the larger scale of the ARNF's 1,289,000 acres, indications are that in lodgepole pine the early seral stages are now substantially below RNV and the intermediate seral stages are slightly above RNV. In spruce-fir forests, intermediate seral stages are now slightly over RNV and late seral stages are substantially over RNV. These indications are not, however, consistent with estimates of late seral RNV for both lodgepole pine and spruce-fir using the approach of the second scenario.

The second scenario takes as a reasonable assumption that the vegetation structure currently existing in high-elevation wilderness areas is within the RNV that existed prior to human influence. While this influence has affected wilderness areas to some extent, with fire suppression probably the largest, the degree of influence on structural stages has generally been low in contrast to other NFS lands. Looking at existing structural stages in wilderness may thus offer a starting point for defining RNV vegetation structure.

Table 3.53 Seral Stages by Percent, ARNF Wilderness Areas

Forest Type	Early	Intermediate	Late
Lodgepole pine	1	38	61
Spruce-fir	1	16	83

Given the fire activity that would have probably occurred naturally and without fire suppression over the past century, it is reasonable to conclude that the current amount of early lodgepole pine (1 percent) is below RNV. Because lodgepole pine is dependent on fire, it is probable that the first scenario's estimate of 20 to 50 percent more closely approximates the lower extreme of RNV. For the same reasons, the current level of late seral spruce-fir in wilderness (83 percent) is likely higher than RNV. However, whether the first scenario's estimate of 50 to 70 percent better approximates the upper value of RNV is less certain.

Table 3.54 Forest Structural Stages by Major Forest Type Inside and Outside Wilderness Areas, ARNF, 1997

Major Forest Type/ Structural Stage	Wilderness Areas		Outside Wilderness Areas	
	Acres (Approximate)	Percent of Type Subtotal	Acres (Approximate)	Percent of Type Subtotal
Lodgepole pine				
Grass-forb	0	0	5,300	1
Shrub-seedling	600	1	7,400	2
Sapling-pole	34,900	38	219,300	54
Late successional - Mature	46,300	50	149,500	36
Late successional-Old Growth	10,000	11	28,000	7
SUBTOTAL	91,800	100	409,500	100
Spruce/Fir				
Grass-forb	200	<1	1,500	1
Shrub-seedling	100	<1	1,300	1
Sapling-pole	13,600	16	40,500	25
Late successional - Mature	44,500	51	76,800	48
Late successional - Old	28,100	32	41,100	25
SUBTOTAL	86,500	100	161,200	100

For ponderosa pine and Douglas-fir old growth, comparison with wilderness is not possible but present amounts of old growth are estimated to be lower than in times prior to humans dating back to prehistory (Mehl 1995). The extremely low existing amounts (Tables 3.55 and 3.56) are quite possibly below the RNV.

Old Growth Forests

Late successional forests are identified as old growth and mature. According to one recent source, "Old-growth forests are ecosystems distinguished by old trees and related structural features. Old growth encompasses the later stages of stand development that typically differ from earlier stages in structure, composition, function, and other attributes" (USDA 1992a). Within the mature forest structural stage is a portion inventoried as relatively close to becoming

old growth, and termed "developing" old growth. The remainder of the mature forest stage is not considered close to becoming old growth.

Mehl (1992) notes that old growth is typically distinguished from younger growth by *several of the following stand attributes:* large trees for species and site; variation in tree sizes and spacing; standing and down dead trees; decadence in the form of broken or deformed tops, or bole and root decay; multiple canopy layers; and gaps in the tree canopy and understory patchiness. *Several of the stand attributes* is notable because old-growth attributes differ among conifer types. For example, "multiple canopy layers" is a standard and "mandatory"old-growth attribute for spruce/fir but not for lodgepole pine, ponderosa pine, or Douglas-fir. The Glossary and Appendix B give further definition and details.

About 12 percent (107,500 acres) of the major forested types exist as old growth on the ARNF. About two-thirds of this acreage is spruce and fir, one-third is lodgepole pine and 1 percent is Douglas-fir and ponderosa pine. Another 14 percent (132,000 acres) is inventoried as "developing" old growth, or estimated to become old growth within the next century in the absence of catastrophic changes at these sites[1]. Most old growth and "developing" old growth occurs in high-elevation spruce and fir, less occurs in mid-elevation lodgepole pine, and least occurs in low-elevation Douglas-fir and ponderosa pine. The *old-growth map* is available at the ARNF-PNG offices.

Table 3.55 Existing Old Growth and Developing Old Growth by Area and Percent of Conifer Forest (approximate) ARNF, 1997

Major Conifer Types	Existing Old Growth	Developing Old Growth	Totals
Spruce/fir 248,000 acres	69,200 acres 28 percent	72,900 acres 29 percent	142,100 acres 57 percent
Lodgepole pine 501,400 acres	38,000 acres 8 percent	57,200 acres 11 percent	95,200 acres 19 percent
Ponderosa pine 136,700 acres	1,300 acres 1 percent	300 acres <1 percent	1,600 acres 1 percent
Douglas-fir 57,300 acres	400 acres <1 percent	1,600 acres 3 percent	2,000 acres 3 percent
Totals **943,400 acres**	108,900 acres 12 percent	132,000 acres 14 percent	240,900 acres 26 percent

[1] The inventory of "developing" ponderosa pine and Douglas-fir old growth is incomplete. In addition to 1,900 acres inventoried as "developing" old growth, almost 114,000 acres of mature ponderosa pine and 40,000 acres of mature Douglas-fir occur, and a portion of these acreages may be within 100 years of reaching old-growth conditions.

About two-thirds of all inventoried old growth exists outside of wilderness (Table 3.56). This varies by conifer type with about 59 percent of spruce-fir, 74 percent of lodgepole pine and 100 percent of ponderosa pine and Douglas-fir old growth found outside of wilderness (Tables 3.55 and 3.56).

The RNV is not known for old growth. However, it may be reasonable to assume that the existing situation in high-elevation wilderness areas is near the upper value of RNV or within RNV values discussed earlier in the comparison of two possible scenarios. It was noted there that while human influences have affected wilderness areas to some extent, with fire suppression probably the largest, the degree of influence on structural stages has generally been low in contrast to other NFS lands. Using this assumption, comparisons can be made for spruce-fir and lodgepole forests (Tables 3.56 and 3.57). The present proportional amounts of structural stages are seen to differ, with existing old-growth lodgepole pine totaling 11 percent of the type inside wilderness and 7 percent outside wilderness. Existing old-growth spruce-fir totals 32 percent inside, versus 25 percent outside wilderness. If the assumption is generally accurate, even though not precise, it indicates downward trends in spruce-fir and lodgepole pine old growth outside of wilderness since human arrival.

For ponderosa pine and Douglas-fir old growth, comparison with wilderness is not possible, but present amounts of existing old growth are estimated to be below those of times prior to Euro-American settlement (Mehl 1995). The extremely low existing amounts are, in fact, quite possibly below the RNV (Tables 3.55 and 3.56). This relatively rare situation is addressed further in the Fire Scale Overview section.

Table 3.56 Existing and Developing Old Growth—Approximate Area and Percent of Conifer Forest Outside of Wilderness Areas, ARNF, 1997

Major Conifer Types	Existing Old Growth	Developing Old Growth	Totals
Spruce/fir 161,300 acres	41,100 acres 25 percent	42,700 acres 26 percent	83,8000 acres 52 percent
Lodgepole pine 409,600 acres	28,000 acres 7 percent	38,500 acres 9 percent	66,500 acres 16 percent
Ponderosa pine 128,600 acres	1,300 acres 1 percent	300 acres[a] <1 percent	1,600 acres 1 percent
Douglas-fir 53,400 acres	400 acres <1 percent	1,600 acres 3 percent	2,000 acres 4 percent
Totals **752,900 acres**	70,800 acres 9 percent	83,100 acres 11 percent	153,900 acres 20 percent

[a] The inventory of "developing" ponderosa pine and Douglas-fir old growth is incomplete. In addition to 1,900 acres inventoried, approximately 106,700 acres of mature ponderosa pine and 36,400 acres of mature Douglas-fir occur, and a portion of this acreage may be within 100 years of reaching old-growth conditions.

Table 3.57 Existing and Developing Old Growth—Approximate Area and Percent of Conifer Forest,Wilderness Areas, ARNF, 1997

Major Conifer Types	Existing Old Growth	Developing Old Growth	Totals
Spruce/fir 86,700 acres	28,100 acres 32 percent	30,200 acres[a] 35 percent	58,300 acres 67 percent
Lodgepole pine 91,800 acres	10,000 acres 11 percent	18,700 acres 20 percent	28,700 acres 31 percent
Totals **178,500 acres**	38,100 acres 21 percent	48,900 acres 27 percent	87,000 acres 49 percent

[a] The inventory of "developing" ponderosa pine and Douglas-fir old growth is incomplete, and some of the 7,100 acres of mature ponderosa pine and 3,200 acres of mature Douglas-fir may be 'developing' old growth in wilderness.

Other Structural Features

Within the vegetation structural stages previously discussed are other structural components as well. Standing dead trees are present across the forest because with trees of any size or age there is always tree mortality. Snags (standing dead trees) 8 inches in diameter and 6 or more feet tall, vary from few near roads that are open to public use, to many in inaccessible areas of recent insect, disease or fire occurrence. The larger-sized snags, those most important as wildlife habitat, are most prevalent in late-successional forest stages. Because of the high amount of late-successional forests, the amount of snags is generally high forestwide and except for localized situations, the conditions they provide for wildlife are considered generally adequate.

Down trees result from live and dead trees that fall to the forest floor. Their numbers and distribution are similar to those described for standing dead trees, and except for localized situations, conditions for wildlife are considered generally adequate. As with snags, the larger, fallen trees are most important as wildlife habitat.

The majority of the late successional spruce/fir, Douglas-fir and ponderosa pine forests have at least two-storied canopies. The earlier stages of these forest types and all stages of lodgepole pine are generally single-storied, except where lodgepole pine is being succeeded by fir and spruce. Most late successional ponderosa pine and some lodgepole pine are probably outside of RNV because human suppression of fire has created multi-storied conditions that would not otherwise exist.

Canopy closure or density of crown foliage is estimated for the sapling-pole and late successional stages in Table 3.58. Canopy closure does not apply to the grass-forb stage of forests since trees are not established, and estimates are not available for the shrub-seedling stage. An estimated 26 percent of forests have dense canopy closure, 46 have medium and 26 percent have scattered or

sparse. Canopy closure is used in defining, quantifying and comparing forested and open corridors, habitat effectiveness and interior forests in relation to wildlife habitat.

Table 3.58 Canopy Closures in Forests, ARNF, 1997

Structural Stage Canopy Closure	Acres (Approximate)	Percent of Total Forest
Grass-forb	9,000	1
Shrub-seedling	11,000	1
(canopy closure estimates not applicable to above stages)		
Sapling-pole		
<40% canopy closure	105,000	11
40-70% canopy closure	169,000	17
>70% canopy closure	113,000	11
Late Successional-Mature		
<40% canopy closure	142,000	14
40-70% canopy closure	219,100	22
>70% canopy closure	119,000	12
Late successional - Old Growth		
<40% canopy closure	11,000	1
40-70% canopy closure	71,000	7
>70% canopy closure	27,000	3
TOTAL	996,000	100

Environmental Consequences—Vegetation Structure

Major agents of change including forest growth, timber management, prescribed fire and wildfire are incorporated into the results of the following tables which show estimated changes in forest structural stages by decade and by alternative. Only the major conifer types of lodgepole pine, spruce-fir, ponderosa pine and Douglas-fir are estimated since these types make up 95 percent of the forested types (Table 3.51) and it is here that most change is expected. Forest growth is the primary agent of change, followed next by fire, and last by timber management. The Timber Production, Fire and Insect and Disease Sections discuss each of these agents of change.

Tables 3.59 through 3.64 and Tables 3.67 and 3.68 represent expected changes to forest structural stages at the full budget level. At the experienced budget level, approximately one third fewer acres will be treated and changed by timber and fire management treatments, but the ranking of alternatives remains the same for relative changes. Looking at the extremes of structural stages (early and late) and decades (1 and 5), Alternative B would yield the most grass-forb acres and Alternative E the least. Alternative E would yield the most old growth and Alternative C the least. All alternatives would yield more grass-forb acres than currently exist. Old growth would increase over time in all alternatives except for Alternatives C and I where total old growth of all types would drop slightly, and where lodgepole pine old growth would be reduced by more than 50 percent by decade 5. Overall, most of the changes from late to early successional stages would occur in lodgepole pine. The forest structural tables which follow provide data fundamental to predicting environmental consequences in several of the following sections.

Table 3.59 Forest Structural Stages Alternative A

	Current Acres	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Lodgepole pine						
Late Succ.Old Growth	38,000	34,420	35,311	35,945	33,133	32,318
Late Succ.-Mature	195,800	198,604	209,355	219,651	223,820	231,539
Sapling-pole	254,300	238,822	223,344	207,866	195,048	195,824
Shrub-seedling	8,000	10,660	26,914	30,750	32,638	30,505
Grass-forb	5,300	18,894	6,476	7,188	16,761	11,214
TOTAL	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**
Spruce/Fir						
Late Succ.Old Growth	69,200	71,927	74,654	77,165	79,741	82,468
Late Succ.-Mature	121,400	123,723	126,046	127,238	128,768	131,091
Sapling-pole	54,100	49,095	44,090	39,085	35,385	30,335
Shrub-seedling	1,500	2,805	2,760	2,715	2,712	3,656
Grass-forb	1,800	450	450	1,797	1,394	450
TOTAL	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**
Ponderosa Pine						
Late Succ.Old Growth	1,300	2,254	3,208	4,162	5,116	6,070
Late Succ.-Mature	113,800	111,897	109,994	103,451	101,548	99,645
Sapling-pole	19,300	16,556	13,812	11,068	9,560	10,509
Shrub-seedling	800	2,036	5,729	9,422	16,519	16,519
Grass-forb	1,500	3,957	3,957	8,597	3,957	3,957
TOTAL	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**
Douglas-fir						
Late Succ.Old Growth	400	796	1,192	1,588	1,984	2,380
Late Succ.-Mature	39,600	40,374	41,148	40,536	41,310	42,084
Sapling-pole	16,600	13,989	11,378	8,767	6,457	5,287
Shrub-seedling	300	601	2,042	3,483	6,009	6,009
Grass-forb	400	1,540	1,540	2,926	1,540	1,540
TOTAL	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**
VEGETATION STAGE TOTALS						
Late Succ.Old Growth	108,900	109,397	114,365	118,860	119,974	123,236
Late Succ.-Mature	470,600	474,598	486,543	490,876	495,446	504,359
Sapling-pole	344,300	318,462	292,624	266,786	246,450	241,955
Shrub-seedling	10,600	16,102	37,445	46,370	57,878	56,689
Grass-forb	9,000	24,841	12,423	20,508	23,652	17,161
TOTALS	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**

Table 3.60 Forest Structural Stages Alternative B

	Current Acres	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Lodgepole pine						
Late Succ.Old Growth	38,000	38,412	38,655	39,090	39,603	40,137
Late Succ.-Mature	195,800	197,664	198,166	200,216	202,898	205,749
Sapling-pole	254,300	236,635	218,970	201,305	186,300	184,025
Shrub-seedling	8,000	10,660	26,050	42,970	55,490	54,570
Grass-forb	5,300	18,030	19,560	17,820	17,110	16,920
TOTAL	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**
Spruce/Fir						
Late Succ.Old Growth	69,200	71,855	74,497	77,032	79,627	82,281
Late Succ.-Mature	121,400	123,421	125,295	125,936	127,277	129,289
Sapling-pole	54,100	49,059	44,018	38,977	35,241	30,565
Shrub-seedling	1,500	2805	3,170	3,695	4,255	4,995
Grass-forb	1,800	860	1,020	2,360	1,600	870
TOTAL	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**
Ponderosa Pine						
Late Succ.Old Growth	1,300	2,105	74,497	3,715	4,520	5,325
Late Succ.-Mature	113,800	110,051	125,295	102,546	98,797	95,048
Sapling-pole	19,300	15,163	44,018	6,889	3,988	6,933
Shrub-seedling	800	2,036	3,170	16,186	22,053	22,053
Grass-forb	1,500	7,346	1,020	7,367	7,346	7,346
TOTAL	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**
Douglas-fir						
Late Succ.Old Growth	400	796	2,910	1,588	1,984	2,380
Late Succ.-Mature	39,600	39,823	106,316	40,266	40,489	40,712
Sapling-pole	16,600	12,969	11,026	5,707	2,377	1,758
Shrub-seedling	300	601	9,118	6,619	9,339	9,339
Grass-forb	400	3,111	7,332	3,120	3,111	3,111
TOTAL	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**
VEGETATION STAGE TOTALS						
Late Succ.Old Growth	108,900	113,168	1,192	121,425	125,734	130,123
Late Succ.-Mature	470,600	470,959	40,052	468,964	469,461	470,798
Sapling-pole	344,300	313,826	9,338	252,878	227,906	223,281
Shrub-seedling	10,600	16,102	3,613	69,470	91,137	90,957
Grass-forb	9,000	29,347	3,105	30,667	29,167	28,247
TOTALS	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**

Table 3.61 Forest Structural Stages Alternative C

	Current Acres	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Lodgepole pine						
Late Succ.Old Growth	3,800	32,294	27,737	25,125	21,081	16,231
Late Succ.-Mature	195,800	197,852	201,491	207,816	212,164	215,399
Sapling-pole	254,300	238,822	223,344	207,866	195,048	198,702
Shrub-seedling	8,000	10,660	29,792	46,188	55,293	51,335
Grass-forb	5,300	21,772	19,036	14,405	17,814	19,733
TOTAL	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**
Spruce/Fir						
Late Succ.Old Growth	69,200	71,927	74,654	77,193	79,635	82,362
Late Succ.-Mature	121,400	123,723	126,046	127,661	128,913	131,236
Sapling-pole	54,100	49,095	44,080	39,085	35,385	30,335
Shrub-seedling	1,500	2,805	2,760	2,715	2,261	3,617
Grass-forb	1,800	450	450	1,346	1,806	450
TOTAL	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**
Ponderosa Pine						
Late Succ.Old Growth	1,300	2,254	3,208	4,162	5,116	6,070
Late Succ.-Mature	113,800	111,897	109,994	103,579	101,676	99,773
Sapling-pole	19,300	16,556	13,812	11,068	9,560	10,509
Shrub-seedling	800	2,036	5,729	9,422	16,391	16,391
Grass-forb	1,500	3,957	3,957	8,469	3,957	3,957
TOTAL	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**
Douglas-fir						
Late Succ.Old Growth	400	796	1,192	1,588	1,984	2,380
Late Succ.-Mature	39,600	40,374	41,148	40,418	41,192	41,966
Sapling-pole	16,600	13,989	11,378	8,767	6,457	5,287
Shrub-seedling	300	601	2,042	3,483	6,127	6,127
Grass-forb	400	1,540	1,540	3,044	1,540	1,540
TOTAL	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**
VEGETATION STAGE TOTALS						
Late Succ.Old Growth	108,900	107,271	106,791	108,068	107,816	107,043
Late Succ.-Mature	470,600	473,846	478,679	479,474	483,945	488,374
Sapling-pole	344,300	318,462	292,624	266,786	246,450	244,833
Shrub-seedling	10,600	16,102	40,323	61,808	80,072	77,470
Grass-forb	9,000	27,719	24,983	27,264	25,117	25,680
TOTALS	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**

Table 3.62 Forest Structural Stages Alternative E

	Current Acres	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Lodgepole pine						
Late Succ.Old Growth	38,000	39,874	41,744	43,614	45,484	47,354
Late Succ.-Mature	195,800	206,723	217,507	228,290	239,087	249,871
Sapling-pole	245,300	238,822	223,344	207,866	195,048	182,251
Shrub-seedling	8,000	10,660	13,341	16,165	16,330	16,460
Grass-forb	5,300	5,321	5,464	5,465	5,451	5,464
TOTAL	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**
Spruce/Fir						
Late Succ.Old Growth	69,200	71,925	74,652	77,379	80,106	82,833
Late Succ.-Mature	121,400	123,600	125,923	128,246	130,569	132,892
Sapling-pole	54,100	49,095	44,090	39,085	35,385	30,460
Shrub-seedling	1,500	2,805	2,885	2,840	1,590	1,365
Grass-forb	1,800	575	450	450	450	450
TOTAL	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**
Ponderosa Pine						
Late Succ.Old Growth	1,300	2,254	3,208	4,162	5,116	6,070
Late Succ.-Mature	113,800	111,897	109,994	108,091	106,188	104,285
Sapling-pole	19,300	165,563	13,812	11,068	9,560	10,509
Shrub-seedling	800	2,036	5,729	9,422	11,879	11,879
Grass-forb	1,500	3,957	3,957	3,957	3,957	3,957
TOTAL	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**
Douglas-fir						
Late Succ.Old Growth	400	796	1,192	1,588	1,984	2,380
Late Succ.-Mature	39,600	40,374	41,148	41,922	42,696	43,470
Sapling-pole	16,600	13,989	11,378	8,767	6,457	5,287
Shrub-seedling	300	601	2,042	3,483	4,623	4,623
Grass-forb	400	1,540	1,540	1,540	1,540	1,540
TOTAL	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**
VEGETATION STAGE TOTALS						
Late Succ.Old Growth	108,900	114,849	120,796	126,743	132,690	138,637
Late Succ.-Mature	470,600	482,594	494572	506,549	518,540	530,518
Sapling-pole	344,300	318,462	292,624	266,786	246,450	228,507
Shrub-seedling	10,600	16,102	23,997	31,910	34,322	34,327
Grass-forb	9,000	11,393	11,411	11,412	11,398	11,411
TOTALS	943,400	943,400	943,400	943,400	943,400	943,400

Table 3.63 Forest Structural Stages Alternative H

	Current Acres	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Lodgepole pine						
Late Succ.Old Growth	38,000	38,924	39,850	40,773	41,701	42,625
Late Succ.-Mature	195,800	201,291	206,912	212,253	218,110	223,594
Sapling-pole	254,300	235,852	217,404	198,956	183,168	176,753
Shrub-seedling	8,000	10,660	22,693	34,595	44,119	43,749
Grass-forb	5,300	14,673	14,542	14,824	14,303	14,680
TOTAL	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**
Spruce/Fir						
Late Succ.Old Growth	69,200	71,520	73,842	76,164	78,486	80,805
Late Succ.-Mature	121,400	122,883	124,518	126,155	127,757	129,112
Sapling-pole	54,100	48,825	43,550	38,275	34,305	30,502
Shrub-seedling	1,500	2,805	4,277	5,595	5,606	5,485
Grass-forb	1,800	1,967	1,813	1,811	1,846	2,096
TOTAL	**24,800**	**24,800**	**24,800**	**24,800**	**24,800**	**24,800**
Ponderosa Pine						
Late Succ.Old Growth	1,300	2,086	2,872	3,658	4,444	5,230
Late Succ.-Mature	113,800	110,004	106,211	102,360	98,567	94,739
Sapling-pole	19,300	14,981	10,662	6,343	3,260	6,271
Shrub-seedling	800	2,036	9,366	16,693	22,842	22,839
Grass-forb	1,500	7,594	7,591	7,649	7,591	7,626
TOTAL	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**
Douglas-fir						
Late Succ.Old Growth	400	796	1,192	1,588	1,984	2,380
Late Succ.-Mature	39,600	39,953	40,307	40,652	41,006	41,354
Sapling-pole	16,600	13,089	9,578	6,067	2,857	2,108
Shrub-seedling	300	601	3,363	6,124	8,593	8,592
Grass-forb	400	2,861	2,860	2,869	2,860	2,866
TOTAL	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**
VEGETATION STAGE TOTALS						
Late Succ.Old Growth	108,900	113,326	117,756	122,183	126,615	131,040
Late Succ.-Mature	470,600	474,131	477,948	181,420	485,440	488,799
Sapling-pole	344,300	312,747	281,194	249,641	223,590	80,665
Shrub-seedling	10,600	16,102	39,699	63,007	81,160	80,665
Grass-forb	9,000	27,095	26,806	27,153	26,600	27,268
TOTALS	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**

Table 3.64 Forest Structural Stages Alternative I

	Current Acres	Decade 1	Decade 2	Decade 3	Decade 4	Decade 5
Lodgepole pine						
Late Succ.Old Growth	38,000	32,857	28,456	24,316	20,995	17,907
Late Succ.-Mature	195,800	196,357	198,176	200,440	204,097	208,153
Sapling-pole	254,300	238,822	223,344	207,866	195,084	199,634
Shrub-seedling	8,000	10,660	30,724	48,785	63,479	58,557
Grass-forb	5,300	22,704	20,701	19,994	17,782	17,150
TOTAL	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**	**501,400**
Spruce/Fir						
Late Succ.Old Growth	69,200	71,741	74,468	77,195	79,714	81,531
Late Succ.-Mature	121,400	122,978	125,301	127,624	129,113	127,795
Sapling-pole	54,100	49,095	44,090	39,085	35,385	31,266
Shrub-seedling	1,500	2,805	3,691	3,646	2,296	2,407
Grass-forb	1,800	1,381	450	450	1,492	5,001
TOTAL	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**	**248,000**
Ponderosa Pine						
Late Succ.Old Growth	1,300	2,254	3,208	4,162	5,116	6,070
Late Succ.-Mature	113,800	111,888	109,985	108,082	103,653	101,750
Sapling-pole	19,300	16,556	13,812	11,068	95,600	10,518
Shrub-seedling	800	2,036	5,738	9,431	11,888	14,405
Grass-forb	1,500	3,966	3,957	3,957	6,483	3,957
TOTAL	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**	**136,700**
Douglas-fir						
Late Succ.Old Growth	400	796	1,192	1,588	1,984	2,380
Late Succ.-Mature	39,600	40,371	41,145	41,919	41,980	42,754
Sapling-pole	16,600	13,989	11,378	8,767	6,457	5,290
Shrub-seedling	300	601	2,045	3,486	4,626	5,336
Grass-forb	400	1,543	1,540	1,540	2,253	1,540
TOTAL	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**	**57,300**
VEGETATION STAGE TOTALS						
Late Succ.Old Growth	108,900	107,648	107,324	107,261	107,809	107,888
Late Succ.-Mature	470,600	471,594	474,607	478,065	478,843	480,452
Sapling-pole	344,300	318,462	292,624	266,786	246,450	246,708
Shrub-seedling	10,600	16,102	42,198	65,348	82,289	80,705
Grass-forb	9,000	29,594	26,648	25,941	28,010	27,648
TOTALS	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**	**943,400**