Terrestrial Vegetation

Range of Natural Variability

The vegetation of Jackson Creek has varied as widely as its climate. During the last ice-age, the landscape was dominated by a dry-subalpine woodland composed of bristlecone and limber pines and Engelmann spruce (Brubaker 1988). This was followed by the Xerothermic period, when the vegetation of southwest Oregon was similar to the present-day chapparal type of California (White 1994). The Douglas-fir dominated forests that dominate the current landscape have only existed for about 5,000 years (Brubaker 1988, White 1994). More recent variation in Jackson Creek's vegetation is difficult to identify because of its complex fire regime:

* Large, stand replacing fires near the turn of the seventeenth century;

* Protracted periods of understory reinitiation (Oliver and Larson 1990) following frequent low intensity fires since the 1700's.

The "natural range of variation" has become a popular, if ambiguous, way of describing a template for evaluating current ecosystem conditions in terms of historic conditions and suggesting management options. Its ambiguity stems from the extreme variation in historic conditions and the difficulty of deciding which historic period to use for the comparison, not to mention the entirely different set of conditions that exist today:

* Approximately 1500 clearcut units

* 564 miles of road

* Greatly simplified stream channels

* Temperatures as warm as they've been since about 700 A.D.

Most investigators agree that continued, rapid accumulation of atmospheric greenhouse gases will affect climate change in the next century (Brubaker 1988). The hotly disputed effects of accumulating greenhouse gases aside, future climate change is both unpredictable and inevitable. However, Brubaker (1988) recommends against making vegetation changes in anticipation of these unkown changes. Considering this, previous disturbance and vegetation patterns can provide a coarse filter approach to maintaining ecosystem processes and diversity. At least in the near-term.

The Regional Ecosystem Assessment Project (REAP) (USDA, Forest Service PNW Region 1993) made an initial effort to characterize the "natural range of variation" for the Pacific Northwest. Results for the South Umpqua Basin are presented in Table 11.

Seral Stage	Range of Variation, Percent of Area	Current Mode, Percent of Area
Riparian Vegetation		
Early Succession	10-40	20
Late Succession	45-75	70
Upslope Vegetation		
Early Succession		
without snags	<5	20
with snags	10-40	0
Late Succession		
single layer	<5	15
multilayered	45-75	50

Table 11. Historic range and current mode of seral stage distribution within the South Umpqua basin as estimated by REAP.

The report correctly suggests that these broad scale results may be misleading when applied to specific locations. Fire history analysis suggests the following ranges of conditions, may have existed in Jackson Creek since the late 18th century (Table 12). The magnitude of the variation from these historical conditions is less significant where historical fire frequency was lower. They represent relative shifts from those ranges presented by REAP rather than absolute values. They too, are coarse and will lose some resolution at finer scales.

	North of Jackson Creek	South of Jackson Creek	
Seral Stage		<3800 ft, south to 4800 ft	>3800 ft, south from 4800 ft
	Range of Variation,	Percent of Area	
Riparian Vegetation			
Early Succession	10-15	10-20	15-25
Late Succession	80-90	60-90	60-80
Upslope Vegetation			
Early Succession			
without snags	<5	<5	<5
with snags	10-20	15-25	15-30
Late Succession			
single layer	60-80	40-70	15-30
Multilayered	10-20	20-45	40-80

Table 12. Proposed historic range of seral stage distribution by fire regime area within Jackson Creek.

Although the stem exclusion stage is not identified in this table, it's area is assumed to have been roughly equal to the area in establishment.

Historic Vegetation

The successional stages discussed throughout this report include establishment, thinning, and late succession (FEMAT 1994). Early succession and establishment are considered synonomous and follow a stand replacing event. Mid-succession and the thinning stage are considered synonomous as well. However, the "thinning" stage will be referred to as the "stem exclusion" stage (Oliver and Larson 1990) because the latter term is more descriptive and to avoid confusion with the silvicultural method-thinning. Late succession includes maturation, transition, and shifting gap (FEMAT 1994).

Historic Landscape Structure

Landscape-level investigations of the proportions and distribution of various forest structural or successional conditions vary, among other ways, by method, assumptions, and the scale and focus of the analysis (Ripple 1994, Zybach 1994, Harris 1984). A landscape analysis of forests in western Oregon, prior to logging, indicated that 80% of those dominated by Douglas-fir and 68%

of those dominated by mountain hemlock/true fir within the Umpqua Basin were in a large (greater than 20 and 16 inches in diameter for each type, respectively), closed condition. These values, and their relative differences, are consistent with the ranges proposed for late successional conditions in Table 12. Frequent, low intensity fire in the Douglas-fir type eliminated understory competition and perpetuated the dominance of large, fire resistant species. In the mountain hemlock/true fir type, infrequent fire allowed development of an understory between stand replacing events which, in turn, resulted in a smaller proportion of the landscape in this condition. The distribution of these conditions across the landscape is as important as their proportions (Diaz and Apostol). For western Oregon, exlcuding the north Coast, 89% of this large forest was contiguous (Ripple 1994). Mean patch sizes of smaller trees and deforested burns (13,300 acres and 5,287 acres, respectively) were smaller in the Umpqua Basin than elsewhere in the region (Ripple 1994).

Maps of historic vegetation are often created using tree age data (Diaz et al. 1993). These data aren't available for Jackson Creek and, if they were, interpretation of near-continuous tree establishment dates is beyond the scope of this analysis. Vegetation conditions circa 1930 (Figure 6) were mapped by applying the following assumptions to the Current Vegetation Map:

I. All harvested areas, with the exception of those commercially thinned, were considered as late successional, with spatially different vegetation conditions corresponding to Jackson Creek's three fire regimes.

   A. The north side of Jackson Creek, Douglas-fir and White Fir Series, was in the initial stages of late succession. Relatively low-density stands were dominated by large, early seral trees with a broad range of establishment dates and a relatively open understory. Snags, large woody debris and intolerant tree species had short residence times and stands with these conditions were rare. Charles Jackson, an early settler, describes the Tallow Butte-Two Mile Creek area as "an open forest with tall stands of ponderosa pine" (Appendix Z).

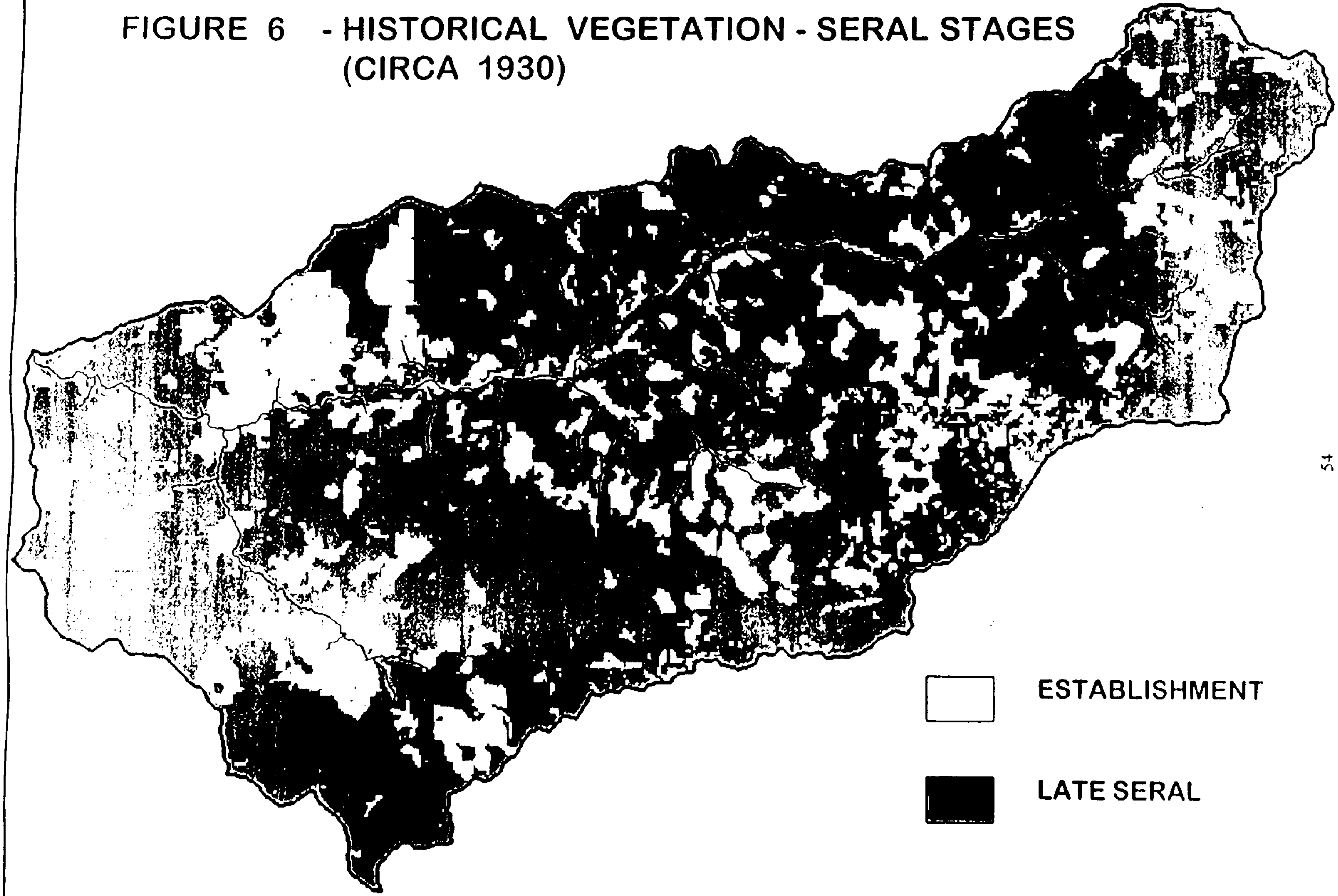
   B. At low elevations, south of Jackson Creek, small, isolated patches with a multi-layer canopy, including late seral species, snags, and large woody debris, generally Western Hemlock Series, existed in a matrix of forest conditions, Douglas-fir and White Fir Series, similar to those north of Jackson Creek.

   C. As fire frequency declined in riparian zones, Western Hemlock Series, and higher elevations, Mountain Hemlock and Shasta Red Fir Series, late successional stands had multi-layer canopies, and included more tolerant species, snags and large woody debris.

II. Stands currently in the stem exclusion stage and those that have been commercially thinned were in establishment, with snags.

III. No satisfactory way could be found to identify those stands that were in stem exclusion. Within the basin, the area in stem exclusion was roughly equal to the area in establishment. However, its spatial arrangement is unknown.

FIGURE 6 - HISTORICAL VEGETATION - SERAL STAGES (CIRCA 1930)



Statistics describing landscape characteristics are often more meaningful in high-contrast than in low-contrast landscapes (Diaz et al. 1993). Historically, much of Jackson Creek was low-contrast because of its fire regime and remains so today because of extensive selective timber cutting. Furthermore, the significance of these landscape statistics' magnitude is ambiguous (Diaz et al. 1993). However, they may validate qualitative judgements and, when compared to historical conditions, can quantify the magnitude of changes. This process has risks if the comparison is made with a map representing a single point in time. However, a point in time representation may be stronger when describing a high frequency, low intensity fire regime.

Landscape statistics describing the historical condition throughout Jackson Creek are presented in Table 13. The proportion of the landscape in the stem exclusion stage was assumed to have approximated the proportion in establishment, except as noted below. The establishment stage includes permanent as well as successional openings.

Seral Stage	Proportion	Edge	Number of	Average Patch
	of Area %	Distance	Patches	Size ac.
Establishment	25		838	30
		679		
			-	
Closed Forest,			75	975
Stem Exclusion	19			
Late Seral	56			

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	636	62	119	21
Closed Forest,	53	10	11	1
Stem Exclusion				
Late Seral				

Table 13. Proposed Historic Landscape Structure within the Jackson Creek Watershed, circa 1930.

The proportional distribution of seral stages was within the range predicted by REAP, although the late successional stage was near the upper limit of its range. Nearly all the closed forest patches were less than 220 acres in size. Many were in a matrix of permanent openings, others were remnant late successional patches within a matrix of fire-caused establishment vegetation. The only patch greater than 220 acres in size was the forest matrix, a contiguous mid and late seral forest over 95,000 acres in size. Establishment patches were generally small, although some were larger than 220 acres. Because the miles of edge between establishment and closed forest conditions were calculated from pixel, rather than vector, data they are overestimated and are best used for relative comparisons.

The watershed was stratified into four "Ecosystem Strata", each composed of groups of Watershed Analysis Areas (WAA) with similar ecological or management conditions (Figure 7):

A. North side of Jackson Creek: WAA's A, B, C, D and W.

B. Late Successional Reserve: WAA's E (includes some non-Late Successional Reserve): WAA's F, G, H, I, J, K, L, M and X.

C. Beaver Creek: WAA's P, Q, R, S, T and U.

D. Whisky-Soup and north of Pickett Butte: WAA's N, O and V.

Landscape statistics for each of these WAA groups are presented in Tables 14-17. Riparian seral stage percentages are for the area delimited by the Record of Decision Riparian Reserves (Figure 8). For the Umpqua, 170 feet is one site potential tree height (Site Index 110, base age 50).

FIGURE 7 - ECOSYSTEM STRATA

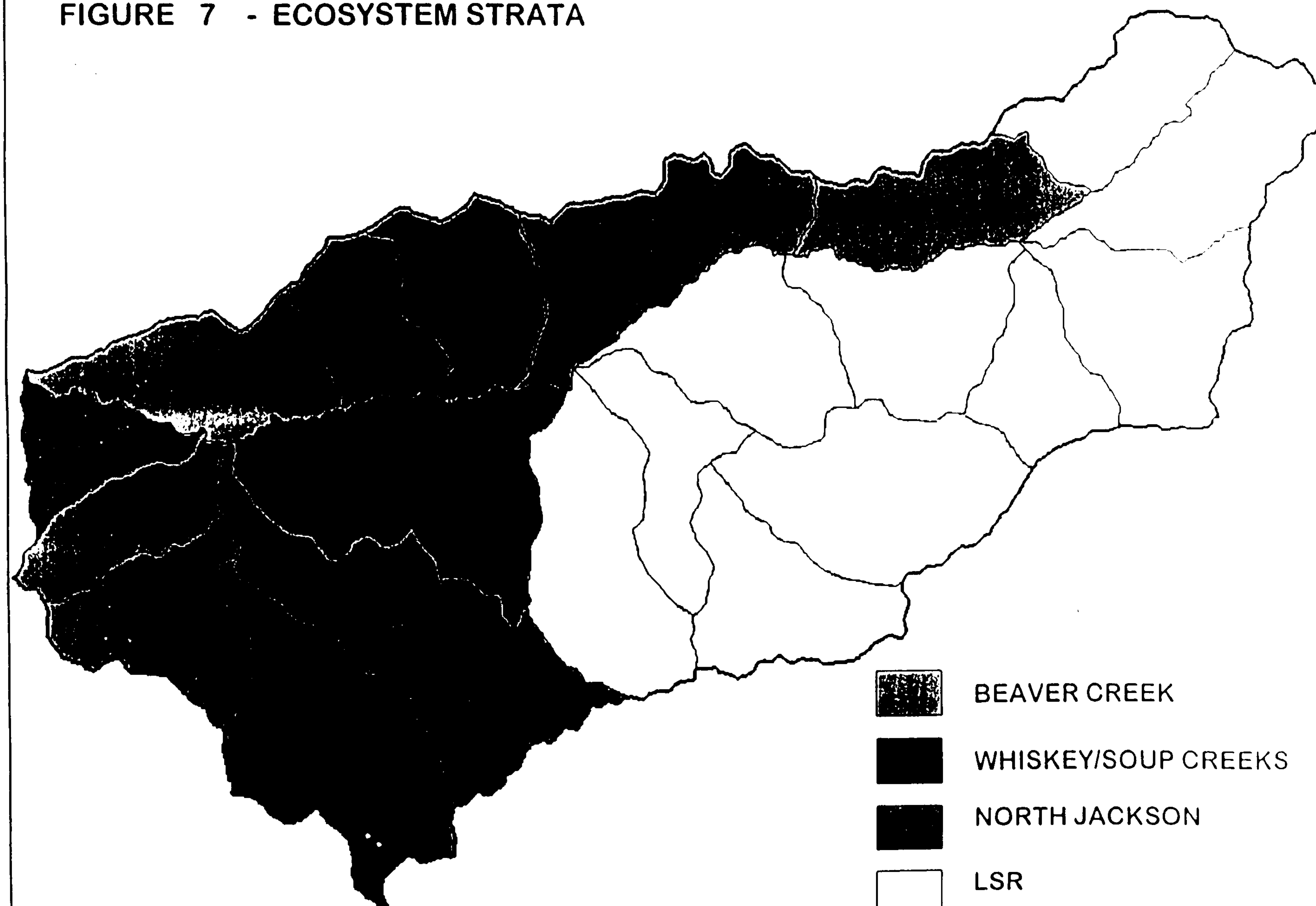
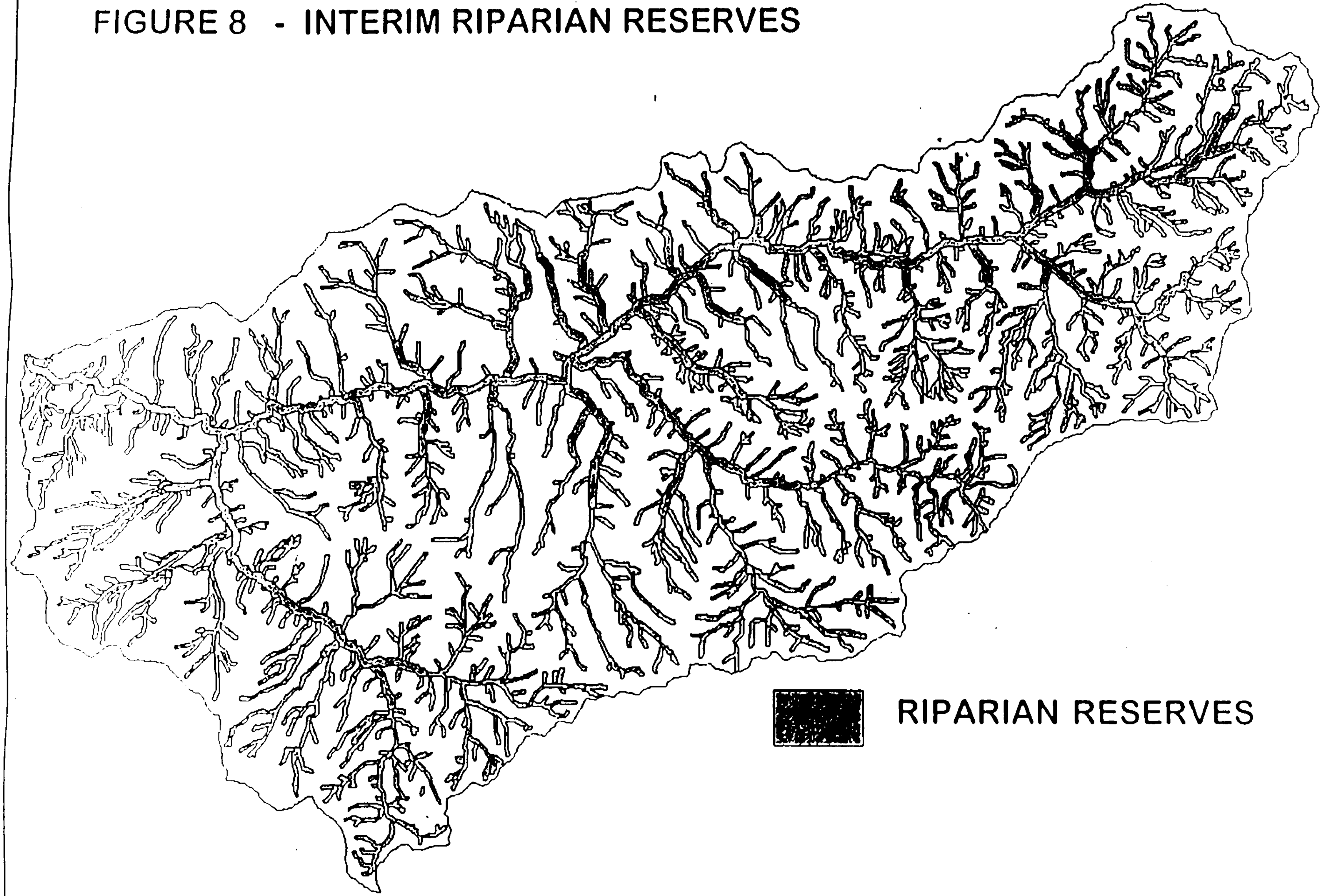


FIGURE 8 - INTERIM RIPARIAN RESERVES



Seral Stage	Proportion of Area %		Upslope Edge Distance	Number of Upslope Patches	Average Upslope Patch Size ac.
	Riparian	Upslope			
Establishment	20	28		169	34
			120		
Closed Forest				46	330
Stem Exclusion	20	20			
Late Seral	49	33			

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	130	15	21	3
Closed Forest	39	2	3	2
Stem Exclusion				
Late Seral				

Table 14. Historic Landscape Structure for the North Side of Jackson Creek Area

Seral Stage	Proportion of Area %		Upslope Edge Distance	Number of Upslope Patches	Average Upslope Patch Size ac.
	Riparian	Upslope			
Establishment	23	24		482	23
			367		
Closed Forest				38	908
Stem Exclusion	23	24			
Late Seral	54	52			

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	359	34	80	9
Closed Forest	29	4	4	1
Stem Exclusion				
Late Seral				

Table 15. Historic Landscape Structure for the Late Successional Reserve Area

Seral Stage	Proportion		Upslope Edge	Number of	Average Upslope
	of Area %		Distance	Upslope Patches	Patch Size ac.
	Riparian	Upslope			
Establishment	29	28		175	34
			131		
Closed Forest				33	476
Stem Exclusion	29	28			
Late Seral	42	44			

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	391	25	39	2
Closed Forest				
Stem Exclusion	42	6	14	5
Late Seral	35	9	18	5

Table 16. Historic Landscape Structure for the Beaver Creek Area.

Seral Stage	Proportion		Upslope Edge	Number of	Average Upslope
	of Area %		Distance	Upslope Patches	Patch Size ac.
	Riparian	Upslope			
Establishment	25	25		237	11
			80		
Closed Forest				14	558
Stem Exclusion	25	25			
Late Seral	50	50			

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	262	10	17	0
Closed Forest				
Stem Exclusion	29	7	10	5
Late Seral	41	5	8	2

Table 17. Historic Landscape Structure for the Whisky/Coffin/Pickett Areas.

In general, the landscape patterns described for the entire watershed are apparent for each WAA group. High proportions of establishment stage north of Jackson Creek, in Beaver Creek and in the FEMAT riparian buffer areas are a result of assumptions used to create the historic vegetation map. The private land in Jackson Creek was probably late seral around 1930. However, much of it is currently in stem exclusion and it was included in the assumption that current stem exclusion was establishment around 1930. Thus, the historical proportion of establishment is overestimated. Because of the road and timber cutting adjacent to Jackson Creek, much of the valley bottom is currently included in stem exclusion. Consequently, it was included in the same assumption as private land and historic riparian vegetation is wrongly mapped as establishment, rather than late successional. The Beaver Creek fire in the1930's is another reason for that watershed's high proportion of establishment.

Composition and Structure of Historic Vegetation

Riparian vegetation

Frequent, low-intensity surface fires burned through the riparian zones of intermittent streams north of Jackson Creek, and at low elevations to the south, thus maintaining them in a late successional, understory reinitiation condition. In addition to fire resistant trees, fire enduring shrubs and herbs were common in these riparian zones. Anecdotal evidence contradicts this, suggesting that "brush along the river never occurred" (Appendix AA). In any case, understory variation was considerable. An interesting possibility is that frequent, low intensity fires kept tree density, thus transpiration levels, low and many currently intermittent streams were perennial. Perennially wet segments of these streams were less affected by fire. Stand replacing riparian fires, and consequently early successional conditions, were rare north of Jackson Creek. At low elevations, south of Jackson Creek, the combination of high fire frequency, fuel accumulation in riparian zones, and frequent long-term drying probably left a higher proportion of riparian zones in early succession. At higher elevations, a reduction in fire frequency reduced the proportion of early successional riparian vegetation. In riparian zones, where less frequent, higher intensity fires occurred, shrubs and hardwoods were overtopped and killed by tolerant conifers.

Early successional vegetation

In areas of frequent, low intensity fire, low fuel loadings were maintained and establishment conditions occurred beneath an overstory of fire resistant trees and where surface fires flared to stand-replacing intensity. Where fires were less frequent but more intense there were fewer surviving trees and establishment conditions were more open. In addition, there was more temporal variation in the proportion of the landscape dominated by establishment conditions.

Late successional vegetation

For the high frequency, low intensity fire regimes on both sides of Jackson Creek, late successional conditions did not include abundant snags, large woody debris, and a multi-layered canopy of intolerant trees--these things burned up. Rather, the landscape was dominated by understory reinitiation (Oliver and Larson 1990) conditions where intolerant, fire resistant trees, with a broad range of establishment dates, dominated a relatively open understory. This combination of large tree dominance and frequent fires maintained favorable conditions for a wide range of plant species. Where fires were less frequent but more intense, late successional stands with an understory dominated by tolerant, fire sensitive trees were more common. It is important to note that low intensity, smoldering or surface fires did burn at higher elevations, but they tended to favor development of a multi-layered understory dominated by tolerant trees.

Current Vegetation

Current Landscape Structure

Current vegetation is mapped by the combination of three GIS layers (Figure 9):

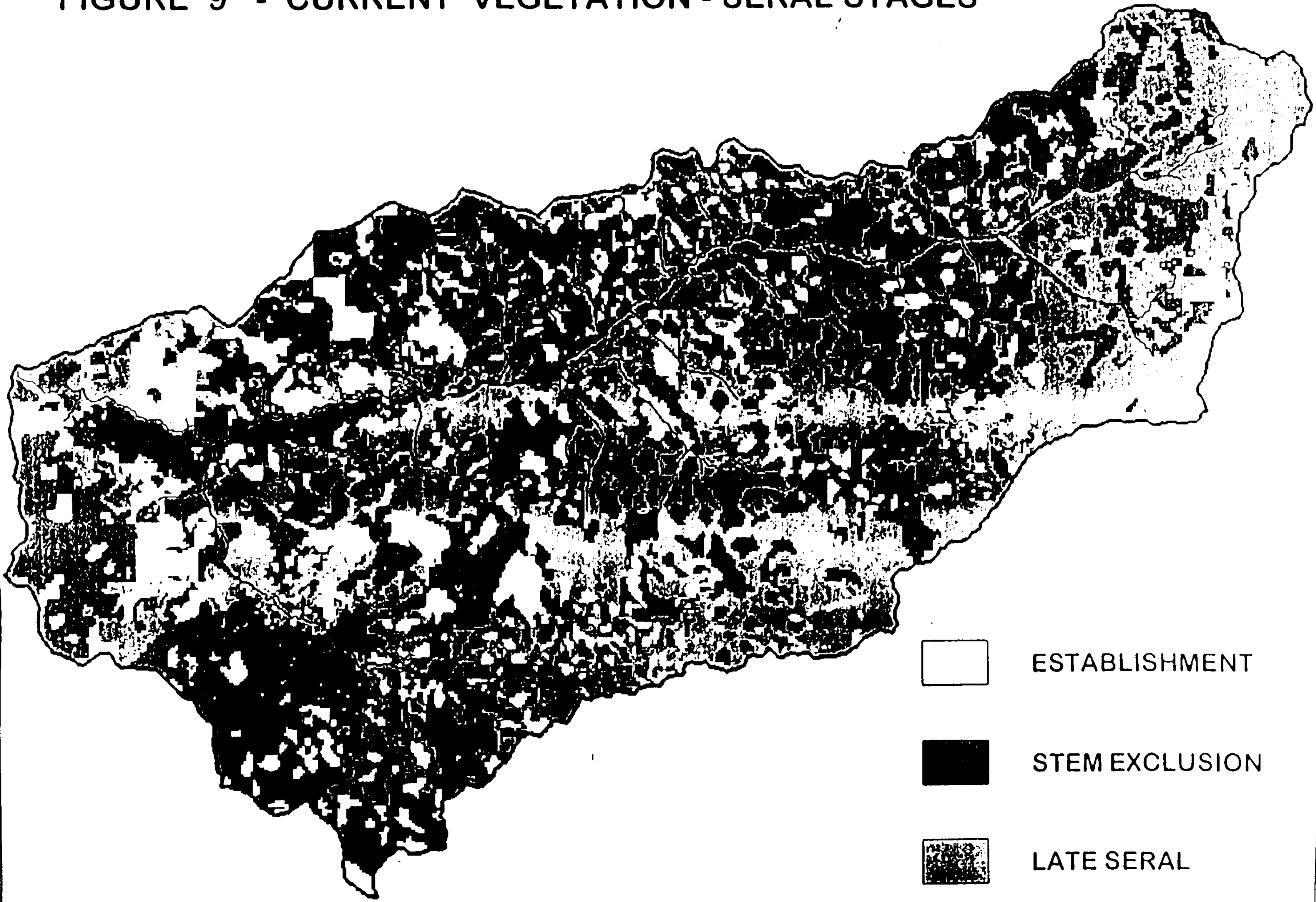
* Unique Habitats - consisting of wet and dry meadows, rock outcrops, shrub fields, and some hardwood stands;

* Timber Harvest Activity - including all but 70 selection and 250 salvage harvests of the watershed's documented entries;

* Seral Stage from 1988 satellite imagery - delineates public land where timber harvest has not occurred and all private land into successional stages. The delineated seral stages are: establishment, stem exclusion and late succession (FEMAT 1994).

Management activities recorded in the Umpqua Preliminary Activities Database (UPAD) and pixel size/structure and canopy closure data allow classification of this mapped vegetation into a variety of habitat conditions as well as seral stage (Table 18).

FIGURE 9 - CURRENT VEGETATION - SERAL STAGES



Mapped Habitats, Successional Processes, and Information Sources					
Brown's Structures	Deer & Elk Habitat	Spotted Owl Habitat Condition	Spotted Owl Habitat Capable	Successional Stage	Vegetation Information Source
(Soil or Climate Controlled) Grass/Forb (Follow Regeneration Harvest)	Forage	Non-Habitat	Not Capable	NA Establishment	Unique Habitat Layer MM, MX, MD UPAD: S aspect: < 3000 ft, yrs 1-10 S aspect: > 3000 ft, yrs 1-5 N aspect: all elev, yrs 1-5
(Soil or Climate Controlled) Shrub (Follow Regeneration Harvest)	Forage	Non-Habitat	Not Capable	NA Establishment	Unique Habitat Layer SX, SC, SM UPAD: S aspect: < 3000 ft, yrs 11-15 S aspect: > 3000 ft, yrs 6-10 N aspect: all elev, yrs 6-10
Open Saplings and Poles (< 70% Crown Closure)	Forage	Non-Habitat	Capable	Establishment	PMR: 10, 11, 20, 23, 27, 30, 33 With Crown Closure < 70% UPAD: S aspect: < 3000 ft, yrs 16-20 S aspect: > 3000 ft, yrs 11-15 N aspect: all elev, yrs 11-15
Closed Saplings and Poles (> 70% Crown Closure)	Hiding	Non-Habitat	Capable	Stem Exclusion	PMR: 10, 11, 36 (none mapped) with Crown Closure > 70% UPAD: S aspect: < 3000 ft, yrs > 20 S aspect: > 3000 ft, yrs > 15 N aspect: all elev, yrs > 15
Open Small Sawlogs (< 70% Crown Closure)	Hiding	Non-Habitat	Capable	Stem Exclusion	PMR: 12, 13, 21, 24 With Crown Closure < 70% UPAD: Selective Harvests
Closed Small Sawlogs (> 70% Crown Closure)	Thermal	Dispersal	Capable	Stem Exclusion	PMR: 12, 13, 21, 24, (14) With Crown Closure > 70% UPAD: Commercial Thinnings
Large Sawlogs (> 70% Crown Closure)	Thermal	Nesting, Roosting and Foraging	Capable	Maturation	PMR: 15, 16, (14)
	Thermal	Dispersal	Capable	NA	UPAD: None
Old Growth	Optimal Thermal	Nesting, Roosting and Foraging	Capable	Transition	MR: 25, 26, 28, 29, 31, 32, (14

Table 18. Mapped Habitats, Seral Stage, and Information Source.

The three layers of the Current Vegetation Map provide the following proportions for seral stages, harvest history, and unique habitats within Jackson Creek (Table 19).

	Total Watershed Acres	Percent of Area All Owners	Percent of Area,Public Owne
Jackson Creek	102,903		
Unique Habitats Layer	5,970	6	6
Seral Stage Layer			
Establishment	2,034	2	<2
Stem Exclusion	18,409	19	<19
Late Succession	40,451	39	~39
Timber Harvest Activity			
Regeneration Harvests	20,922	20	22
Other Harvests	14,714	14	15

Table 19. Current proportions of unique habitats, seral stage of uncut public land and all private land, and public land harvest activity in Jackson Creek.

The Seral Stage Layer includes 6,212 acres of private land, most of which has been cut and is in the establishment and stem exclusion stages.

Landscape statistics calculated from the Current Vegetation Map are presented in Table 20. The establishment stage includes unique habitats and successional openings.

Seral Stage	Proportion of Area %	Edge distance	Number of Patches	Average Patch Size ac.
Establishment	17		2421	7
		937		
Closed Forest				
Stem Exclusion	44		302	148
Late Seral	39		178	221

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	2092	148	172	9
Stem Exclusion	139	33	111	19
Late Seral	93	23	49	13

Table 20. Current Landscape Structure within the Jackson Creek Watershed.

The establishment and late successional stages are near the lower end of the ranges proposed by REAP. The stem exclusion stage, not evaluated by REAP, occupies 44% of the landscape, two times the amount proposed for the historic vegetation condition. This stage includes stands regenerated after fire and currently in stem exclusion, 56% of the basin's regeneration harvested acres, and commercial thinnings and selective harvests. The late successional forest is quite fragmented 13 patches are larger than 220 acres, yet the average patch size is only 221 acres. Establishment patch size is small, 2092 are less than 11 acres in size and very few are larger than 220 acres.

Some qualitative observations can be made from the map as well:

1) The watershed is fragmented as a result of dispersed regeneration harvesting.

2) Unique habitats are concentrated on south aspects in Beaver Creek, the lower reaches of Jackson Creek, and at high elevations along the Rogue-Umpqua Divide.

3) There has been extensive and relatively contiguous selective harvesting extending north-northeast from the upper reaches of Pipestone/Devil's Knob Creeks through Whisky/Soup Creeks and into Ralph/Tallow Creeks; and east of Saboo Creek,

4) The strip of "stem exclusion" tracing Jackson Creek represents the road rather than successional processes.

Landscape statistics for each of the four WAA groups are presented in Tables 21-24.

Seral Stage	Proportion		Upslope Edge	Number of	Average Upslope
	of Area %		Distance	Upslope Patches	Patch Size ac.
	Riparian	Upslope			
Establishment	19	23		533	9
			232		
Closed Forest					
Stem Exclusion	50	44		103	92
Late Seral	31	33		113	63

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	441	41	48	3
Closed Forest				
Stem Exclusion	64	8	26	5
Late Seral	91	2	16	4

Table 21. Current Landscape Structure for the North Side of Jackson Creek Area

Seral Stage	Proportion of Area %		Upslope Edge Distance	Number of Upslope Patches	Average Upslope Patch Size ac.
	Riparian	Upslope			
Establishment	13	15		1223	6
			438		
Closed Forest					
Stem Exclusion	30	34		168	94
Late Seral	57	51		58	416

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	1079	72	69	3
Closed Forest				
Stem Exclusion	68	16	69	15
Late Seral	34	8	12	4

Table 22. Currrent Landscape Structure for the Late Successional Reserve Area

Seral Stage	Proportion of Area %		Upslope Edge Distance	Number of Upslope Patches	Average Upslope Patch Size ac.
	Riparian	Upslope			
Establishment	16	17		457	8
			186		
Closed Forest					
Stem Exclusion	57	61		67	200
Late Seral	27	22		67	74

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	391	25	39	2
Closed Forest				
Stem Exclusion	42	6	14	5
Late Seral	35	9	18	5

Table 23. Current Landscape Structure for the Beaver Creek Area.

Seral Stage	Proportion of Area %		Upslope Edge Distance	Number of Upslope Patches	Average Upslope Patch Size ac.
	Riparian	Upslope			
Establishment	10	12		289	4
			77		
Closed Forest					
Stem Exclusion	56	57		51	115
Late Seral	34	31		56	58

Seral Stage	Patch Size Class			
	<11 Acres	11.1-22 Acres	22.1-220 Acres	>220 Acres
Establishment	262	10	17	0
Closed Forest				
Stem Exclusion	29	7	10	5
Late Seral	41	5	8	2

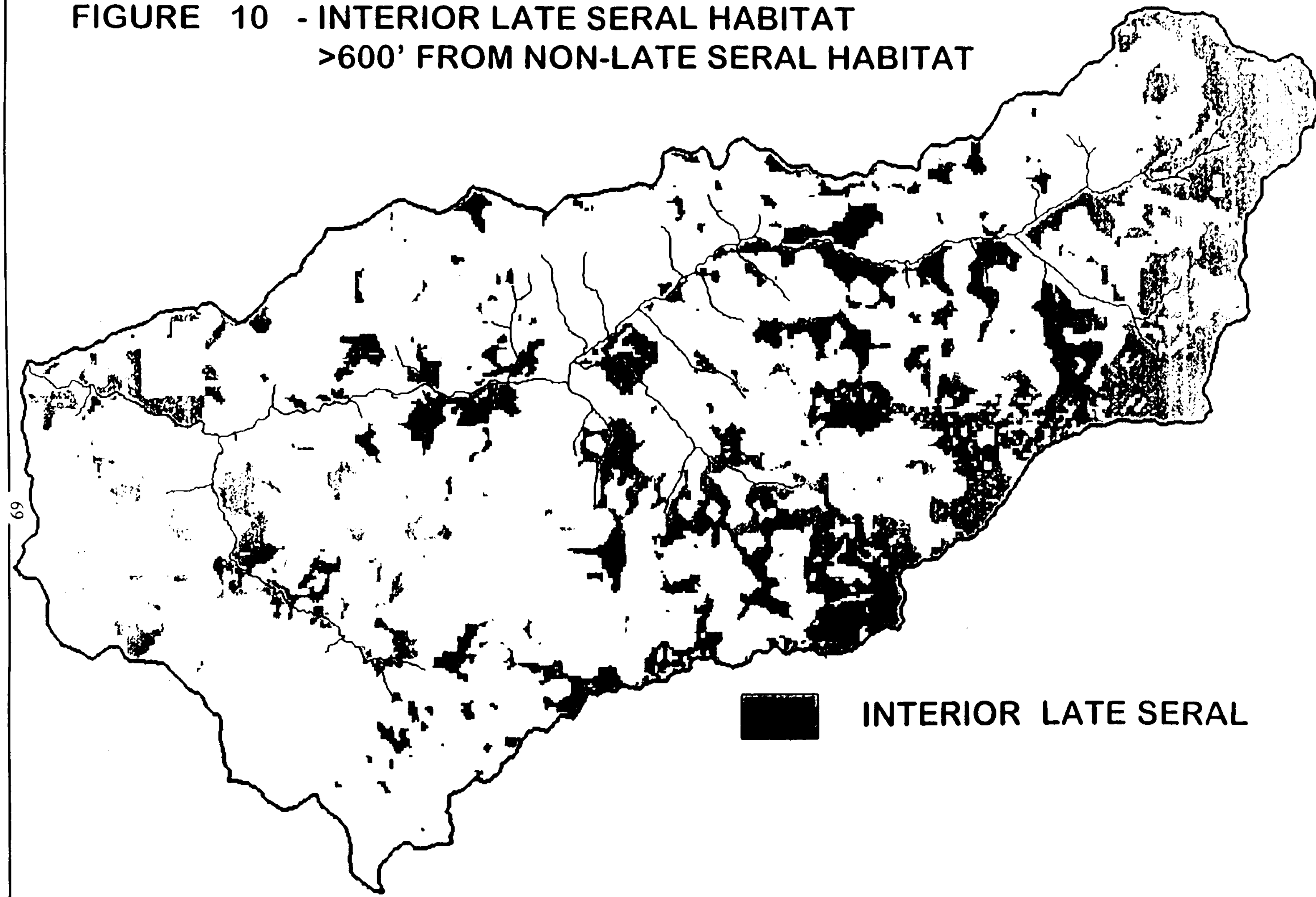
Table 24. Current Landscape Structure for the Whisky/Coffin/Pickett Areas.

The landscape patterns described for the entire watershed are apparent for each WAA group. A high proportion of stem exclusion vegetation and many small patches for all successional stages was found. There are some notable differences among the groups however. The Late Successional Reserve group has the highest proportion of late successional conditions and much of that is interior habitat. Relative to the historic condition, the proportions of stem exclusion and late succession are reversed in all but the Late Successional Reserve Group. North of Jackson Creek, the proportion of establishment is above the proposed historic range. In the Whisky-Coffin-Pickett Butte WAA group it is near the bottom of the proposed historic range.

Interior Forest

Interior forest conditions do not occur immediately at the boundary between a clearcut and closed forest. There is a microclimatic gradient extending into the closed forest that affects burning, vegetation, and wildlife conditions. This "edge effect" depends on the contrast of the edge and the forest condition being considered (Chen et al. 1992). For the western Cascades, Chen et al. (1994) describe a "depth-of-edge-influence" as the distance from a clearcut edge at which several forest conditions have recovered to two-thirds of their interior forest levels. Canopy cover, trees per acre, and western hemlock regeneration (in the 0-25 inch class) recover at 145 feet, 194 feet, and 452 feet, respectively. Edge microclimate conditions may persist for up to 600 from the clearcut boundary (Chen et al 1990). To evaluate interior, late successional forest conditions for wildlife, a 600 foot buffer was applied to all but late seral stands (Figure10). The area inside this buffer is considered edge, rather than interior habitat. The area outside this buffer provides a

FIGURE 10 - INTERIOR LATE SERAL HABITAT >600' FROM NON-LATE SERAL HABITAT



very conservative representation of interior habitat. The following discussion includes the assumption that the stem exclusion stands can function as interior habitat because of their low contrast boundary with late successional stands (Harris 1984). This is a slightly less conservative evaluation of interior habitat conditions within Jackson Creek.

1) Interior habitat is provided by the low-contrast mosaic of relatively unfragmented mid and late successional vegetation in parts of Beaver Creek, from Donegan to lower-Black Canyon Creek, and Eden, Cougar and Paradise Creeks, and the Rogue-Umpqua Divide Wilderness. Local connectivity between high and low elevations is provided by these areas.

2) With the exception of the above areas, late successional patches (lacking interior habitat) are embedded in a matrix of establishment vegetation.

3) The Late Successional Reserve provides a connection between Jackson Creek and the Rogue Basin, via the Rogue-Umpqua Divide.

4) There is no obvious connection between Jackson Creek and Buckeye Creek to the north.

5) Interior, late successional conditions are not continuous along Jackson Creek suggesting that it does not function as an effective east-west corridor. However, interior conditions do occur from just above Beaver Creek to Whisky Creek, and for about two miles east of Bean Creek.

6) The Squaw Flat Research Natural Area provides isolated, interior habitat.

Composition and Structure of Current Vegetation

People have modified the vegetation of Jackson Creek. Indians modified it primarily by fire, intentional and otherwise. Introduced cultures have modified it primarily by grazing (White, 1994, personal communication), timber cutting and subsequent management, and fire ignition and suppression. Jackson Creek's current vegetation is more shaped by fire suppression than ignition. Plant series provide a surrogate for Jackson Creek's potential vegetation and are mapped and discussed in Appendix G.

Initially, two vegetation strata were defined: vegetation affected by fire exclusion; and vegetation affected by timber harvest and subsequent management activities. Although vegetation on harvested lands has been affected by fire exclusion, this impact is generally, small relative to other management activities. Uncut Vegetation, primarily affected by fire exclusion, was stratified into four vegetation types based on seral stage:

* Stem exclusion with greater than 70 percent crown closure;
* Stem exclusion with less than 70 percent crown closure;
* Late succession;

* Late succession/high elevation-meadow mosaic, these are areas of old, closed forest surrounding the meadows mapped by the Unique Habitat Layer.

Vegetation affected primarily by timber management was stratified into three vegetation classes based on silvicultural system:

* plantations following regeneration harvest;
* selective harvests and/or salvages; and commercial thinnings.

These vegetation conditions were further stratified by which side of Jackson Creek they were on and plant series. The vegetation plots were grouped according to which of these mapped strata they occurred in and processed through the Forest Vegetation Simulator as a type. Their series was determined from plot data, rather than map location. Stand structure, composition and yields were tabulated to describe the average conditions for these types. The range of these conditions is in the Jackson Creek analysis file. Data are not presented when only two plots existed for a type. None of the sample statistics were tested for their significance and they should only be used, along with knowledge of stand development processes, to identify patterns and trends. Vegetation mapping and sampling methods are discussed in Appendix H.

Stem Exclusion Vegetation Types

Stem exclusion conditions with greater than 70% canopy closure occupy 34% of the watershed (Table 25). These stands generally initiated after a fire, thus they can be expected to retain structures absent from a harvested stand. The two plots with snag and large woody debris information suggest that dead wood abundance in this type is more like that of a late seral stand than a managed plantation. In fact, with the exception of smaller diameters and less variety in tree species, the stem exclusion types are quite similar to the late successional types. This may be due to successional processes. It could just as easily be due to sampling, plot within a stem exclusion stand may, in fact, have been a relict late successional patch and overwhelmed the small sample. Large woody debris density appears slightly higher in this type than in the regeneration harvested type. However, piece length may be quite different. Stand density is high in both types, more than 1,200 trees per acre. Stand Density indices greater than 312 suggest that competition mortality is occurring. There are many conifer and hardwood species present, although there is more variety within the dominant diameter classes. Absent disturbance, the madrone, many of the ponderosa pine and some of the Douglas-fir in the intermediate and suppressed classes can be expected to be outcompeted by their more tolerant neighbors. The more tolerant chinquapin and incense cedar in the understory will remain there unless some disturbance reallocates growing space to them.

Stem exlusion conditions with less than 70 percent canopy closure occupy 5 percent of the watershed. There is much variation within this class which includes, among other conditions: stands where conifer crown closure is less than 70 percent and stem exclusion is due to tree plus shrub dominance; stands that are in transition from establishment to stem exclusion; and stands with low crown closure due to harsh site conditions.

Stem Exclusion Vegetation Type																
Series	Side of Jackson Cr	Basal Area Per Ac (ft2)	Board ft per Ac	Tree Hgt (ft)	Trees > 6" in Dia QMD, In.	SDI	Trees/AC (TPA)	Trees per Acre By Diameter Class (In) < 6	6-9	9-21	21-34	> 34	Species Proportions by Diameter Class (In) < 6	6-9	> 9	Hardwoods per Acre, By Species
PSME	North	200	21700	106	12.8	312	1309	1100	115	79	10	5	63% PSME 14% ABCO 7% CADE 3% TSHE	72% PSME 8% ABCO 8% RIPO 7% CADE 5% TSHE	72% PSME 17% PILA 4% CADE 2% TSHE < 1% ABCO	129 CACH X ARME
PSME	South	Insufficient Data														
ABCO	North	Insufficient Data														
ABCO	South	373	39600	107	14.6	553	1202	902	75	190	35	0	35% ABCO 25% PSME 1% TSHE 1% CADE 1% OTHER	44% PSME 23% ABCO 13% OTHER 12% TSHE	66% PSME 19% OTHER 14% ABCO	25 ACMA 1 CACH X TABR X SALIX
TSHE	North	Insufficient Data														
TSHE	South	Insufficient Data														

Table 25. Composition and Structure of the Stem Exclusion Vegetation Type.

Late Succession Vegetation Types

Late successional forests, not associated with dense areas of high elevation meadows, occupy 34% of the watershed (Table 26). Stand density is high for all types with basal areas in the low 200s and Stand Density Indices in the low 300s. Tree volume per acre, another measure of density, is lower in both Douglas-fir types. Tree density is apparently lower only in the Douglas-fir Series on the North side of Jackson Creek. This is intuitively appealing but its statistical significance was not evaluated. The next lowest tree density, occurring within the Western Hemlock Series south of Jackson Creek, contradicts this intuitive interpretation. Structurally then, these types are virtually indistinguishable--even among Series. The intent of this stratification was to identify geographic as-well-as among-Series differences. A larger sample would be required to do so, if meaningful differences exist at all. Ponderosa pine occurred only in the Douglas-fir Series. This is consistent with data gathered by the Ecology Program. Of the 19% of Jackson Creek's ecology plots where Ponderosa pine occurred it averaged 15% cover in the overstory and ranged from 2 to 35%. Other species were present in all types although incense cedar is inconspicuous in the White Fir Series South of Jackson Creek and in the Western Hemlock Series. North of Jackson Creek and in the Douglas-fir Series south of Jackson Creek, hardwood diversity is higher and incense cedar is conspicuous in the overstory. These incense cedar and hardwood conditions are probably a result of previous wildfire. Curiously, sugar pine is no more than 2% of tree stocking in any type. This is consistent with ecology program data. Sugar pine occurred on 42% of the ecology plots in Jackson Creek. However, it contributed only 5% of overstory cover and averaged 1% cover in the understory. Anecdotal reports suggest that sugar pine represented less than 15% of stand density historically and that it has been aggressively logged since the 1950's (Lagoudakis 1994). Snags and large woody debris are abundant in all types. The statistical significance of the higher snag density north of Jackson Creek was not evaluated.

A knobcone pine was found in Black Canyon on a very harsh site. The field crew reported that a fire had occurred there around 1860. This short-statured, extremely intolerant pioneer tree is still alive because it germinated on this harsh site where it is competitive. Isolated knobcone pine have also been found further north on the south shoulder of Acker Rock and about two miles north of South Umpqua Falls. Fire exclusion and the ascendance of larger, more tolerant conifers has restricted it to isolated outposts from which it will eventually disappear.

Late Succession Vegetation Type

Series	Side of Jackson Cr	Basal Area per Ac, ft2	Board ft per Ac	Tree Hght, ft.	Trees > 5" in Diameter QMD, In.	SDI	Trees/AC TPA	Trees Per Acre By Diameter Class (in) < 5	5-9	9-21	21-34	> 34	Species Proportions by Diameter Class, In. < 5	5-9	> 9
PSME	North	210	26800	105	16.9	300	544	367	96	60	17	5	45% PSME 22% CADE 4% PIPO 3% ABCO 2% PILA	48% PSME 37% CADE	78% PSME 15% CADE 6% PIPO
PSME	South	230	28900	109	17.1	337	1043	834	94	98	12	5	65% PSME 14% CADE 2% TSHE 2% PIPO 1% ABCO 1% PILA	61% PSME 7% TSHE 3% ABCO 2% CADE 2% PIPO	68% PSME 18% ABCO 7% PIPO 5% TSHE 3% CADE
ABCO	North	238	37000	105	16.8	332	1286	1115	103	54	4	10	50% PSME 14% CADE 10% TSHE 4% ABCO 1% PILA	18% ABCO 11% PSME	32% PSME 29% AABCO 15% CADE 6% TSHE 1% PILA
ABCO	South	248	41700	128	19.3	342	902	764	51	59	17	11	34% PSME 25% ABCO 1% PILA	69% PSME 45% ABCO	70% PSME 16% TSHE 14% ABCO 2% CADE
TSHE	North	Insufficient Data													
TSHE	South	220	31300	114	21.6	321	778	528	200	30	11	9	83% TSHE 8% ABCO 2% PSME 2% PILA 2% CADE < 1% PIMO	83% PSME 16% TSHE	56% PSME 38% TSHE 4% ABCO < 1% CADE

Table 26. Composition and Structure of the Late Succession Vegetation Type.

Late successional forests that are closely associated with dense, high-elevation meadows occupy five percent of the Jackson Creek landscape (Table 27). Their distinguishing features are lower tree species diversity and their close association with meadows. Structurally, they are similar to the other late successional types. Only two plots existed for each geographical area. Both plots north of Jackson Creek appear very productive.

Late Succession, High Elevation-Meadow Mosaic Vegetation Type

Series	Side of Jackson Cr	Basal Area per Ac, ft3	Board Ft per Ac	Tree Hght, ft	Trees > 5" In Diameter QMD, In	SDI	Trees/AC TPA	Trees Per Acre By Diameter Class, In < 5	5-9	9-21	21-34	> 34	Species Proportions by Diameter Class, In < 5	5-9	> 9	Hardwoods per Acre, by Species
ABCO	North	515	76700	120	22.1	793	515	183	7	260	53	12	54% PSME 40% ABCO 7% OTHER	100% ABCO	90% PSME 8% ABCO 2% CADE	
ABCO	South	182	16100	62	13.1	299	2451	2093	332	19	2	5	69% ABCO 21% PSME 10% CADE	100% PSME	69% ABCO 15% CADE 4% PSME	

Table 27. Composition and Structure of the Late Succession, High Elevation-Meadow Mosaic Vegetation Type.

Regeneration Harvested Vegetation Types

Twenty two percent of the public land within the watershed has been regeneration harvested (Table 28). Depending on their age and site, these stands are in the establishment or stem exclusion stage. This discussion applies only to stands in the stem exclusion stage. The average, breast height, age of the sampled plots is 20 years. The snags still present in the fire-established, stem exclusion type are completely absent from the regeneration harvested type. Large woody debris density is comparable to the late successional and stem exclusion types. However, piece length may differ between the two types. The diameter distribution of this type could indicate good differentiation in tree height among trees planted at a very high density. Alternatively, it could be due to precommercial thinning with subsequent natural regeneration contributing to the less-than-five inch diameter class. The latter scenario is more likely. Stand differentiation results primarily from variation in tree spacing, age, genetic makeup, and microsite (Oliver and Larson 1990). Reforestation in Jackson Creek is predominantly Douglas-fir and ponderosa pine planted at densities in excess of 500 trees per acre, conditions associated with slow differentiation and tree growth after crown closure (Oliver and Larson 1990). Stand Density Indices, in all but the White Fir Series south of Jackson Creek, are curiously low, suggesting that conifers are not fully occupying these sites (Long 1985). This may be an artifact of precommercial thinning. The exclusive dominance of Douglas-fir and ponderosa pine in the larger diameter classes is in sharp contrast to the tree species diversity of the stem exclusion type regenerating naturally after a fire. The conifer diversity in the smallest diameter class and the few hardwoods present are probably natural regeneration following planting or precommercial thinning that made growing space available. Growing at such close spacings and in the absence of disturbance, the suppressed, intolerant conifers and the hardwoods will soon be outcompeted and die. The more tolerant and tenacious incense cedar will be remain in the understory where it will die a lingering death. There is considerably more ponderosa pine in this type than in the late succession or stem exclusion types and probably more than occurred historically. Ponderosa pine has been planted at high densities throughout Jackson Creek. The seed provenance was non-local between the mid-1950s and the mid-1960s. Without future disturbance, this type will not develop the characteristic structure and composition of naturally regenerated stands.

Series	Side of Jackson Cr	Basal Area per Ac. (ft)	Board Ft per Ac	Tree Hght (ft)	Trees > 5" In Diameter QMD, In.	SDI	Trees/AC TPA	Trees Per Acre By Diameter Class, In. < 5	5-9	9-21	21-34	> 34	Species Proportions by Diameter Class, In. < 5	5-9	> 9	Hardwoods per Acre, by Species
PSME	North	Insufficient Data														
PSME	South	88	5000	63	9.7	134	831	701	62	66	2	0	64% PSME 8% ABCO 5% CADE 2% PIPO 1% PILA 1% TSHE	77% PSME 8% ABCO 15% PIPO	50% PSME 9% ABCO 32% PIPO	12 ACMA 8 ALRU 25 CACH 12 CLGA, X CLKE X ARM, X SALIX
ABCO	North	54	253	39	7.8	97	681	532	139	10	0	0	47% PSME 25% ABCO 25% PIPO	84% PIPO 16% PSME		X ARME
ABCO	South	129	7300	61	10.6	215	624	436	32	156	0	0	48% PSME 17% CADE 15% ABCO 3% PIPO	59% PIPO 41% PSME	72% PSME 28% PIPO	12 ALRU X SALIX X CONU
TSHE	North	73	3000	61	10	103	719	580	90	49	0	0	23% PSME 3% PIPO		76% PSME 3% TSHE	198 ACMA
TSHE	South	Insufficient Data														

Table 28. Composition and Structure of the Regeneration Harvested Vegetation Type.

Commercially Thinned Vegetation Types

Virtually all of these stands regenerated naturally after fire and are in the stem exclusion stage (Table 29). Compared to the uncut stem exclusion type, this type lacks tree diversity in the larger diameter classes. Higher conifer diversity in the suppressed diameter class and the hardwoods are probably a response to growing space made available by disturbance. The presence of intolerant sugar pine in the smaller diameter class further supports this hypothesis that it is not likely to survive long beneath such a dense overstory. Snags are absent and large woody debris levels are a result of previous logging practices. The type represented by these, few, plots is on a developmental trajectory similar to that of stands following regeneration harvest.

Commercially Thinned Vegetation Type																
Series	Side of Jackson Cr	Basal Area per Ac, ft2	Board Ft per Ac	Tree Hght (ft)	Trees > 8" in Diameter QMD, in.	SDI	Trees/AC TPA	Trees Per Acre By Diameter Class, in. <5	5-9	9-21	21-34	>34	Species Proportions by Diameter Class, in. <5	5-9	>9	Hardwoods per Acre, by Species
PSME	North	198	17500	105	11.1	344	917	626	138	152	1	<1	67% PSME 10% ABCO 4% PILA 2% ABCO 1% CADE	88% PSME	99% PSME	50 ACMA, 36 CACH 36 CACH X ARME X CONU X QUERCUS
PSME	South	Insufficient Data														
ABCO	North	Insufficient Data														
ABCO	South	Insufficient Data														
TSHE	North	Insufficient Data														
TSHE	South	Insufficient Data														

Table 29. Composition and Structure of the Commercially Thinned Vegetation Type.

Selection Harvested Vegetation Type

Individual tree selection logging is mapped on less than 15% of the public land within the watershed (Table 30). This excludes significant documented, but unmapped, acreage, 250 salvage and 70 miscellaneous tree selection entries. Generally, these entries were in late successional stands but many were in stem exclusion stands with several emergent fire survivors. The nominal objective of these entries varied greatly, the outcome less so. Large, high value trees, especially sugar pine were removed. In some cases, advanced regeneration, usually of tolerant species, quickly occupied the newly available growing space. The plot data suggest that another outcome was more common. The newly available growing space was rapidly filled by a new and diverse cohort of trees which are now experiencing considerable competition (Stand Density Index = 270) among themselves and from the pre-harvest cohort of trees. In the absence of disturbance, the intolerant conifers and hardwoods among these young trees will die and incense will remain a canopy subordinate. Compositionally, this type is more like the late successional type than is any other. However, because the large trees and snags have been removed, it lacks the structure of the late successional type. Large woody debris density is comparable for the two types but average piece length may be shorter for the selection harvested type. Armillaria root disease is more conspicuous in this type than others, particularly at higher elevations (Appendix E).

Selection Harvested VegetationType

Series	Side of Jackson Cr	Basal Area per Ac, ft2	Board Ft per Ac	Tree Hght (ft)	Trees > 5" In Diameter QMD, In.	SDI	Trees/AC TPA	Trees Per Acre By Diameter Class, In. < 5	5-9	9-21	21-34	> 34	Species Proportions by Diameter Class, In. < 5	5-9	> 9	Hardwoods per Acre, by Species
PSME	North	152	9361	56	14 2	272	2360	2010	247	91	11	1	55% PSME 15% CADE 12% ABCO 5% PIPO 4% PILA	81% PSME	67%PSME 8% PIPO 7% PILA	73 CACH 66 CLGA
PSME	South	201	21500	91	16.4	271	1210	1041	75	75	14	5	69% PSME 8% PILA 4% ABCO 6% CADE 1% PIPO	49% PSME 29% CADE	70% PSME 21% CADE	25 CLGA X ARME X SALIX
ABCO	North	98	7000	64	9.6	170	743	575	101	63	4	0	17% PSME 5% CADE 70% ABCO	50% PIPO 40% ABCO 10% CADE 1% PSME	54% PSME 33% ABCO 10% PILA	X ARME X CONU
ABCO	South	Insufficient Data														
TSHE	North	Insufficient Data														
TSHE	South	Insufficient Data														

Table 30. Composition and Structure of the Selection Harvested Vegetation Type.

Special Cases

Riparian vegetation

Because of similar fire regimes, management practices and fire exclusion effects, the vegetation types described above can be extended from the hillslopes to the riparian zones of many intermittent streams. They do not apply to the riparian zones of perennial streams.

Subjective impressions during riparian vegetation sampling suggest that riparian buffers between perennial streams and clear cuts are not retaining such riparian zone functions as: a mesic microclimate, stream shade, nutrient uptake and sediment filtering, and streambank stabilization. This is probably because, for such a high contrast edge, a buffer width of one tree height provides negligible interior conditions (Chen et al. 1992). However, large woody debris input may be elevated, for the short term, because many of these trees tip over. Probably because the buffer is all edge and was placed to meet a prescribed distance rather than an ecosystem function.

It is striking that Jackson Creek's path is apparent from satellite imagery as a strip of seedling-sapling-pole pixels. This is not a natural, successional phenomenon. It is a direct effect of the road, by its presence, and an indirect effect from logging and increased access for dispersed recreation sites.

Early succession

A great deal of attention has been paid to late succession and the effects of its truncation. Specific ecological mechanisms are associated with early succession as well (Oliver 1990, Agee 1993). Silvicultural practices, designed to effect rapid conifer dominance, have foreshortened successional processes. Data for the stands developing after regeneration harvest suggest that by about year 25, they have been precommercially thinned and are still dominated by conifers at the rate of more than 600 trees per acre. Conifer establishment and ascendance following historic fires occurred over longer time periods (Agee 1993) allowing a greater role for non-conifers. Establishment conditions are within the proposed historical range for the watershed. However, their arrangement and turnover rates may not allow full function of some ecosystem processes. As an extreme example, consider the intolerant C. velutinus. If the conifer canopy closes and kills the ceanothus before it completes its lifecycle its seeds may be lost from the soil seedbank. There may be similar species whose seeds are viable for a much shorter time. A. umbraticus, a species more intermediate in tolerance, may be affected in the same way.

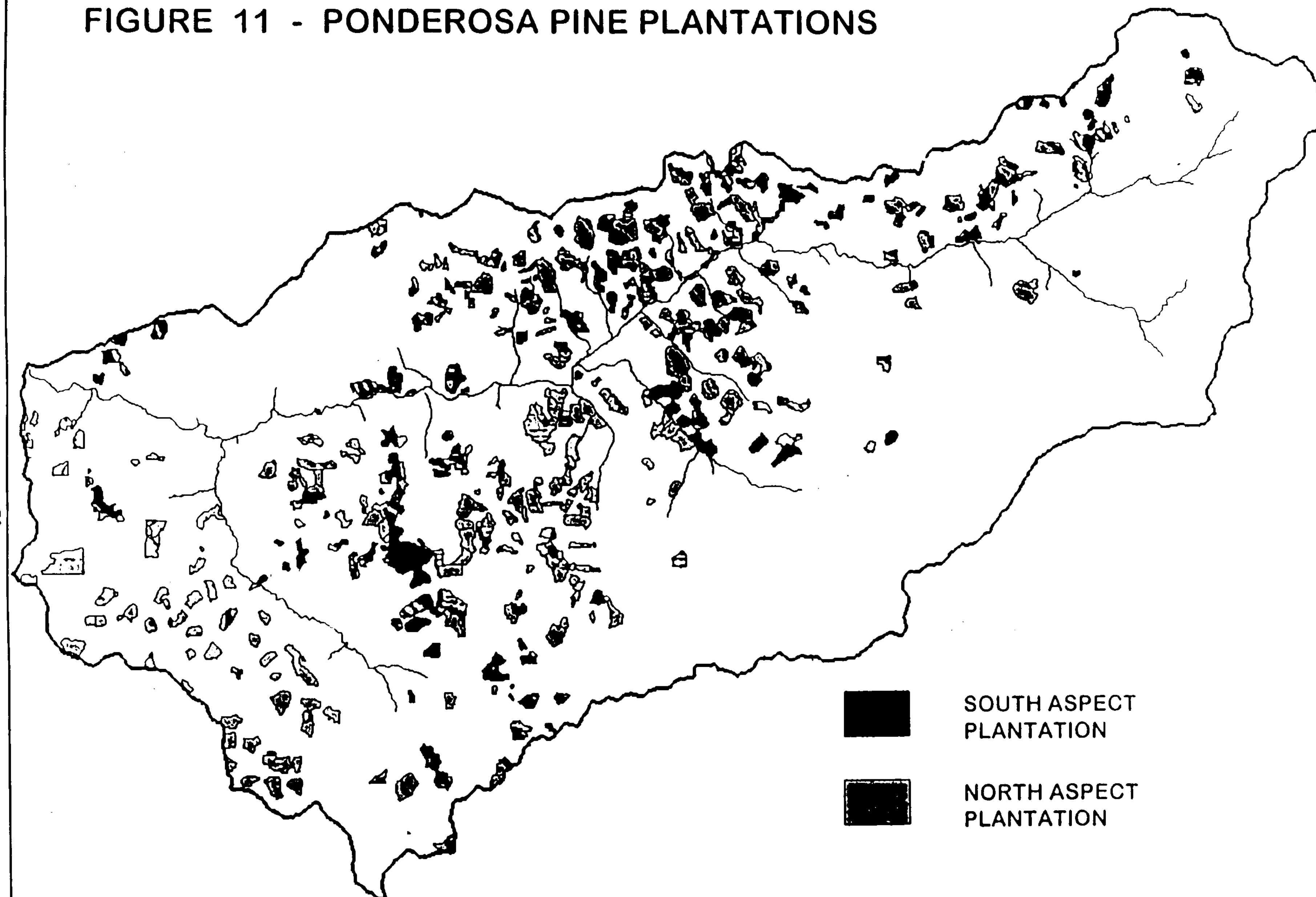
Off-site pine

During the 1950s and 1960s, 78 regeneration harvested units were reforested with out-of-provenance ponderosa pine. These "off-site pine" plantations are shown in Figure 11. There is much variation in the current condition of these stands. On better sites, local species have established and become dominant. On poorer sites, the off-site pine retains dominance or shares dominance with shrubs or hardwoods. Between these two extremes there is a continuum of conditions. In nearly all cases the off-site pine is of poor form, not thrifty and subject to Bynum's blight. The existing off-site pine plantations do not threaten the integrity of the local ponderosa pines (Hamlin per. comm. 1994). In any case, these stands are not consistent with naturally occurring ecosystem processes. Depending on site specific conditions, they will only slowly attain the structure and composition characteristics typical of stands, in any stage of development, in Jackson Creek. Soil chemistry too, may be altered by these pure stands of pine on sites formerly occupied by primarily Douglas-fir/mixed conifer stands.

Oak Woodlands and Oregon Ash Stands

Prior to fire suppression, oak woodlands occurred in the Jackson Creek watershed. Their exact extent is unkown but they probably amounted to less than a few hundred acres. In fact oaks are still a significant presence in the Douglas-fir Series on both sides, and occurred in the White Fir Series north, of Jackson Creek. The pre-European extent and distribution of these woodlands isn't known, but they were found near the confluence of Jackson and Beaver Creeks and in lower Tallow Creek. Some, especially at lower elevations are due to heavy, clay soils (Atzet, per. comm. 1994) and some were maintained by fire. Agee (1993) discusses the complex processes that have historically maintained these woodlands. Fire would likely play a pivotal role in any attempt to restore and maintain these woodlands structurally because it kills conifers and functionally by creating favorable germination conditions and, in some cases, favoring native perennials over introduced herbs. Agee (1993) cites other investigators (Sugihara et al. 1987

FIGURE 11 - PONDEROSA PINE PLANTATIONS



and Saenz and Sawyer 1986) who report that grazing causes an increase in annual grasses and alien species. This may have an indirect effect on acorn germination or germinant success as well as a direct effect from grazing. The decline of the Tallow Creek woodland is striking. It is

dominated by, about, 80 year old Douglas-fir at a density of, about, 100-150 trees per acre that have established as a result of fire exclusion. There are relict white oak and large ponderosa pine at a density of 10-20 trees per acre. The young cohort of Douglas-fir has outcompeted and is killing its contemporaneous ponderosa pines, the old oaks and their germinant progeny. This particular woodland is quite close to Jackson Creek and may have been purposely maintained by Indians.

Much less is known about stands dominated by Oregon ash. However, two stands were found that had been underplanted with conifers that, in time, will overtop and kill the ash.

Meadows

At high elevations, conifer encroachment into meadows is commonly attributed to fire exclusion. Agee (1933) and Franklin and Dyrness (1973) report that in many cases it is due to favorable growing conditions associated with anomalous weather patterns. The fire history and encroachment pattern of these meadows in Jackson Creek wasn't investigated. Considering the short fire/growing season at these elevations it's reasonable to attribute meadow encroachment to weather anomalies. On the other hand, a curious stand of lodgepole pine was reported near Donegan Prairie. In any case, more investigation should precede any effort to remove the encroaching trees.

The influence of fire in lower elevation meadows is less ambiguous. If they supported enough grass that, when cured, it would carry a fire, these meadows certainly burned at a frequency approaching that of their surrounding area's mean fire-return interval. In any case, excluding fire from the forest matrix of these meadows has changed what was a low contrast meadow-forest interface into a very high contrast one. Sheep and cattle grazing was intense in the early 1900's (Appendix AA) and continues, at a lower level, in the present. Grazing and the exclusion of fire are likely responsible for the ascendance of alien plants in these meadows (Agee 1993).

Huckleberry patches, harvested and burned by the Cow Creek Indians (Appendix Z), on the Rogue-Umpqua Divide appear to be declining. Huckleberry production is a complicated process requiring more than just the application of fire (Dahlgreen, 1984, Miller, 1977, Minore et al., 1979). However, without disturbance, these huckleberry stands will continue to decline in productivity and they will become inconspicuous in the late successional forest understory. Restoration should be well thought out with clear and measureable objectives. If fire is applied, the prescription should be thoughfully tailored to meet those objectives and it should be strictly adhered to. Short and long term results should be monitored--increased fruit production should not be expected for several years (Miller 1977).

Special Habitats

Introduction

Special habitats are features, conditions, and plant/animal communities which contribute significant species diversity and habitat values to the landscape. These habitats are termed by the Umpqua Forest Plan as unique and mosaic habitats. Though uncommon in a forest landscape, they may dictate species occurrence, abundance, distribution, or home range size. Special habitats include but are not limited to meadows, unique or rare plant communities, talus, caves, cliffs, rock outcrops, mineral deposits, elk wallows and high quality calving areas, riparian areas and wetlands. Generally, these habitats are highly sensitive to changes in environmental conditions such as soil structure, wind, humidity, temperature, human disturbance, etc. (See Table 34). Natural successional pathways are often slow and can be completely altered by human activities causing long term impacts on the plant communities and animal species dependent upon them. Adjacent forest habitats are also an important habitat component associated with special habitats often functioning to meet part of a wildlife species habitat requirements or amelioration of a plant species habitat condition. Finally, in addition to wildlife and plant values, special habitats and adjacent forest are culturally rich. Pre-European contact American Indian habitation sites are coincident with the edges associated with meadow/forest habitats and provide significant information about past cultures. Certain special habitat features also had religious significance for the past American Indian culture as evidence of use can still be found in Jackson Creek. Protection of habitation sites can often be achieved in conjunction with special habitat protection.

Protection of special habitats is derived from the need to maintain diversity throughout National Forests to meet the expectations of our public as described in the 1976 National Forest Management Act (NFMA) Section 219.26:

"Forest planning shall provide for diversity of plant and animal communities and tree species...Inventories shall include quantitative data making possible the evaluation of diversity in terms of its prior and present condition. For each planning alternative, the interdisciplinary team shall consider how diversity will be affected by various mixes of resource outputs and uses..."

The need to address special habitats in Jackson Creek watershed analysis arose because:

A) The occurrence, integrity and function of special habitats may be highly affected by past, present and future management activities.

B) We have no baseline inventories, classification or landscape scale information of such habitats to determine the significance of past and future loss or degradation of such habitats.

C) All of the features and plant communities are rare or have become rare lending importance to determining the present condition and developing protection and restoration measures which can be further developed at the project level and monitored at the forest level. Over 90% of the Forest's R6 sensitive plants and rare plant communities are in special habitats. About 50% of the threatened, endangered and R6 sensitive animal species are also associated with special habitats.

D) There is a need to develop guidelines to: (1) aid planners and field going personnel in identification of special habitats, (2) to outline critical factors to consider when designing methods for maintenance of the habitats, (3) to suggest criteria for prescriptions which may prevent disturbance to the microclimate, soil, water, vegetation, and wildlife in these areas, (4) Identify restoration considerations and opportunities.

E) There is a need to develop a monitoring plan which will be responsive to measuring environmental change.

Issue and Analysis Questions

The following issue statement and analysis questions were developed to specifically address special habitats in the Jackson Creek Drainage:

Issue: Maintenance of integrity and function of special habitats.

Analysis questions:

- What is the existing, historic, and desired future condition of special habitats in Jackson Creek Drainage?
- What processes influence the integrity and function of special habitats in Jackson Creek Drainage?
- What is needed for protection, maintenance and restoration of these habitats in Jackson Creek?

Significant Information Gaps

While forested communities on national forest lands in southwest Oregon have received considerable study in community composition and classification, non-forested communities and other key habitat features have not. As mentioned earlier, susceptibility to disturbance by logging, road building, grazing, exotic species introductions etc., is high. Considerable changes in key environmental factors and processes have occurred within and adjacent to these areas with no baseline information to measure affects and trends which could lead to species or community loss. The Jackson Creek Watershed Analysis process was too limited to characterize and classify special habitat plant communities occurring in the drainage. Considering the Forest Service's first priority is to ensure ecosystem health and this involves maintenance of biological diversity defined as genetic diversity, species diversity, and community diversity (Reinvention USDA 1994)(Lagner and Flather 1994), we need to know species, species range, and communities occurring in non-forested habitats in order to measure how they are doing. This is a critical information gap which needs further attention. A limited effort was made to obtain a general idea of some species present in non-forest plant communities and identification of factors which probably influence maintenance of their structure, composition and function as a part of the Jackson Creek watershed analysis process. This effort focused on mesic and dry non-forest

communities and did not use sampling design which would allow the classification of plant vegetation composition and structure.

Assessment of wetland communities is lacking in this analysis. Inventories and community/habitat characterization of wetlands is needed. Existing information was insufficient, reflecting a small percentage of the actual wetland communities occurring in the watershed. Because of high sensitivity to change in conditions, specific focus and attention to wetland inventories and community classification is needed. Lending more importance to a comprehensive effort to inventory and assess wetland habitats is the need for information to address past, and present conditions and spatial relationships of breeding, feeding and resting areas for wetland obligate species listed by the Regional Forester as sensitive. Lacking this information restricts the ability to address cumulative effects in project planning, identification of key areas and development of a conservation, monitoring and restoration strategy.

Finally, mosaic habitats were not considered as a part of this analysis and need further assessment, delineation and consideration of protection needs.

Past and Current Conditions

A The main objective of this section is to outline the relationship between special habitats and those environmental factors or processes which either maintain or degrade diversity, quality and function (Table 31). Environmental factors and causes of EF alteration need consideration in project level planning and monitoring plans to assure maintenance and restoration of special habitats. Lacking baseline and trend information, this approach is used to assess risk to maintenance of health[1] of special habitat communities.

[1] Health is defined as vigorous self-renewal and incorporates resiliency and diversity of composition, structure and function (Reinvention, USDA 1994)

List 1 HABITAT	List 2 ENVIRONMENTAL FACTORS	List 3 DISTURBANCES
dry meadows	soil moisture	drought
shrublands	soil structure and comp	wildfire
oak woodlands	veg structure	landslides
rock outcrops	veg composition	floods
rock gardens	wildlife composition	mechanical soil compaction
talus	ground and surface water	silvicultural practices
mineral deposits	air temp	water developments
caves	wind	pond-dredging/blasting
mesic meadows	water temp	pond-fish introductions
vine maple talus	humidity	tree removal
ponds	solar exposure	human presence
bog	water chemistry	livestock grazing
swamp		alien species introductions
sedge meadow		ground water interception
adjacent forest		stream entrenchment
		surface water diversions
		roads
		rock quarrying
		human fire setting
		timber harvest
		disease
		fire exclusion

Table 31. Environmental factors and disturbance effecting special habitats.

Wetlands: (Ponds, bogs, swamps, seeps, sedge meadow etc.)

Wetland communities are highly susceptible to disturbance. Particularly changes in microclimate, vegetation structure, hydrologic processes, water chemistry, soil erosion and sedimentation. Introductions of exotic species (bull frogs, brook trout, purple loosestrife (Lythrum salicaria), etc.) and fish stocking may also have significant affects to native wetland populations by competition, predation and disease spread (Hayes and Jennings 1988, Liss and Larson 1992, Blaustein et al 1993, pers.comm. Wolf 1995). Human management activities having the highest potential to impact habitat integrity and populations are timber harvest, roads, exotic species introductions and fish stocking (areas where fish did not naturally occur), wetland "developments", and grazing.

Timber harvest and roads have the greatest potential to change microclimate, hydrological processes and important adjacent forest habitat conditions. In both cases accessibility to wetlands by cattle is also increased.

During field sampling for watershed analysis, some of the wet habitats visited had been severely grazed or trampled by cattle. Cattle tended to concentrate in wetland habitats (including riparian) especially where they were accessible by road or trail or harvest unit (pers. field obs. Barkhurst, Wolf. LaMarr). This issue needs further attention.

Exotic species introductions and fish stocking needs focused consideration. Skookum pond, Blue Bluffs pond, Beaver lake (private), Poole lake, Snow lake and Triangle lake have stocking records. Some lakes have been stocked with brook trout, others with rainbow or both. Development of recreational fisheries has also brought unplanned introductions of fish by public users such as large mouth bass and bull heads. Once introduced it is extremely hard or expensive to eradicate unwanted fish. Blue bluffs pond is in a wetland system known to be a key habitat area for red-legged frogs and western pond turtles, federal candidates (Category 2), for listing as threatened or endangered. Wilderness lakes, (Triangle, Poole, and Snow lake) have been stocked with brook trout which prey upon both adult and egg masses of native amphibians. Anecdotal information from publics who have camped in the wilderness for years have commented on less frogs and/or toads observed.

Little is known about natural catastrophes (fire, drought, floods, landslides) in relation to local wetland communities. Some flood and landslide events may possibly create or enhance wetland habitat and may be important for habitat maintenance. Drought, fire and temperature extremes likely generate limiting factors which when coupled with ongoing human influences such as non-native species introductions, timber harvest, roading, and livestock grazing, could devastate a species or community.

Drylands: (dry meadows, shrublands, oak woodlands etc.)

Drylands in Jackson Creek are usually associated with soil type, shallow soils or high solar exposure. Processes important to maintenance of dryland habitats are soil development, hydrological, vegetation development, and climate. Natural disturbance patterns potentially affecting dry habitats are fire and drought. Fire frequencies were likely similar in dry meadows as adjacent forest. Natural disturbance in Jackson creek is confounded by a long-history of fire setting by pre-European American Indians. Early European settlers also practiced fire setting to clear land and increase grassy range for their livestock in the watershed (Beckham and Minor 1992). Such activities occurred into the early 1900's and were largely reduced by 1940.

Dry meadows are susceptible to changes in soil structure, soil composition, hydrological processes, and vegetation composition. Human management activities having the highest potential for impact are grazing, roads, and adjacent timber harvest. Concerns regarding the effects of livestock grazing and road access and hydrological processes on soil structure, water relationships, plant community productivity and diversity arose during Jackson Creek watershed analysis field sampling and needs further investigation. It appears many dryland plant communities have not recovered from grazing and continue to be impacted in some places. Roads can change hydrologic processes critical to these water limited areas and bring in undesirable non-native species. Adjacent forest is important wildlife habitat and ameliorates microclimate conditions.

Many of these meadows, especially those along main Indian trails to the Rogue/Umpqua Divide, were important hunting and food gathering areas for the Cow Creeks. Though Jackson Creek Watershed analysis team could not turn up information related to patterns of travel and use by early cattle and sheep ranchers in the area, it is most likely they followed some of the same trails to the highlands (Rogue/Umpqua Divide) as the Cow Creeks and grazed their livestock on the same meadows along the way that were once food gathering areas (Appendix Z).

Rock Habitats: (rock outcrops, cliffs, rock gardens, talus, caves, etc.)

Rock habitats are highly susceptible to changes in microclimate and hydrologic timing. Many of the species associated with these habitats are narrowly adapted to certain microclimate conditions. One example is a species group of bryophytes, Heterocladium, identified in FEMAT which grow at the base of rock outcrops shaded by old growth canopy and are found no where else on the landscape. Human management activities having the greatest impacts to rock habitats are rock quarrying, roading, human presence where raptor nesting or bat roosting occur, and tree removal within microclimate influence zone. Past prescribed burning practices such as those conducted in the 1960s were severe and may have also affected rock habitats. Natural disturbance patterns associated with these features indicate fires were more often low intensity. As shown in 1930s photos of Jackson Creek, extensive late successional forest blanket most of the drainage regardless of years of active fire setting by native Americans and European settlers. Present conditions show rock habitats have been extensively affected as a result of 50 years of timber harvest and road development.

Mesic Habitats: (mesic forb, mesic grass, mesic shrublands, etc.)

Most of the mesic habitats in Jackson Creek occur on the south side of the drainage (north slope). Mesic habitats are mainly associated with adjacent wetland habitats, higher elevation (4000' and above), and frost pockets. High water table through most of the growing season and untimely freezing events are likely the primary factors holding back forest development. Surrounding forest provides shade for part of the day. High elevation sites receive most of their water from snowmelt. The affect of wildfire on these areas is not known. Fire history studies as a part of Jackson Creek Watershed analysis suggest fires in conifer forest at the higher elevations toward the Rogue/Umpqua Divide were less frequent and when they occurred, likely more intense. Again as with dry habitats, some of these meadows may have been frequently burned especially on the Rogue/Umpqua Divide by American Indians and early European settlers up through the early 1900's. Forest encroachment has been observed on the Rogue/Umpqua Divide, is noted in Frankin and Dyrness (1973) and supported by Jackson Creek Watershed analysis field observations. This may be related to lack of fire and/or recent drought cycles which made conditions for tree establishment favorable.

Areas such as Green Prairie and meadows at the head of Donegan Creek, are prime elk, deer, and bear spring, summer and fall foraging areas and elk calving habitat. Adjacent forest and clumps of trees and shrubs provide security and resting, and travel areas.

Mesic communities are most susceptible to changes in soil structure and moisture, solar exposure, hydrological processes, snow accumulation, and vegetation composition. Roading, adjacent forest timber harvest, and livestock grazing are the main human activities causing changes in environmental factors.

Methods for Determining Habitat Types

The methods used to identify special habitats in Jackson Creek for watershed analysis are summarized below:

1. 1992 aerial photos were reviewed. Special habitats recognizable on aerial photos were delineated.

2. General ecoclass codes (first two alphanumeric characters in lifeform code) (USDA R6Ecol 1988) were assigned to each polygon.

3. Each polygon's unique polygon number and ecoclass attribute were mapped using district's and Forests's GIS.

4. Field sampling of 112 polygons to varying levels of intensity was completed to identify species groups and gather limited information on plant communities and habitat conditions. Field classification can be compared with prefield classification. Ecoclass codes were refined for sampled polygons were intensity of field sampling allowed.

As mentioned earlier, ecological unit classification for non-forest habitats in southwest Oregon has not been completed. Our field sampling techniques did not use methods which would support ecological unit classification. Without such classification and baseline inventories of special habitats, rare communities or communities at risk cannot be identified and monitored.

Field sampling as a part of Jackson Creek watershed analysis did enable us to refine ecoclass information to the 4 character lifeform code (Hall 1988) and get some idea of plant communities occurring in the drainage. As might be expected, our observations suggest appropriate sampling would likely classify different associations unique to this province than those presently published. The most intense level of sampling (39 polygons) consisted of general walk through surveys. Plant species and community structure were identified. Adjacent forest was also visited and described when time allowed.

Conclusions

Special habitats, in general, represent a very small percentage of the total land area (6%) in Jackson Creek yet a very significant proportion of the biological diversity (approximately 90%). Each special habitat "lifeform" represent an even smaller percentage (Tables 32 and 33). Further, individual plant associations (when identified), are an even smaller (%) as a subset of lifeforms. Pre-field aerial photo delineation estimated 10 different lifeforms. Field sampling classified 40 lifeform/species groups out of 112 sample polygons having species groups or other features different from one another. Our sample size was too small to identify all lifeforms likely occurring in Jackson Creek.

Ecoclass/type	Code	Total Polygons	Percent %
Lakes/ponds	WL	23	02
Nonvegetated/rocky	NR	160	14
Shrubland/chaparral	SC	14	01
Shrub/moist	SM	47	04
Shrubland(unclassified)	SX	4	<1
Hardwood(unclassified)	HX	53	05
Meadow(unclassified)	MX	17	<1
Meadow/Dry	MD	595	51
Meadow/Wet	MW	3	<1
Meadow/Moist	MM	228	20
Unclassified		11	01

Table 32: Lifeform codes identified during aerial photo analysis. Percent of 6% total special habitats occurring in Jackson Creek.

Ecoclass Type	Code	Ecoclass Type	Code
shrubland	SX	subalpine/alp. mdw.w/conifer	MSCO
shrub/wetlands (willow alder)	SW	mdw complex-wet-pothole->dry	MMBO
willow wetlands	SW10	sedge/marsh/marigold	MM39
moist shrubland	SM	moist meadow	MM
moist shrubland/forb wetland	SMFW	dry meadow	MD
tall shrub	SM81	oak w/shrub dom. ground veg	HOSO
chaparral	SC	ash/willow	HCS2
chaparral/bunchgrass	SCGB	red alder/overflow bottomland	HAM1
tallus/vine maple	NTS2	grassland	GX
rocky land/minimal veg	NR	bunchgrass spp.	GB
rocky scattered shrubs	NRSO	bunchgrass/wet forbland	GBFW
rock garden (flat xeric)	NRR9	bunchgrass w/scattered conif	GBCO
rock garden (steep xeric)	NRL9	fescue/bunchgrass	GB50
ledge/cliff/broken face/>20ft	NRL6	needle grass/bunchgrass	GB20
ledge/cliff/smooth face>20ft	NRL2	annual grass	GA
ledge/cliff/grass/shrub	NRGS	dogtail/annual grass	GA30
wet meadow	MW	cheat grass/annual grass	GA10
wet meadow-rush	MW30	wet forbland	FW
wet meadow-tall sedge	MW10	moist forbland	FM
bullrush meadow	MT10	conifer/hardwood/shrub	CHS2
Oak annual grass	H063	Maple overflow bottom land	HBM1

Table 33 List of additional special habitat types identified during field sampling.

General field observations:

Bunch grass communities:

As in other places throughout the west, native bunch grass communities in Jackson Creek have been replaced with non-native annual grass communities as a result of non-native species introductions and livestock grazing in the past 150 years. However, a few areas in Jackson Creek have retained bunch grass. Fescue bunch grass communities and needle grass communities as well as a number of other bunch grass species were found during field sampling. These areas appear generally to have less environmental factors affecting their condition, especially those associated with grazing and roads.

Along with their value as being some of the last remnant bunch grass communities occurring in the watershed and province, these areas are local seed sources providing opportunities to restore bunch grass on other sites, enhance forage for big game, and for erosion control. Some of the bunch grass communities had birchleaf mountain mahogany along with other plant species uncommon in Jackson Creek and becoming more uncommon in the river basin on the hills and slopes of the lower Umpqua Valley due to development and agricultural practices.

Wetlands:

Many plant species in wetland habitats were not identified due to either time limitations during field work or intensive grazing by cattle. Tall manna grass, a species valuable to wildlife and past human cultural value (food) was identified in several wetlands during sampling. Tall manna grass is associated with poorly drained marshes, boggy meadows or moors. We observed intensive livestock grazing and and associated trampling damage to tall manna grass.

Adjacent Forest:

Adjacent forest is important habitat in combination with non-forest special habitat features for many wildlife species. Not only important to big game as cover and travel corridors, species such as pond breeding amphibians use adjacent forest during most of their adult life (northwestern salamander, red-legged frog, etc.). Adjacent forest often had high tree and understory species diversity including hardwoods such as oak and madrone (dry) or big leaf maple, alder, ash (wet). High wildlife use was observed including extensive game trails leading to other nearby special habitats. These forested habitat conditions are also uncommon and should be regarded as part of the special habitat component.

Key environmental factors affecting condition and maintenance of special habitats:

Little information is available which specifically addresses the potential consequences of changes to environmental factors which may impact structure, composition, processes and functions of special habitats. As stated in FEMAT, (Chapter IV-pg 124), modification of the hydrology, shading and microclimate of these sites could result in extirpation of locally adapted species with highly specific habitat requirements. Losses of plant communities, community structure, or individual plant species have occurred throughout the Pacific Northwest as a result of changes in environmental factors such as those changed by livestock grazing and alien plant species introductions. As stated in Brown et al (1985), even if features and plant communities remain unchanged after management activities such as timber harvest, microclimates and usefulness as habitat for certain wildlife species may change. This also applies to adjacent forest habitat for wildlife that require both habitats.

Current research on effects of fragmentation on old growth interior habitat (Chen et al 1990) describe edge width over which edge effects are measurable for different environmental factors associated with microclimate change. Table 34 (Dimling and McCain 1992), represents conditions of greatest penetration into the stand and were determined from data taken in mid-elevation stands on relatively flat terrain.

Factor	Edge Width/Meters	Edge Width/Feet
Light	< 60m	(<200ft)
Air Temp	120-180m	(390-590ft)
Soil Temp	< 60m	(<200ft)
Wind	180-240m	(590-790ft)
Humidity	>240m	(>790ft)
Tree Mortality	120m	(390ft)

Table 34. Environmental Factors Affecting Interior Old Growth (Chen, et. al. 1990).

Comparing edge width values with prescription buffer sizes outlined in the 1990 Umpqua National Forest Plan and those described in the 1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD), shows that buffers may not completely extinguish all edge effects on the microclimates of special habitats. Site specific assessments considering special habitat type and sensitivity to microclimate change, other environmental factors and cumulative effects such as roads, livestock grazing and timber harvest, will need consideration in developing site specific prescriptions for protecting special habitats.

Field observations associated with this watershed analysis generated concern that even the dryer sites including native bunch grass communities may be sensitive to microclimate conditions in addition to having very fragile soils. Soil/water/plant relationships can be severely altered by livestock grazing and trampling. We observed a pattern of remnant native bunchgrass occurrence along meadow perimeters. This is an area where microclimate provided by the adjacent forest likely ameliorates affects of soil damage and water availability. In the center of the meadows, alien annual grass species occupied nearly all of the growing space. High amounts of bunch grass were found in a couple of small sample meadows removed from management activities and less likely to have had past livestock grazing. Considering the rarity of native bunch grass throughout its range due to past livestock grazing and alien grass species introductions, these observations may have important implications for restoration and management of bunch grass communities.

Activities altering the Environment

Four main activities generating "Environmental Factor" (See Table 34) alteration were evaluated in Jackson Creek for: (1) Roads, (2) Timber harvest and associated post harvest management, (3) Site conversion to Ponderosa Pine forest and, (4) Livestock grazing. Others were less extensive (pond habitat alterations including fish introductions, rock quarrying) but no less important considering associated changes in habitat or habitat loss of a limited of special habitat resource.

Roads

To determine the level of influence roads may have on all special habitats in Jackson Creek, special habitats occurring within 200, 400, and 600 feet of all mapped roads were summed and compared to the total number of special habitats (Table 35).

Results:	200'	400'	600'
# SP HT	250	412	555
Total # SP HT JK CR	1155	1155	1155
% of Total	22	36	48

Table 35. Total percent of special habitats affected by roads within 200, 400, and 600 feet respectively is 22%, 36%, 48%.

Roads engage numerous processes which may affect the timing, duration, and magnitude of environmental factors (EF) on special habitats. Roads remove trees, opening an area up to changes in wind, temperature, humidity, solar exposure. Soil is compacted affecting soil structure and ground and surface water dynamics. Associated drainage networking may cause stream entrenchment through a habitat area affecting water table or surface water diversions. Subsurface water once available to plant communities or to wetlands may be intercepted by a road cut.

Roads also encourage alien species introductions, increase human presence (disturbance), and increase accessibility for livestock grazing which in turn engages additional EFs.

Timber Harvest

To determine the level of influence timber harvest and associated post harvest activities may have on special habitats in Jackson Creek, adjacent harvest within 200 and 600 feet of all mapped special habitat polygons was summed and compared to the total number of polygons in the drainage (Table 36). Further, plantations containing > than 25% ponderosa pine within 1200 feet of a special habitat were also summed as they generally do not occur in greater abundance naturally in Jackson Creek and generate differences in EFs (In field sampling we also noticed ponderosa pine was planted in special habitats initiating early encroachment of trees into non-forest habitats).

Results:	200'	600'	PIPO 1200'
# SP HT	239	482	430
Total # SP HT JK CR	1155	1155	1155
% of Total	21	42	37

Table 36. Total percent of special habitats in Jackson Creek affected by adjacent timber harvest is 21% and 42% within 200 and 600 feet respectively. Plantations having greater than 25% ponderosa pine are found within 1200 feet of 37% of all mapped special habitats in Jackson creek.

Tree removal associated with timber harvest changes microclimate conditions such as wind, air temperature, humidity, and water temperature potentially leading to extremes in climatic affects on a special habitat. Further, adjacent forest is a key habitat component for wildlife species needing both special habitat and late successional forest conditions. Coupled with cumulative effects of other management activities, effects on individual species populations and community composition could be significant.

Tree removal and associated post harvest activities can increase use of special habitats by livestock and invasions of alien plant species by increasing accessibility.

Sensitivity to tree removal may be different for different habitat types. As previously stated, prior to field sampling, we assumed dry habitats were likely less sensitive compared to other types. While conducting field sampling we noticed an interesting pattern of remnant native bunch grass species occurring along meadow margins where microclimate conditions may have ameliorated the effects of past grazing impacts and alien species invasions. Tree removal adjacent to dry habitats where livestock grazing occurs may remove refuge habitat for bunch grass and other species. More intensive sampling is needed to determine if this observation is valid.

Grazing

Livestock grazing or simply use for resting, water source and travel especially in very dry habitats or very wet habitats can change fragile soil composition and structure. Vegetation composition and structural diversity are also reduced as a result of livestock grazing as was observed in Jackson Creek. Roughly 80% of Jackson Creek is in an active grazing allotment. Over the years a few small areas around springs have been fenced to reduce impact by cattle. Grasshopper meadows (now in an inactive allotment) was fenced to exclude cattle in 1914. Generally special habitats continue to be used extensively by cattle for grazing, watering and resting. Field sampling documented high use in grassland ecoclasses, shrubland ecoclasses, and meadow ecoclasses including wetlands. Of those areas sampled in the field 35% were grazed to the extent that vegetation structure differences or soil disturbance were apparent and documented. Some of the wetlands sampled were trampled and grazed intensively. In one meadow hay was placed to concentrate cattle for round up with resulting soil impacts and risk to introduction of weeds. Vegetation in meadows once used as salting areas continue to be disturbed as cattle still concentrate in those areas. Bunch grass meadows still occur in Jackson Creek but are few and appear to be related to no or low levels of grazing. Issues with regard to regeneration of oaks, mountain mahogany, and sensitive plants have not been fully considered. Soil and vegetative recovery from past and current use in special habitats was not readily apparent.

Ponderosa Pine Reforestation

A high percentage of reforestation plantations in Jackson Creek have been planted with ponderosa pine ranging from the 1950's to present reforestation practices. Historically, Jackson Creek watershed had a significantly lower abundance and frequency of ponderosa pine compared to present conditions in plantations. This analysis estimated ponderosa pine comprising greater than twenty five percent of tree species planted in plantations outside the natural range of conditions. Series associations (Atzet and McCrimmon 1990) in Jackson Creek (from greatest coverage to least) are White fir, Douglas fir, Western hemlock, and Mountain hemlock. Douglas fir series would be the series with the highest likely occurrence of ponderosa pine and covers about 24% of the watershed at lower elevations on exposed southerly slopes. Atzet and McCrimmon's (1990) constancy tables which sampled stands ranging in age from 100-300 years, for Douglas Fir series, identified ponderosa pine occurring in only 26% of their plots and mean percent cover where it occurred in plots was 13.6%. Even lower representation was found (<10%) in unmanaged plots during Jackson Creek watershed analysis (See Appendix H) in Douglas fir series.

Concerns arise for plant and animals adapted to habitat conditions associated with the natural conditions and processes once present in these forest stands and the potential for impairing normal plant and animal succession and recovery cycles. Species assemblages including carryover species from previous older stands may be at higher risk of elimination. Conditions are very different in ponderosa pine plantations. They are generally more open, hotter and dryer as the canopy character is different allowing greater solar radiation to reach the ground over the many years the stand develops. The nutrient cycling will be different given the dominance of ponderosa pine needles. Further, ponderosa pine needles change the character and habitat conditions of the forest floor as well as canopy habitat structure. Tree species diversity, especially in the older plantations is very low.

Many special habitats have ponderosa pine plantations near or adjacent to them. Wetlands, where the adjacent forest was harvested and replanted in ponderosa pine has lost important habitat conditions for amphibians and small mammals which use forest and wetland habitat for parts of their life history and as a food source. This includes riparian habitats. A change in forest habitat condition in association with wetlands likely has an affect at least up to 1200 feet from the perimeter of the wetland since many amphibian species travel at least that far into forest terrestrial habitats (McComb et al 1993). Preponderance of ponderosa pine in these areas slows microclimate recovery by maintaining open forest habitat conditions and may completely change potential forest floor structure and plant species composition. Recovery of some rock habitats from changes in microclimate conditions may also be impaired such as <u>Heterocladuim</u> spp., a group of bryophytes mentioned in FEMAT and bat roosting habitat. Dryland habitats have also been affected. Though ponderosa pine may have occurred more frequently near dry meadows, species diversity is much lower with little madrone and oak than would be expected to occur after disturbance in adjacent developing stands. Due to the lingering of grass and other palatable forb species in pine plantations, locations next to unique habitats also tend to encourage use by cattle causing greater use and damage to special habitats.

Not all affects have been negative to wildlife. Big game and turkey have benefited. Since stands tend to stay open, there is an extended forage opportunity well into mid-successional stand conditions with excellent hiding cover.

Wildlife

Wildlife Population

For many wildlife species in the Jackson Creek Watershed, sufficient baseline information such as species occurrence, distribution and abundance is very limited. Lacking population information, coarse filter landscape design concepts, (Hunter 1991, Turner 1989, Samson 1992) and a population vulnerability analysis, (Lehmkuhl and Ruggerio 1991) were applied in relation to the upslope and riparian vegetation condition in Jackson Creek to identify and track wildlife issues (1- 5). The most pertinent of these issues are summarized below, and this analysis will endeavor to address them.

- The existing condition and trend of populations and habitats.
- The range of natural conditions in the watershed (integrated with the vegetation analysis) as a baseline for successful maintenance of populations.
- The ability of the existing condition to provide sufficient habitat to maintain local populations well distributed in the watershed.
- The ability of the President's Plan Riparian Reserve allocation (present condition and future) to maintain suitable habitat for population connectivity and source areas for carryover populations for riparian associated or late successional species.
- The detection of key source areas or "hot spots" which may be important to population persistence.
- Processes and factors affecting species (natural/anthropogenic).

Maintenance of Late Successional Species Populations/Communities

Two groups of wildlife species, associated with late successional forests, and having different requirements were determined to be at high risk of local extirpation (Lemkuhl and Ruggerio 1991). Within these groups several species were at greater risk than others. These species are specifically addressed.

GROUP 1: Small Mammals and Amphibians Small body-low mobility species

This species group is vulnerable to loss of genetic diversity and at high risk of local extinction caused by population isolation and habitat fragmentation (Lehmkuhl and Ruggerio 1991). There are many factors which probably affect their ability to persist in Jackson Creek, including changes in microclimate processes, interior habitat conditions, complex closed canopy forest structure, and abundant coarse woody debris (Gilbert and Allwine 1991, Bury et. al. 1991). The initiation of patch isolation processes also have a deleterious effect on survival, since small mammals and amphibians require connected habitats, where linkage corridors are wide enough to support resident populations, since their travel distances are too small to cross entire corridor lengths, during dispersal (Bennett 1990).

Amphibian Communities in Jackson Creek

A limited sampling effort to determine species occurrence and distribution of upslope terrestrial amphibians in Jackson Creek watershed was completed in forest habitat representative of the range of existing conditions. The results of this effort were then compared with in depth studies in the Pacific Northwest and Northern California. Specifically, Gilbert and Allwine (1991) conducted a study covering the western Oregon Cascades with study plots on the Rogue and Umpqua National Forest. Bury et. al., (1991) considered regional patterns of terrestrial amphibian communities including the coast range, Washington Cascades, and Oregon Cascades. Raphael (1988), Welsh and Lind (1988), conducted studies in Northern California which had similar results as those study plots on the Umpqua and Rogue included in Gilbert and Allwine's study.

Table 37 lists results of terrestrial amphibian occurrence from sampling efforts. The most prominent observation was the low numbers of individuals observed. This may have been a result of seasonal variation, since the greater part of the survey was completed in May (late in the season for highly successful observations). However, Gilbert and Allwine also commented on the lower numbers of captures in the Rogue and Umpqua basins. They believe their findings support the generalization that amphibians tend to be restricted by dry conditions because the Rogue-Umpqua sub-province had the lowest average annual precipitation within their study area. Further, they stated that many of the Rogue-Umpqua species selected mesic-wet stands over dry stands (except for the ensatina, which preferred dry sites). This has significant implications if genetic integrity is to be maintained. Local amphibian populations may be more sensitive to forest vegetation management and edge effect in Jackson Creek than in other areas within a species geographic range. Activities which reduce forest cover and increase drying may severely restrict occurrence, distribution and abundance.

Species	Number obs	Forest Type	$2m^2$plot	TCS
Western red-backed salamander *Plethodon vehiculum*	1	LSV	X	
	1	RIP		X
	11	LSV		X
Ensatina *Ensatina eschscholtizii*	17	LSV	X	X
	3	MIX	X	X
	3	MS	X	X
	2	RIP		X
	1	CC		X
Clouded salamander *Aneides ferrius*	2	MIX	X	
	4	LSV		X
Northwestern salamander *Ambystoma gracile*	1	LSV		X
Roughskinned newt *Tarica granulosa*	1	MIX	X	
	1	RIP		X
Pacific giant salamander *Dicamptodon tenebrosus*	1	RIP		X
Northern red-legged frog *Rana aurora aurora*	1	LSV	X	
	17	RIP		X

Table 37. Results from Plot and Time Constraint Sampling (TCS) in 6 Different Upland Forest Vegetation Conditions and Time Constraint Sampling in Riparian Habitats. Forest Type codes: LSV=late successional forest, MIX= mixed coniferous forest (MATURE), MS= mid-successional forest(40-80 yr), ES= early successional forest (20-30 yr), CC=Clearcut (0-20 yr) OSP=offsite ponderosa pine plantation (30-40 yr).

Another general observation during our sampling effort was the high occurrence of reptiles and low occurrence of amphibians in early successional stands (ES) and off site ponderosa pine stands (OSP) (See figures 12-15). Off site pine plantations had the highest observations of reptiles and the least observations of amphibians. Again, our sample sizes were small and could not measure relative abundance. Our results however, are consistent with Raphael's (1988) and Bury and Corn (1988) studies which sampled seral stages.

Table 38 summarizes District records of amphibian species and outlines aquatic, riparian, and upslope habitat associations observed in Jackson Creek Watershed.

Species	pond breedin g	riparian	upslop e	other	required habitat features
Western red-backed salamander *Plethodon vehiculum*				seeps	CWD
Ensatina *Ensatina eschscholtizii*			x		CWD
Clouded salamander *Aneides ferrius*			x	talus	CWD
Northwestern salamander *Ambystoma gracile*	x	x	x		CWD
Roughskinned newt *Tarica granulosa*	x	x			CWD
Pacific giant salamander *Dicamptodon tenebrosus*		x			CWD
Northern red-legged frog *Rana aurora aurora*	x	x	x		
Foothill yellow-legged frog *Rana boylii*		x			
Cascades frog *Rana Cascadae*	x	x			
Pacific tree frog *Pseudacris regilla*	x	x	x		
Western toad *Bufo boreas*	x	x	x		

Table 38. Total District records of amphibian observations. General habitat associations

Species not documented but likely occurring in watershed:

Southern torrent salamander (headwater habitat)
Rhyacotriton variegatus

Dunn's salamander (riparian and aquatic habitats small streams seeps)
Plethodon dunni

Species determined not to occur in the watershed:

The Black salamander, *Aneides flavipunctatus* was suspected to occur due to a sighting report on the District from a visiting biologist (1992). Specimens which closely resembled the black salamander were collected as part of the Jackson Creek sampling effort, but were determined to be dark phases of clouded (Beatty OSU). We believe the 1992 sighting was a mis-identification.

Examples of occurrence and distribution results from sampling effort in different habitat conditions in Jackson Creek watershed:

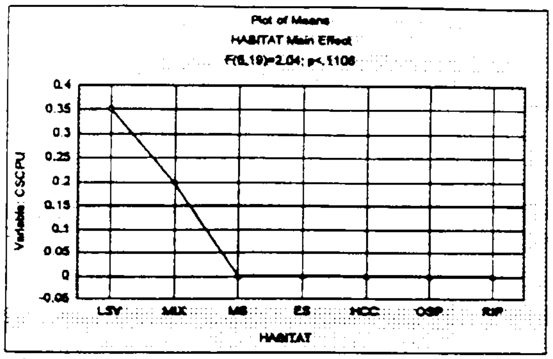


Figure 12. Clouded Salamander

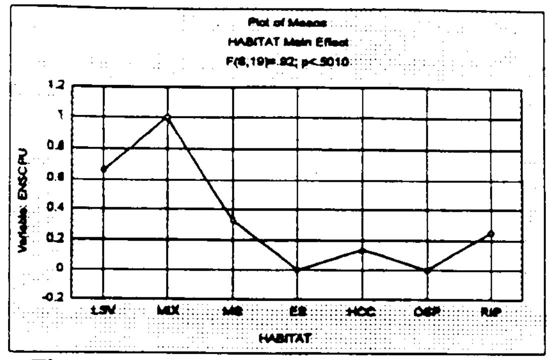


Figure 13. Ensatina

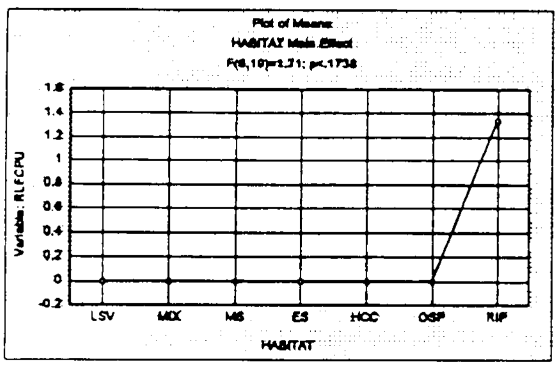


Figure 14. Red-legged Frog

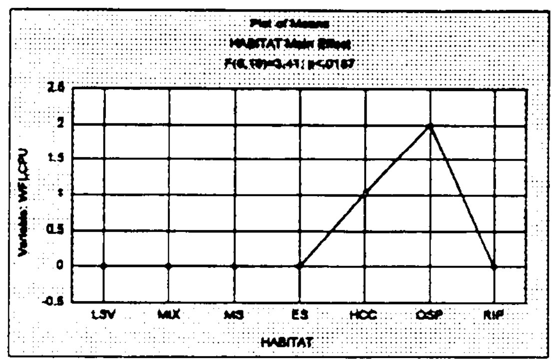


Figure 15. Western Fence Lizard

Terrestrial Amphibians

Clouded salamander

Some studies suggest that, though this species is an old growth associate, it will persist in clearcuts and early successional stands under bark or inside downed logs, if logs are sufficiently abundant (Raphael 1988). Other studies suggest this species is far more abundant (with capture rates five times greater) in mature and old growth stands (Gilbert and Allwine 1991).

Lehmkuhl, et al., (1991) cautions that processes such as lag in population decline, packing affect, and source and sink affects, coming from nearby old growth habitats may influence results of bird and amphibian abundance studies in early successional stands.

We did not observe clouded salamanders in early successional managed habitats or in riparian habitats in Jackson Creek. All captures of clouded salamanders were in upslope, old growth stands.

Welsh and Lind (1988) found that although coastal forests did not show significant differences in abundance between stand age, the clouded salamander preferred older forests inland. They suspected the difference was due to different moisture regimes. Further, they suggest logs on inland young stands are subject to greater evapo-transpiration rates than logs in old growth stands, because of more intense radiation. This would also suggest longer lasting affects in ponderosa pine plantations which tend to maintain greater insolation during stand development in Jackson Creek.

In summary, clouded salamanders occur in upslope terrestrial mesic habitats rather than riparian habitats, and are associated with old growth. Riparian reserves may not provide patch connectivity for this species. Further, dependence on remnant legacies in clear cut stands, as described in the ROD (C-40 B and C-41 B), given the dryer climatic conditions found in Jackson Creek, may pose a high risk to local isolation and possible extirpation of this species within the drainage.

Headwater Stream Breeding Amphibians

Tailed Frog and Southern Torrent Salamander

Headwater amphibians are associated with higher stream class aquatic habitats (class 3 and 4), and terrestrial habitats to varying degrees depending on species. The same aquatic habitat conditions and processes as detailed in aquatics section of this report affect these species in the headwater areas where fish do not occur. Changes in aquatic and terrestrial conditions are very dramatic adjacent to higher class streams due to greater levels of past harvest and road construction in headwater areas. Baseline inventories providing information on occurrence, distribution and abundance for tailed frogs or southern torrent salamanders have not occurred in Jackson Creek watershed. Key source areas, or areas where these species are absent cannot be identified.

The tailed frog breeds, and larvae develop, in cool, permanent flowing small streams and the location of these streams can greatly influence the occurrence of the species in nearby forest stands (Bury and Corn 1988). Tailed frogs have a largely unknown terrestrial life history. Bury and Corn (1988) suggest terrestrial forest habitat may be important to their continued local occurrence and abundance and needs further research. Observations of dispersing juveniles have occurred hundreds of yards away from streams up to ridge top (pers. comm. Bury). Adults have been observed in forest stands, more than 1000 feet from water. Adults captured by Gilbert and Allwine (1991) Rogue-Umpqua NF study sites were found only in old growth stands. Though not mapped or documented, incidental observations of tailed frog have been reported in the Jackson Creek drainage.

The southern torrent salamander also occurs in or near small headwater streams and seeps. Though this species has not been observed in Jackson Creek it probably occurs there. The closest known location is Deadman Creek watershed which is a short distance upstream, and west of, the main South Umpqua from the mouth of Jackson Creek.

Pond breeding amphibians

The northwestern salamander, northern red-legged frog, Cascades frog, and rough skinned newt have highly complex life cycles which expose them to hazards both in aquatic and terrestrial environments (SEIS 1994). All of these species occur in Jackson Creek. Northern red-legged frog and Cascades frog populations have been declining and are candidates for listing under the Endangered Species Act. Trends of population condition are not known in Jackson Creek.

The Cascades frog is generally a higher elevation species (3000-5000 feet), the northern red-legged a lower elevation species (sea level-3800 feet). In Jackson Creek, however, there is considerable overlap in range between the Cascades frog and northern red-legged frog. The Cascades frog has been observed as low as 2000 feet on the mainstem of Jackson Creek in the upper half of the drainage, and a few individual northern red-legged frogs have been observed in the upper reaches of Squaw and Service Berry Creek drainages, at elevations near 4000 feet. The northwestern salamander is known to occur at elevations from sea level to above 5000 feet. Adult observations of this species occurred in the Squaw Creek and Black Canyon Creek drainages, however egg masses have been observed in ponds in the Beaver Creek drainage.

Past years observations, confirmed during this watershed analysis suggest Beaver Creek drainage, with its extensive wetlands, sag ponds, vernal pools and low gradient stream channels is a key "hot spot", or source area, for the northern red-legged frog and the northwestern salamander (as it prefers many of the same conditions as the northern red-legged frog).

Complex life history requirements, introductions of exotic species, and the warm, dry climatic conditions found in Jackson Creek watershed, compared to other areas in these species geographic range, leave these species at high risk to major population declines or local extirpation.

Specifically, these species need access and suitable conditions in two habitats, ponds for breeding, and terrestrial habitats for foraging and dispersal. They require cool, moist terrestrial conditions and stable aquatic conditions (water quality, depth, temperature and duration). Hydrologic processes such as ground water interception, extension of the drainage network caused by roads, sedimentation, high peak flows/low duration of water may have drastic destabilizing affects on forest ponds and wetlands. These effects have been analyzed for streams (See Aquatics section of this chapter for detailed description of processes). However, a focus on condition of forest ponds and wetlands and adjacent forest terrestrial habitats is lacking in this report and constitutes a significant information gap needing further study.

Terrestrial life histories of pond breeding amphibians are largely unknown (Bury et. al. 1991). The dependence of amphibians on moist microclimates requires preservation of internal habitat structure and dynamics within patches and corridors. The northwestern salamander was found to be more abundant in cool old growth forests than in other forest conditions (Bury and Corn 1991). Red-legged and Cascades frogs, in general, were found in mature/old growth forest stands (Gilbert and Allwine 1991, Welsh and Lind 1988). However, Bury et. al. (1991) found a higher number in mature and old growth forests near "meltwater" ponds. A study of forest fragmentation in the tropics found that frogs which required standing pools of water for reproduction showed the greatest decline with fragmentation (Lovejoy 1984). Such findings prompted Wilcove (1990) to postulate that the negative effects of habitat fragmentation on amphibians would include barriers preventing movement to one of multiple necessary habitats, particularly between ponds for breeding and forests for foraging.

Edge effect processes accompanying fragmentation causes lower humidity, increased desiccation, higher temperatures, more variability in moisture and temperature, wind damage, and changes in erosion and sedimentation patterns (Manley and Minsker 1992). For corridors to be of use to these species they need to be wide enough to maintain internal terrestrial microclimate. Further, habitat patches around ponds need to be large enough to accommodate internal terrestrial microclimate conditions and have abundant habitat components, e.g. CWD for northwestern salamander and rough skinned newt. In southwest Oregon this is likely far more important due to moisture limitations than in other northern and coastal Oregon provinces. Present Riparian reserve widths (ROD C-30) may be too small (300' and 150' slope distance per side) to maintain microclimate conditions in the adjacent terrestrial habitats near breeding ponds and as corridors along streams though they may meet aquatic condition requirements. Chin, et. al. (1990) described a return to temperature and humidity from clearcut edges between 394' and 787'. In addition, the study areas were in moister climates than southwest Oregon (Wind River Washington and H.J. Andrews Experimental Forest) and differences in habitat use by amphibians were observed by Gilbert and Allwine (1991) on the Rogue-Umpqua compared to H.J. Andrews Ex. For. and the Mt Hood Forest.

Small Mammal Communities in Jackson Creek

Occurrence, distribution and abundance in Jackson Creek watershed for all small mammal species addressed below are unknown. This analysis draws upon information from 20 study plots occurring on the Rogue and Umpqua National forests (Gilbert and Allwine 1991) and other recent publications. Focus is on species with greatest vulnerability based on recent studies.

Western red-backed vole

The western red-backed vole,(WRBV) is a member of the late successional ground dwelling rodent community and is specifically addressed here due to its association with upslope late successional mesic habitats and aversion to riparian areas. Because of its association with upslope late successional habitats, it may be difficult to maintain ecologically functional populations in matrix lands, with the attendant emphasis on intensive timber harvest. In addition to being important prey for other wildlife species including the northern spotted owl, this species plays an important functional role as a lichen and fungi-eating animal, assisting in the spread of forest plants beneficial to maintenance of healthy coniferous forests and nutrient cycling.

WRBV primary habitat occurs at distances of >650 feet from second and third order streams (Mc Comb et. al. 1993). The western red-backed vole prefers old growth habitats and was highly associated with areas of lichen ground cover and large, rotting, punky logs (decay class 5) using the overhang space as travel corridors (Gilbert and Allwine 1991).

Gilbert and Allwine (1991) found this species to be more abundant on the Rogue and Umpqua National Forests than in the northern Cascades forests. Raphael (1988) described abundance and trends of WRBV along with other species in northern California which Gilbert and Allwine (1991) suggest is in an area not dissimilar to the Rogue and Umpqua. Raphael (1988) estimated major population declines with continued harvest of old-growth forests.

Because this species is not a riparian associated species, Mc Comb et. al. (1993) suggests that stream side corridors may not be sufficient linkages for western red-backed voles. Therefore this species may be subject to higher risk of isolation, major population declines and local extirpation. Further, Mc Comb et. al. (1993) states that if managers wish to promote linkages among upslope mature forest patches, stream side corridors should be sufficiently wide to include optimal habitat used by western red-backed voles, or upslope areas need to retain significant amounts of within-stand structure and link to patches of suitable habitat. As will be established in the habitat analysis modeling results, later in this document, drainages on the north side of Jackson Creek, Soup and Whisky Creek drainages, Pickett and Beaver Creek watersheds are all highly fragmented with few remaining suitable patches and linkage areas.

Red Tree Vole

The red-tree vole is a member of the late successional forest arboreal rodent community. Occurrence and distribution information is limited to a few individuals collected in pitfall traps from the 20 study plots on the Rogue and Umpqua Forests (Gilbert and Allwine 1991). Nothing is known about species occurrence, distribution and abundance in Jackson Creek. Brian Bisswell, in association with the Forestry Science Lab in Olympia recently reported (December 1994) preliminary observations of his master's thesis in the Rock Creek Drainage near Mary's Peak in the Oregon coast range. Bisswell's observations suggest this species is presently very rare and has a clumpy distribution. Further, he suggested the Umpqua National Forest may have some of the best contiguous habitat remaining in the species range

The red tree vole was rated as most vulnerable of the arboreal rodents to local extirpations resulting from loss or fragmentation of old-growth Douglas-fir forests (Huff et. al. 1992) and has been classified as a survey and manage species (ROD table C-3) requiring additional protection with the addition of patches of late successional reserves when local populations are found (ROD Standards and Guidelines Section C). This species is a habitat specialist, poor disperser and has a limited geographic range (western Oregon and northwestern California). Maintaining this species in Jackson Creek watershed would best be accomplished by the restoration of large contiguous patches of suitable habitat (see vegetation DFC) or will require maintenance of occupied old-growth patches and linkages to other old- growth patches.

Red tree voles, (RTV) are found exclusively in forests having Douglas fir in the canopy. They are believed to be associated with low elevation forests (<4000). RTV prefer upslope mesic forest (coast range) near ridge tops. It is postulated this is because it may be tied to fog drip for water since this species is highly arboreal limited (Bisswell pers. comm. 1995). Douglas fir needles are the primary food of red tree voles. However, they will also eat needles of grand fir and western hemlock (Huff et. al. 1992). Douglas fir trees are also selected for nesting. Particularly, Douglas fir trees having large branches and deep crowns.

Preliminary review of plantations in Jackson Creek raises issues regarding tree species diversity. Successful reforestation of clearcut and shelterwood stands in Jackson Creek may have depended heavily upon planting of ponderosa pine. Though ponderosa pine is common and an important part of tree species diversity in Jackson Creek, it is generally not found in great abundance in most stands and maintains a dry open microclimate, and a distinct forest floor environment, when found in high abundance. If extensive and well represented (>25%) in plantations, the associated different habitats and site conditions may be detrimental to recovery and maintenance of red tree vole and other moist western Cascades forest species populations.

Stands of high density small diameter Douglas fir had less suitable habitat for this species and is believed to be related to smaller branch diameters which reduce suitability for nesting (Gillesberg and Carey 1991). Gillesberg and Carey found that average diameter of trees with nests versus trees without nests were 39 inches and 171 feet height and 31 inches and 144 feet height respectively. The higher the density of large douglas fir trees the more suitable the habitat for the red tree vole. Huff et. al. (1992) state large trees were nearly four times greater in stands with red-tree voles (15/acre) than without (4/acre) with a mean of 12 large trees per acre.

A habitat suitability index was developed by Huff et. al. (1992) and is recommended for use during project planning to evaluate present condition of stands and silvicultural treatments to develop suitable habitat conditions in the future. These parameters were considered in development of vegetation information for Jackson Creek watershed analysis. However, limitations in plot sampling and lack of stand exam information allows only a coarse identification of suitable stands. Further analysis will need to be done at the stand level. Stand exams incorporating wildlife information needs prior to project planning would allow the wildlife biologist to eliminate the need for surveying unsuitable stands prior to project planning. Information of watershed stand character and classification derived through plot sampling and existing inventory plots can be reviewed in the vegetation section of this document.

GROUP 2: Medium Body size-medium to high mobility species

(Fisher, pine martin, goshawk, pileated wood pecker, northern spotted owl, great grey owl)

Larger home range size, and greater mobility and patch size requirements differentiate this species group from group 1. Though this group of species is less susceptible to patch isolation at the stand level, they are highly susceptible to processes associated with landscape level fragmentation, such as patch size and maintenance of interior habitat conditions. Species identified as having the highest levels of vulnerability in this analysis were fisher, northern spotted owl and great grey owl.

Pine Martin

The pine martin is known to occur in higher elevations of Jackson Creek watershed. Population size and condition is not known. A survey conducted in the winter of 1994-19954 located a few individuals in the Falcon and Squaw Creek watersheds. Numbers of individuals observed are low compared to areas surveyed on the Diamond Lake Ranger District which seems to be this species stronghold, or "key source area", on the Umpqua National Forest. In the pacific northwest losses in range distribution have been major (Ruggerio et. al. 1994). Risks to isolation for this species probably go beyond the Jackson Creek landscape scale. To identify important linkage areas and key source areas, this species should also be considered at the provincial scale.

Martins are reported to prefer pacific silver fir zones and western hemlock zones on the west slope of the Cascades (Ruggerio et. al. 1994). Specifically, Ruggerio et. al. (1994) and Jones and Raphael (1991, unpublished data, cited in Ruggerio et. al.), reported heavy use of areas close to streams for resting and foraging. Processes which affect martins result from habitat fragmentation, such as timber cutting, removal of overhead cover (especially near the ground, such as shade tolerant trees in understory), removal of large diameter coarse woody debris (Ruggerio et. al. 1994). Martins avoid non-forest openings. Other processes affecting martin are human exploitation, for instance, trapping for fur. Historic distribution is unknown for the pine martin in Jackson Creek. However, most of the currently occupied martin habitat in Jackson Creek is in wilderness and LSR. Roads in the LSR have the least density than other parts of the watershed. However, a reduction of roads in the LSR, particularly those in preferred riparian areas would benefit the martin.

Fisher

The fisher is associated with low elevation late successional habitat (large snags and coarse woody debris and high canopy closure) but not necessarily old growth forests (FEMAT 1993) and is a category 2 federal candidate for listing as Threatened or Endangered by the USFWS.

Processes affecting fisher are timber harvest, roads, human disturbance and human exploitation (trapping and ,possibly, predator and porcupine control poisoning) (FEMAT 1993, ODFW 1992). Though trapping and poisoning have often been identified as the main reasons for population declines, studies conducted in areas where trapping hasn't occurred since the 1950's, have shown declines and lack of recovery from extensive logging (Ruggerio et. al. 1994). Fisher appear to be sensitive to forest fragmentation.

Current populations in Oregon are unknown but believed to be small (ODFW 1992). Accounts in the early 1900s suggest the species may have been common (ODFW 1992). ODFW (1992) identifies trapping and strychnine baiting for other species, as the assumed cause of decline in the early 1900s. But it does not explain why the fisher has not recovered. Trapping for fisher was closed in 1939. However, trapping continues for other species and a few fisher may still be trapped incidentally. Few recent observations have been made of this species on the Umpqua National Forest, the most recent having occurred on the Diamond Lake Ranger District (ODFW 1 obs). There are no records of observations of fisher in Jackson Creek, though they probably occurred historically. A survey conducted in the winter of 1994-1995, in cooperation with ODFW, did not result in any fisher observations. However, it is possible that a population exists in the Union Creek area, approximately 4 air miles from Jackson Creek watershed, on the Prospect Ranger District of the Rogue River National Forest. The habitat where they have been found consists of low elevation large tree, multistoried old growth stands and riparian areas.

Ruggerio et. al. (1994) describes a landscape scale home range, requiring extensive contiguous blocks (mean 10,000 acres; range 4800-20000 acres) of late successional habitat below 4000 feet in elevation (though they will use higher elevation habitats in the summer). In geographic areas which tend to accumulate snow, fisher select mature conifer forests, with high canopy cover (70%), since their movements are restricted by deep snow. Since large snags are preferred as natal den sites, their availability may be a limiting factor. If disturbed, females are very likely to move their litters, which could reduce reproductive success. Fishers are highly associated with forested riparian areas, using riparian areas as travel corridors during both summer and winter (FEMAT).

An estimate of historic and current population can be made using vegetation information. At one time, the predominant feature of the Jackson Creek landscape was a large, contiguous patch of late successional forest, approaching 90,000 acres in size, with a few smaller late successional patches dispersed between some early successional patches and meadows (discussed in the habitat section and detailed in the Current and Historic Vegetation section of this report). Even though some parts of the large patch may have been in a "stem exclusion" stage of stand development, the predominant late successional habitat and closed canopy forest provided the character and function of a large late successional patch (Harris 1984). It is this condition which would have been suitable for a population of fisher in the drainage. Given fisher's home range size, approximately 20 fisher could have lived in the Jackson Creek drainage. Given present habitat conditions, it is unlikely that more than 6 individuals could occur. Most of the remaining habitat in the watershed is at higher elevations, which is not as favorable to the fisher. Historically, the best habitat in the watershed for this species was the valley bottom riparian habitats on the mainstem of Jackson and Beaver Creek and the more gentle upslope terrain. These areas are now networked with roads, which are probably formidable barriers to travel and residency by the fisher.

Maintaining or restoring the fisher to the Jackson creek watershed would require a significant change in landscape pattern compared to the present condition. The greatest opportunity to restore habitat suitable for the fisher probably occurs in Beaver Creek drainage and riparian habitats of Jackson Creek mainstem. The extensive area burned in the Beaver Creek arson fire is poised to develop into a fairly large patch of late successional habitat in the next 80 years, most of which is below 4000 feet and reclamation and restoration of riparian habitats would return key habitat components.

Goshawk

There are 5 recorded observations of Goshawks in Jackson Creek but information has not been well documented. Baseline surveys for goshawks have not occurred. One documented goshawk nest in the Hamlin Prairie area displaced a nesting pair of spotted owls. It is expected that this species will be adequately maintained in Jackson Creek watershed within the LSRs.

Pileated woodpecker

Pileated woodpeckers have also been observed in the watershed, but have not been well documented or monitored. It is expected that with riparian reserves, LSRs, wilderness and buffers around special habitat areas, this species will be adequately maintained in Jackson Creek watershed.

Great grey owl

The great grey owl is identified in the ROD as a survey and manage and protection buffer species needing establishment of an LSR if found to reside in an area (ROD Section C). The LSR involves maintenance of adjacent late successional forest around natural meadows to maintain the species nesting habitat. Great grey owls nest in mature/old growth stands in mainly large old snags. They forage in openings where their primary prey, pocket gophers reside. There is one documented location of great grey owl in the Nicholas Ranch area on the north slope of Jackson Creek. Considering 42% of the special non-forest habitats have had harvest of adjacent late successional forest, this species may have limited available nesting habitat next to natural openings. Given the extent of staggered clear cutting, and this species preference for high contrast habitats (old growth and openings) this species may possibly be nesting in other areas in Jackson Creek near complexes of late successional forest and clear cut stands. Surveys for this species prior to design of projects will be necessary.

Northern spotted owl

The northern spotted owl (NSO) is the most studied species in the watershed. The first record of a spotted owl observation within Jackson creek watershed was documented in 1972. The first nest was identified in 1978. With timber sale inventory beginning in 1989, and the subsequent level of increased survey intensity, most activity centers have been identified between 1989 and the present.

There are 34 spotted owl activity centers in Jackson Creek watershed (27 pairs and 7 resident singles). Of those 34 activity centers, 16 occur on Matrix lands; another 16 occur in the LSR, and the remaining 2 centers are in the Rogue-Umpqua Divide Wilderness. Of the 27 activity centers which have pair status, 14 have been documented as reproductive.

Depending on the definition of "take", there are either five or seven sites which are below the threshold for take. Under previous direction, there were three criteria used to evaluate take, based on acres of habitat within the home range radius of a pair or resident single. Under new guidance, there is only one criterion. A core area for each activity center in the matrix has been designated.

Nesting, Roosting and Foraging Habitat(NRF):

Of the 102,332 total acres in the Jackson Creek watershed, 39,460 acres are in NRF, with 12,691 acres in matrix, and 4594 acres in riparian reserves. 50% of the LSR is in suitable NRF condition (15,342 / 31,135 acres), and 6833 acres of NRF occur in the Rogue-Umpqua Divide Wilderness. There are 3000 acres of non-capable habitat in the LSR:

Present Condition NSO Dispersal Habitat:

There are no significant natural barriers to dispersal at the Jackson creek landscape scale. However, the wilderness, which has large areas of marginally suitable habitats and unsuitable habitat, leaves a narrow corridor from Jackson Creek north to Castle Rock Creek. At a basin and province scale, this large LSR (LSR #0222), which partially falls within Jackson Creek, is the largest, or one of the largest, in the network of late successional reserves. LSR #0222 extends north into the Willamette National Forest and west into the Eugene and Roseburg BLM Districts and South into the Rogue River National Forest. It is estimated that 49% of the watershed area is in 11/40 condition. This represents the lower ranges of the area in an 11/40 condition. Because extensive areas in Jackson Creek watershed have had partial cut harvest treatments, and these stands were not considered in the 49% estimate, a substantial amount of field verification of these partial cut stands is needed to further refine those estimates. When these field verifications are completed, it is possible that up to 61% of the watershed is currently in 11/40 condition. It is apparent that riparian reserves and cores , which only account for 16-20% of the area in the watershed, would not adequately support dispersal:

One issue with regard to recovery of dispersal and NRF habitat is the species composition of some regeneration units. Regeneration units may have unnaturally high amounts of ponderosa pine, which is poor habitat for the northern spotted owl and its prey. This may involve up to 10,400 acres of regeneration units or considerably less.

The northern spotted owl, (NSO) is a federally listed threatened species. A set of questions and answers for analysis and future USFWS consultation derived from 1994-1996 watershed analysis guidelines (REO June 1994) are included in Appendix BB (Wildlife).

Additional Wildlife Issues

The following are significant wildlife issues in which analysis is presently incomplete:

Maintenance of Neotropical Migratory Bird Habitat and Populations

Data collection complete. Analysis incomplete.

Game Species Habitat Condition and Vulnerability to Disturbance

Data collection 80% complete. Analysis incomplete.

Maintenance of Nesting and Foraging Habitat for Primary and Secondary Snag Dependent Species

Data collection complete. Analysis complete. Discussion in report incomplete. Note: an evaluation of vegetation plot data generated a Desired Future Condition and Recommendations (see appropriate chapters for DFC and Recommendations).

Viability of Threatened Endangered and Sensitive Species

Data Collection incomplete. Analysis incomplete.

Wildlife Habitat

The health[1] and status of species populations are linked to existing and historic habitat conditions. Habitat analysis is used to estimate species occurrence, distribution, and abundance and to describe the ability of the watershed to provide habitat requirements. when Using habitat to project species occurrence, distribution and abundance carries many risks Very little is known about some species relationships to habitat requirements, for instance, the red-tree vole. Habitat analysis , without baseline inventories, may provide an inaccurate picture of species health and status, since other factors may be influencing occupancy and population dynamics. Some of the inherent risks include:

- Habitat patches may or may not be occupied
- Populations may or may not be stable and interconnected
- Vegetation information is coarse and does not necessarily give an accurate description of specific stand condition

The following Wildlife Habitat section continues to address the issues summarized in the introduction to the Wildlife Population section.

Maintenance of Late Successional Species Populations/Communities

Late successional,(LS) vegetation information for Jackson Creek watershed and wildlife habitat modeling (Mellon 1994) were used to analyze habitat conditions for species groups 1 and 2, which are described in detail in the Wildlife Populations section (pages XX- XX) under the above stated issue.

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1 Health is defined in USDA (1994) Reinvention of the Forest Service: The Changes Begin, as: "vigorous self re-newal", "resiliency and diversity of composition, structure, and function".

Group 1: (Small Mammals and Amphibians)

Results of suitable habitat modeling for this species group are summarized in Table 39, below:

Historic Habitat	Existing Habitat
Suitable Acres: 72,788	Suitable Acres: 32,265
Percent of total acres: 71%	Percent of total Acres: 31%
Percent change: 56%	
LS Riparian: 74%	LS Riparian: 43%
#LS Patches: Very few, Large patches One very large patch of 95,000 acres	#LS Patches: Many, small patches

Table 39. Small body-low mobility species habitat condition in Jackson Creek

Fragmentation is very high, with few interior forest acres remaining. Interior forest patches are isolated. Patch Connectivity (evaluated subjectively) is poor for the east/west section of Mainstem Jackson Creek, and in WAAs A,W,C, Q,R,S,T,U,V,E. It is also poor between WAAs M&N/B&C. moderate in WAAs D,H,I,J,K. Patch Connectivity can be characterized as good only in WAA's F,G,X.{Figure 16}.

More detailed landscape pattern information is summarized in the Historic Vegetation section of this chapter.

Group 1 species have largely unknown life histories. Many may have clumpy distributions (red tree vole, northwestern salamander) and one patch of apparently suitable habitat may not be occupied while another may be a key source area **(Marcot et. al.)**. Loss of occupied patches increases species isolation by increasing the distance between interbreeding sub-populations and reducing the ability of an area to rejuvenate when conditions become favorable. Loss of apparently unoccupied patches becomes an issue when patch connectivity is poor or limited as these areas provide suitable conditions for dispersal between occupied patches.

Species in this group are affected by local climatic conditions which, in southwest Oregon, probably increase affects of microclimate change in relation to patch size (higher temperatures, dryer climate) (Gilbert and Allwine 1991). For these reasons a minimum suitable patch size, of 100 acres was used for modeling habitat suitability. Though species may be found in smaller patches, the habitat condition and population size is assumed to be less favorable as a source area.

Historically, the composition of LS habitat in Jackson Creek included an extensive patch, which was approximately 95,000 acres in size, and several smaller LS patches ranging between 100 and 300 acres in size. Since the entire watrershed is 102,332 acres, the landscape was dominated by this contiguous block of LS forest. Mid-Successional closed forest stands are included with the LS as addressed here. Harris (1984) describes such a condition in unmanaged stands as functioning as one large LS patch due to low edge contrast and high occurrence of old growth structure throughout. This is supported in many of the unmanaged forest studies in recent years in the Pacific Northwest (Ruggerio et. al. 1991).

To evaluate current patch isolation/connectivity for species which are poor dispersers, adjacent suitable patches or linkage corridors (of adequate width to maintain suitable microclimate conditions), were assumed to be necessary to provide population connectivity. Map (Figure 16) displays the location and connectivity of suitable patches. Figure 16 also shows those portions of riparian reserves as described in the ROD which are too narrow to meet suitable patch size (for some species) but presently have LS habitat (shaded black) and may for some species, provide connectivity.

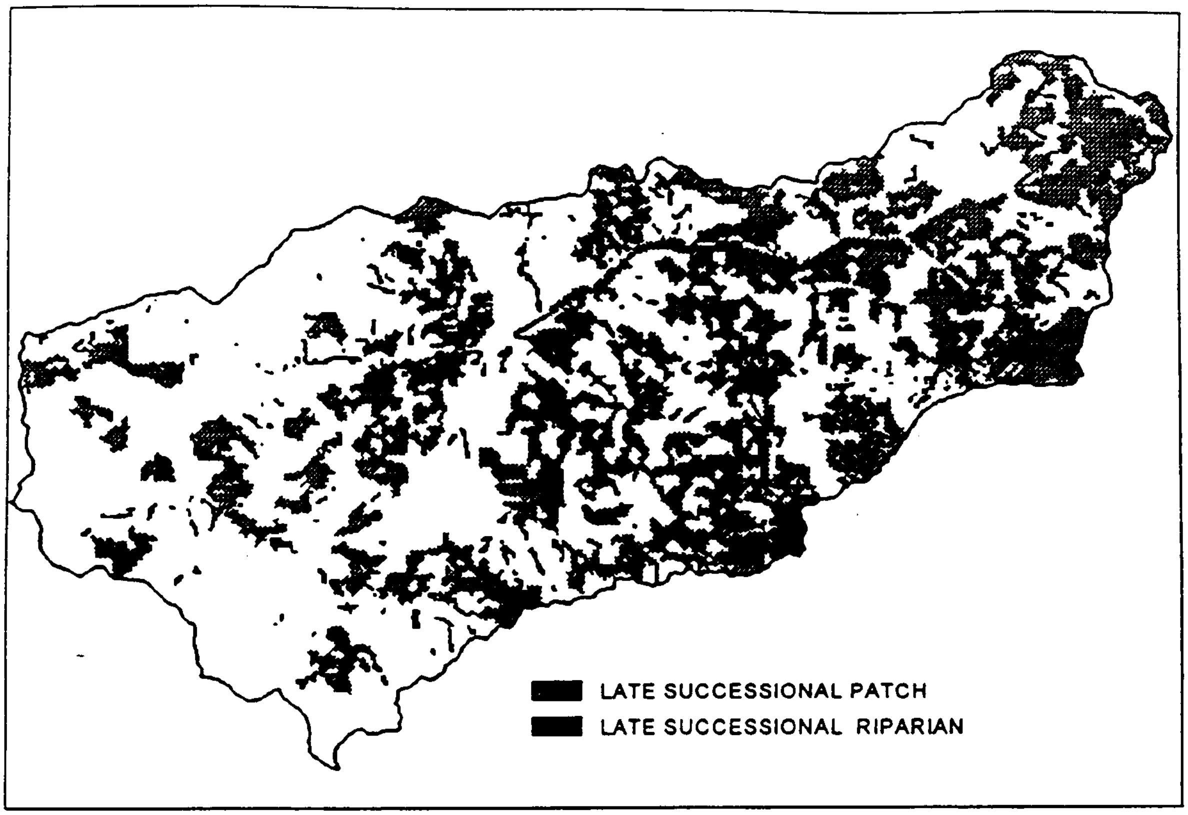


Figure 16. Group 1 Species (Small Mammals and Amphibians) Current Condition of Patch and Riparian Connectivity (See Figure 19 for Historic Condition).

As referred to in the Wildlife Population section of this report, plantations having unnaturally high densities of ponderosa pine create unfavorable habitat conditions for those species which evolved with the natural species composition historically occurring in these patches and . . therefore these areas may retard recovery of species populations. As much as **10,400 or 50% of the regeneration** acres of plantations may have such a condition and needs further investigation. See Figure 17 for map of plantations needing further assessment. Any stands outside the natural range of species composition are a high priority for species diversity restoration to allow wildlife population recovery.

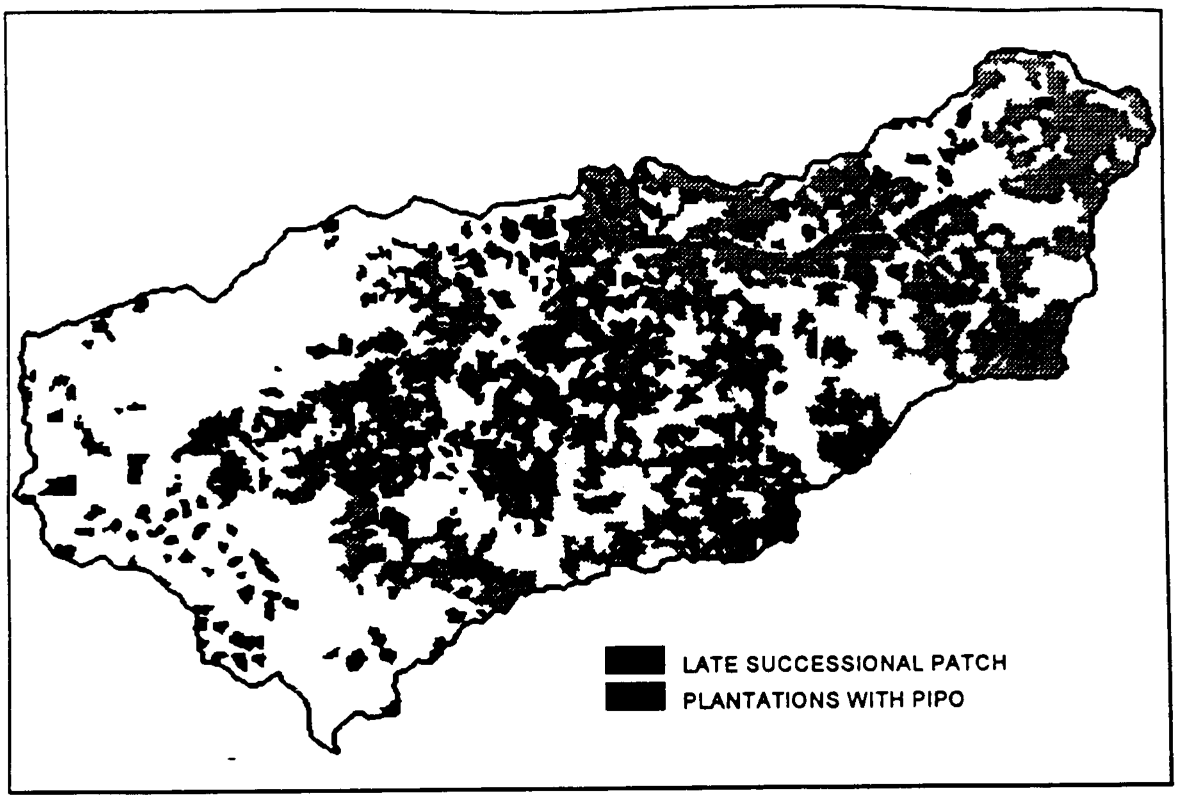


Figure 17. Map Plantations with PIPO in Relation to Group 1 Species Late Successional Patches

Occurrence/Distribution/Abundance

Abundance and condition of group 1 LS patch habitat gives an estimate of species occurrence and distribution. Amphibian sampling results and previous studies in the area (Gilbert and Allwine 1991) suggest group 1 species are generally restricted to LS patches and may be rare in other successional or managed stands in Jackson Creek. Species abundance is only a subjective estimate without population information, but it is probably reduced significantly, compared to historic conditions, and may be absent in some suitable patches.

Connectivity: (Figure 16)

The current condition of the landscape may have isolation processes occurring in WAAS C, W, and A on the north side of Jackson Creek, and WAAS O, P,Q, R, S, T, U, and V on the south side of Jackson Creek. At a larger scale there is a wide band or gap which appears to separate the upper half of Jackson Creek patches from the lower half running from north to south through WAAS C, N, and M. There is also a highly disconnected east/west or upper/lower mainstem corridor condition especially in the lower half and the north side of Jackson Creek.

Riparian Reserves are highly fragmented with 43% in a LS condition. Most contiguous LS riparian habitats are in the LSR (Figure 18). Roads in riparian corridors or high densities of roads in upslope habitats affect connectivity and effective patch size by reducing interior habitat, increasing edge and associated microclimate effects and discouraging travel between patches. There are 572 miles of streams in riparian reserves, and 110 miles of roads in riparian reserves in Jackson Creek. Further, road densities equaling or exceeding 4 miles per square mile likely significantly reduce upslope patch integrity and connectivity.

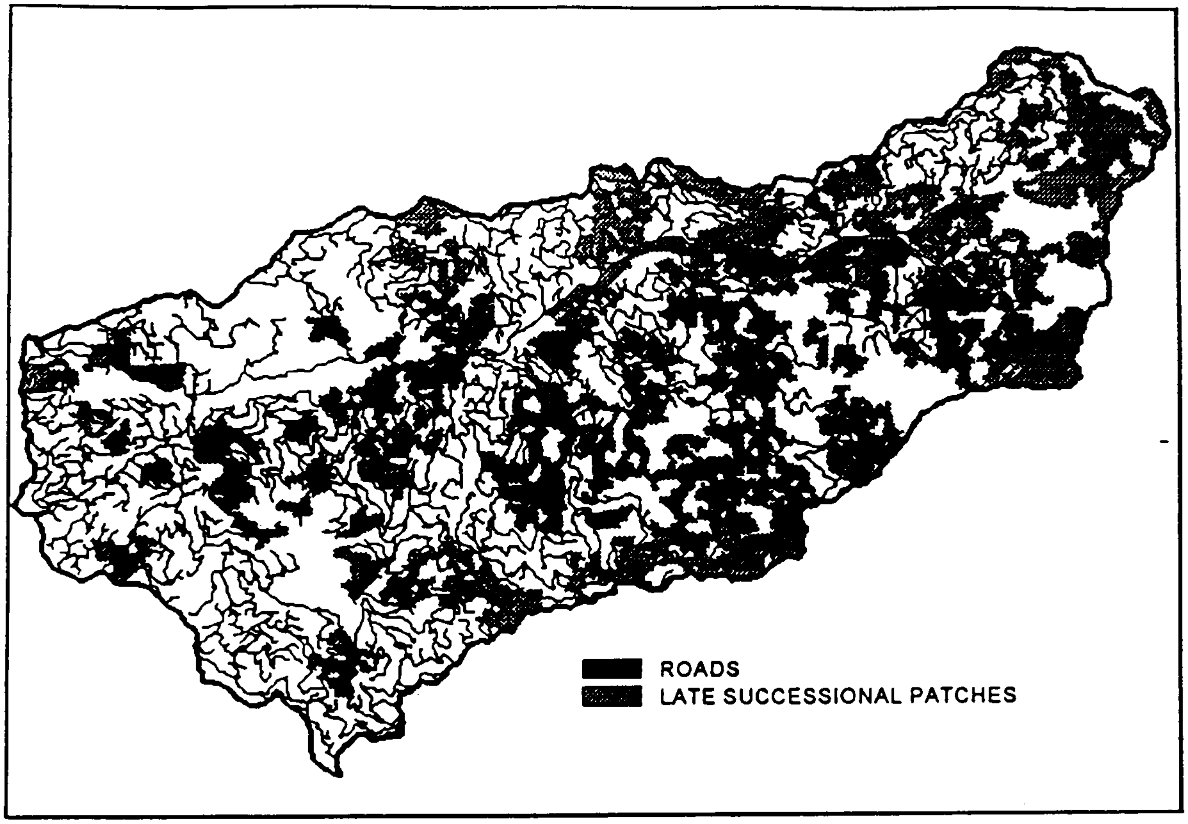


Figure 18. Group 1 Species Late Successional Patches and Relationship of Roads to Connectivity and Future Patch Size.

Modeling patch configuration and size delineated by roads at a density of 4 miles per square mile creates 160 acre patches 1320 feet wide generating edge into most of the patch (assumes most roads run parallel to each other at this density). Where density reaches 6 miles per square mile patch size can be reduced to <50-80 acres generating small patches and extensive edge effects

Head of Beaver Creek and Fawn Creek	T31S R1E Sections 7 8 9 16 17 18 19 20 30
Three Cabin/Devils Knob	T31S R1W Sections 11 14 15 23
Between Whiskey CR. and Black Canyon	T30S R1E Sections 15 16 20 21 Crooked Cr/Jackson Cr./Luck Cr
T30S R1E Sections 2 11 14	
Upper Jackson Creek	T29S R2E Sections 23 24 25 30
Coffin Butte/Jackson Creek	T30S R1W Sections 23 25 26 35 & 36
Winters Cr./Burnt Creek	T30S R1W Sections 31 5 3
Pickett Butte/Pickett Prairie	T30S R1W Sections 19 28 29

Table 40. Some areas with densities >/= 4 miles per square mile in Jackson Creek are:

GROUP 2: Medium Body size-medium to high mobility species

(Fisher, pine martin, goshawk, pileated wood pecker, northern spotted owl, great grey owl)

Since these species have large home range size and are able to utilize a number of patches within their home range, they are affected by fragmentation and loss of interior late successional habitat on the landscape and province scale rather than a patch or stand level.

Results of suitable habitat modeling for this species group ar summarized in Table 41, below:

Patch Connectivity (evaluated subjectively) is poor for the east/west section of Mainstem Jackson Creek, and in WAAs A,W,C, Q,R,S,T,U,V,E. It is also poor between WAAs M&N/B&C. moderate in WAAs D,H,I,J,K. Patch Connectivity can be characterized as good only in WAA's F,G,X.{See Map Figure HAB1}.

Historic Habitat	Existing Habitat
Suitable Acres: 72,788	Suitable Acres: 29,336
Percent of total acres: 71%	Percent of total Acres: 29%
Percent change: 60%	
LS Riparian: 74%	LS Riparian: 43%
#LS Patches: Very few, Large patches One very large patch of 95,000 acres	#LS Patches: Many, small patches

Table 41. Medium body size-medium to high mobility species

Fragmentation is very high, with few interior forest acres remaining. Interior forest patches are isolated. (Figure 10). * More detailed landscape pattern information is summarized in the Historic Vegetation section of this chapter.

Landscape patterns

Landscape patterns have changed significantly in Jackson Creek watershed and have probably reduced the occurrence, distribution and abundance of group 2 species (Figure 19). Patch size has changed from generally one large contiguous LS patch to 178 small patches averaging 221 acres in size and a loss of 43,452 LS acres from a 102,332 acre watershed. A detailed spatial analysis was completed for 4 strata of ecosystems in the watrershed, with the following results:

> The North Side of Jackson Creek Ecosystem Stratum has 33% of its landscape in LS condition and is highly fragmented. The LS component in this eecosssytem has changed from a "matrix" condition to a remnant "patch" condition.
>
> The Beaver Creek Ecosystem Stratum has 22% of its landscape in LS condition and the LS has changed from a "matrix" condition to a remnant "patch" condition. This was not all due to the Beaver Creek arson burn in the 1920s. Analysis aerial photosgraphy from the 1940's -1990's indicates that most of the remaining patches of old growth and remnant large trees and snags after the burn were harvested in the 1960-1980s. Snags were also felled in areas not harvested as a fire hazard reduction measure.
>
> The Late Successional Reserve Ecosystem Stratum has the highest LS condition with 51% in LS vegetation. A higher number of northern spotted owl activity centers are located in this area. WAA E however, (which is partially in the LSR and therefore included in this stratum) is mostly in early and mid-successional condition with a high road density.
>
> The Whisky, Soup, and Coffee Creeks Ecosystem Stratum has 31% of its landscape in LS condition and most of that is in WAAs N&O. WAA V has few remaining LS patches.

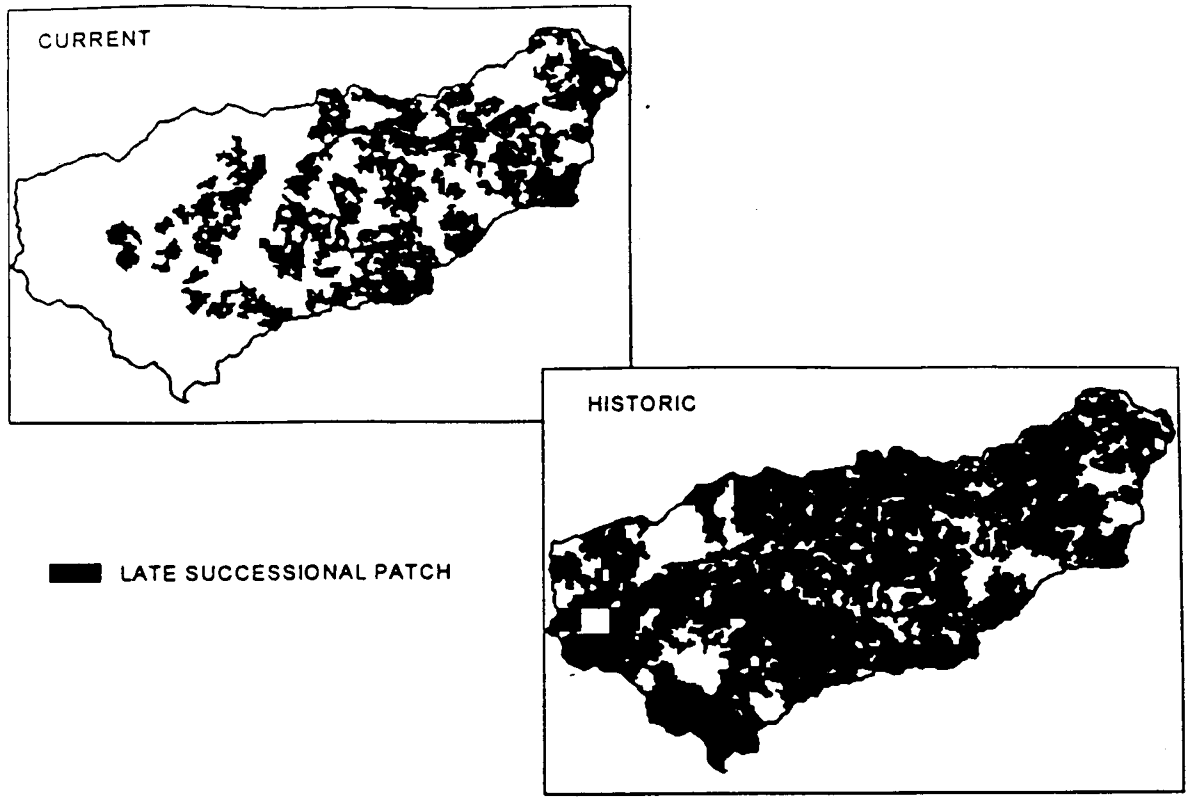


Figure 19. Current and Historic Suitable Patch Habitat for Group 2 Species (Fisher, Northern Spotted owl, Goshawk etc.)

Occurrence/Distribution/Abundance

Habitat for the fisher is extremely limited given the present condition of the riparian corridors, road densities, level of fragmentation and few remaining LS patches at lower elevations. The LSR portion of Jackson Creek is the least fragmented and contains the greater amounts of LS habitat but it is still likely too small. The pine martin, pileated woodpecker, goshawk and northern spotted owl reside in the drainage but probably at low numbers compared to historic levels. Status of the great grey owl is unknown.

Human disturbance processes such as noise generating activities and human interaction affect this species group in addition to vegetation and other natural processes. The fisher is probably the most sensitive to human disturbance the pileated wood pecker, the least (and watch out for the goshawk as you may be more affected than them!).

Landscape Connectivity

Connectivity to the south is established with the LSR which traverses the Rogue-Umpqua Divide over into a fairly large relatively unharvested, unroaded area in the Bitter Lick Creek Drainage. The Bitter lick drainage is known to have a relatively high popualtion density of northern spotted owls. Though the LSR extends north, connectivity is narrow and reduced by extensive harvesting in the Buckeye Creek and main South Umpqua Drainages. The Rogue-Umpqua Divide wilderness area provides the narrow connection much of which is high elevation. The weakest connectivity condition appears to be low elevation late seral habitats.

Discussion in the above section for group 1 species regarding plantations with ponderosa pine, riparian reserve condition, and road densities in riparian and upslope habitats also apply to the fisher, the northern spotted owl, and pileated woodpecker.

Hydrology

A pilot making the twenty mile flight up Jackson Creek in 1939 wouldn't have seen much of Jackson Creek (water, rocks, or gravel bars), just a canopy of big trees blending in with the hillslopes above it. Today, the creek is wider, lots of the big trees are gone, and a road crowds the creek and marks its path. When a pavement roller tumbled into Jackson Creek in 1986, the pilot flying fire observation overhead could see the water surface well enough to report the progress of an oil sheen downstream.

Jackson Creek became wider for many reasons. Before 1946, landslides from burned areas on the Rogue Umpqua Divide flowed down Jackson and Falcon Creeks, opening the canopy in Jackson Creek from its headwaters downstream. Although rivers can narrow again and close their canopy, Jackson Creek has remained wide. The John Rondeau Bridge, over South Umpqua River near the confluence of Jackson Creek, was built in 1948 and by 1954 road construction had continued about 14 miles up Jackson Creek. Right of way logging took trees out of the creek and off its banks in many places. The floodplain deposits on the north side of the creek were the easiest places to locate the road. The road fill raised the floodplain up out of annual floods, and clearing the creek of natural deadfall trees kept the water in its channel. A narrower, swifter stream carved a wider active channel with less cover overhead. The results of this widened channel were warmer water temperatures, fewer side channels and simplification of the floodplain habitat for fish, amphibians and other widlife.

Like many Cascade mountain streams, Jackson Creek flows in winter floods and summer trickles that you can step across. There are at least 570 miles of stream in the Jackson Creek watershed, including 330 miles that only run in winter.

The water temperature reached 79 degrees Fahrenheit near the mouth in July 1994 and most of the twenty miles of mainstem from the mouth to the confluence with Falcon Creek was warmer than 70 degrees. The most striking temperature change occurs 11 miles upstream, where Squaw Creek enters the mainstem with water that's 10 degrees cooler, and a volume that accounts for nearly half Jackson's flow . Like Bend Creek and Castle Rock Fork elsewhere on the Umpqua National Forest, the waters from Squaw Creek cools holes in the main creek where spring chinook adults hold in summer.

Even big streams like Beaver Creek drop to less than 1 cubic feet per second in late summer. At such low flows, any water use, even fire tankers or domestic use, can dry up important aquatic habitat or suck fish and amphibians into the pumps directly. Roads and timber harvest may increase flood peaks by as much as 50%. Jackson Creek has 560 miles of timber harvest roads, as many miles of road as there are streams in the watershed.

Many of the landslides in Jackson Creek weren't caused by man's activity, but those that were scoured more streams with debris flows. Two-thirds of the roads have been built in Jackson Creek since the 1964 flood, and many culverts will plug in the next flood that size. About 40% of the basin has been logged, but cutting was heavier on the less stable earthflow lands north of Jackson Creek and west of Beaver Creek.

A summer water quality survey in 1994 found pH values of 9 in Jackson Creek, which was among the highest readings of those taken in the North and South Umpqua and Little River. This high pH may signal stressful aquatic habitat conditions which didn't exist before channels were widened, and the trees which shaded them were cut.

It will be a long time before water temperature and higher flood peaks are reduced, since big conifers take a long time to grow, and the Jackson and Falcon Creek Roads will be hard to change. Even big floods will only wash away parts of them where rip-rap fails to protect the fills. The next big flood will cause landslides and debris flows in streams from naturally unstable hillsides, and where roads cross streams or unstable sites.

Hundreds of miles of road have been built in the watershed and much less old growth forest exists than before logging began. We can remove portions of streamside roads, and unstable road crossings and road ditches that cause the most damage, and some possible causes of pH and related algae in streams can be avoided.

Floods

Floods in Jackson Creek and the South Umpqua River are smaller than those in Steamboat Creek to the north and West Fork Cow Creek in the coast range, partly because rainfall is less. The U.S. Geological Survey equations for floods in western Oregon (USGS, 1979) give good estimates for flood peaks on ungaged streams with drainage areas greater than about a square mile in Jackson Creek. The appendix Streamflow shows measured 2-year floods of 5740 cubic feet per second (cfs) and the USGS equation predicts 6680 cfs, or 44 cfs per square mile in the 152 square mile watershed above the gage.

A stream gage on Jackson Creek recorded flows from 1955 to 1986, and records on other Umpqua rivers go back much farther. Floods in 1861 and 1890 affected rivers throughout the basin, although gages on the South Umpqua near Roseburg and the Umpqua near Elkton indicate that these did not match the record flood of 1964. Jackson Creek had "10-year floods" or greater again in 1950, 1955, 1956 and the record 100-year flood of 21,100 cubic feet per second on December 22, 1964. Other floods in 1910, 1916, 1938, 1942 and 1945 might have caused landslides and damage to streams and roads in Jackson Creek. See Appendix I for these data and streamflow statistics.

A 25-year flood on January 15, 1974 damaged Jackson Creek Road at mile post 5 above Beaver Creek. Emergency road repairs were made on almost 4,000 feet of road within the annual bankfull channel of the stream. Beaver Creek and other streams on the south side of Jackson basin may have had even more intense flooding in 1974, and in 1981, since these were much larger floods on Elk and Cow Creeks to the south.

Recently, a 10-year flood occurred in December 1983 on Jackson Creek, and high water on January 9, 1995 reached about 8,000 cubic feet per second (just under a 5-year peak).

Annual, bankfull floods shape streams by building bars,and eroding and widening where the stream is constricted. Jackson Creek, like many streams, got wider when it was cleared of wood and the road pushed it against the opposite bank. It's not as clear whether the annual floods have increased, or if all stormflows are higher and put greater water velocity through the simpler stream channel we have today. Jones and Grant (1994 b) found peak flows at least 40% higher in western Oregon Cascade watersheds the size of Jackson Creek, in all seasons, as up to 25% of their area was cumulatively harvested with roads. Christner (1981) found that a plot of the cumulative annual peak flows for some of these basins got steeper (higher peak flows) during the years when timber harvest increased. A similar plot of Jackson Creek does not show similar increased flows at the mouth, but leaves unanswered whether statistically significant increases occur when all flows are examined (Jones and Grant, 1994 b),or whether tributary flows have changed.

Channel Extension

Wemple (1994) showed that road ditches leading to streams and gullies added to the stream length in watersheds where peaks increased, providing one way that roads could account for higher flow. She found approximately a 60% increase over the winter baseflow stream length (channel extension), from road ditches leading to surface flowpaths of Blue River and Lookout Creek in the western Cascades. This is like having 60% more streams than before roads were built and more efficient pathways to get flood peaks downstream faster. In fact, Jones and Grant (1994 a) found flood peaks arrived sooner in small watersheds with roads.

In Jackson Creek, we estimated channel extension from roads ranged from 2% to maximums of 40 percent in Deep Cut, Ralph and Tallow Creeks and 48% in Whisky and Soup Creeks (Appendix J). Most of Beaver Creek showed 27-35% channel extension. The highest percentage of channel extension from roads occurred on earthflow watersheds that had fewer streams, more roads, and more signs of bank and channel bed erosion (Appendix V).

Snow Accumulation and Melt

Some research shows that snow accumulation and melt is greater in forest openings, including clearcuts and plantations less than 40 years old (Harr, 1981). It is difficult to predict how the higher melt rates measured in open stands might result in higher streamflow, but basins with less forest canopy are more likely to experience higher flows during warm storms. The small Watershed Analysis Areas (WAA's) north of Jackson Creek (WAA's A, B and C) feed Chapman Creek, Deep Cut, Ralph, Tallow and Two Mile Creeks, and have less than 35% of their area in closed (> 70%) canopy. Deep Cut Creek, and the Fawn/Maverick tributaries of Beaver Creek, have closed canopies over only 18 and 14% of their watersheds). These are the streams where the cumulative effects of canopy removal and added road ditches are most likely to affect flood peaks and aquatic habitat (Table 42).

Jones and Grant (1994 b) found no "threshold" of harvest level below which no peak flow increases occur, just larger increases with more cumlative area harvested.

Closed Canopy (>70%) in Watersheds of Jackson Creek				
Stream Name	WAA	Total Acres	Ac Closed Canopy	% Closed Canopy
Lower Jackson	A	4444	1549	35%
Deep Cut	B	3928	705	18%
Ralph to Two Mile	C	6134	1510	25%
Middle Jackson	D	4100	2512	61%
Upper Jackson	E	3725	1880	50%
Lonewoman	F	5076	4142	82%
Falcon	G	5153	2754	53%
Abbott	H	3048	2110	69%
Cougar	I	4907	4605	94%
Crooked	J	5042	3335	66%
Upper Squaw	K	6810	5582	82%
Lower Squaw	L	3275	2333	71%
Black Canyon	M	6082	3416	56%
Whiskey Soup	N	2945	1580	54%
Coffin	O	5143	2623	51%
Switchback	P	3478	2062	59%
Fawn Maverick	Q	4811	663	14%
Pipestone	R	3226	1722	53%
Three Cabin	S	3887	2463	63%
Stampede Burnt	T	4021	2054	51%
Winters	U	2915	1118	38%
Pickett	V	2438	1247	51%
Surveyor Freezeout	W	3126	1518	49%
Donegan	X	4345	3399	78%
Total		102059	56880	56%

Table 42. Percent of Watersheds with Closed Canopy.

Only Lonewoman, Cougar, Upper Squaw, and Donegan Creeks have closed canopy across 80-90 percent of their watersheds, and these are in the late successional reserve. Less than 60 percent of Beaver Creek tributaries are closed canopy. Of them, Fawn/Maverick and Winters Creeks have the least. Other Jackson tributaries range from 50-70% closed canopy stands.

Cumulative effects evaluations will have to be made for individual activities in Jackson Creek (Umpqua National Forest Land and Resource Management Plan, 1990). Where watersheds of streams have the least closed canopy and stream channels are wide or eroding, cutting more overstory canopy or building more road will be more likely to increase flood peaks and harm aquatic life (Jones and Grant 1994 b). Appendix K gives estimates of canopy and harvest history on high risk land throughout Jackson Creek.

Low Summer Flows

Jackson Creek and its tributaries can flow so low in late summer and fall, that a few hundred gallons drafted out of the creek could be a substantial portion of its flow. In August 1994, a tanker drawing 225 gallons a minute would have used 1/2 the flow in Beaver Creek's 1 cfs. Lots of streams with fish have lower flows than Beaver Creek, and local effects of water use can be devastating on all forms of aquatic life. Also, some studies suggest that 20-year-old plantations and riparian hardwoods can use more water than mature forests (Hicks, et al 1991), and even slight reductions in streamflow throughout a basin can substantially reduce volume of water for fish.

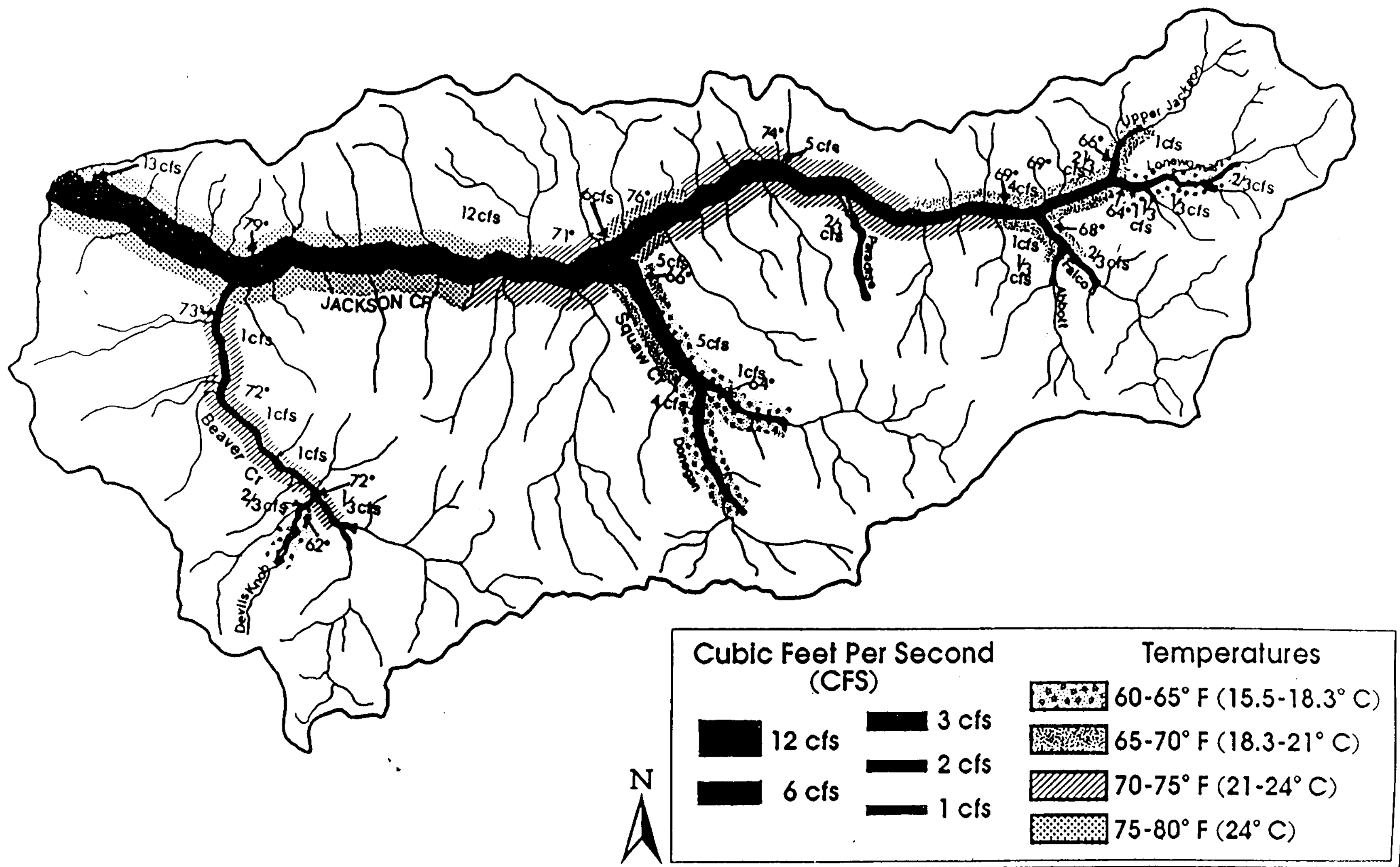
Summer streamflow is a big factor affecting fish in Jackson Creek. Most of the water is present in Jackson Creek and Beaver, Squaw, Falcon and Lonewoman tributaries (Figure 20). Other tributaries are so small that they over-summer fish for often less than a mile of length, and sometimes in pools separated by dry streambeds. Almost 50% of Jackson's summer low flow comes from Squaw Creek and springs below Donegan Prairie. Beaver Creek watershed (one fourth of Jackson basin) contributes less than 1/10 of Jackson's flow. In August 22-29, 1994, Jackson Creek flow was about 12 cfs up to Squaw Creek, where 5 cfs entered the main stream. Below Squaw, which can be 10 degrees (F) cooler than Jackson, the addition of cool water and more flow offers a mile or so of better summer water conditions for aquatic life. Above Squaw Creek, Jackson flowed 5 cfs through the flats between Ralph and Two Mile Creeks. Falcon, Lonewoman and Upper Jackson each added about 1 cfs (Appendix I). Of these, Lonewoman had the most flow for its watershed area (Figure 20).

Notable low flows in the Umpqua basin occurred in 1911, 1926 (the record at Elkton since 1905), 1973, 1977, 1992 and 1994. Jackson Creek's record low of 11 cfs was probably a result of freeze-up the winters of 1976-77 and 1978-79 (flows only measured once). August 1994 flow was 13 cfs, among the lowest on record, and it continued to drop in September. The record September 1911 low flow on the South Umpqua was 20 cfs (about 3 times Jackson's flow).

Figure 20

Jackson Creek Watershed

July 21, 1994, Maximum Water Temperature
August and September 1994, Low Flows Cubic Feet Per Second (CFS)



Channel Extent and Shape

Jackson Creek has approximately 570 miles of stream, estimated from field surveys of 54 miles of stream in six small watersheds (Table 43). We found from 3 to 5 miles of stream per square mile of watershed, and used the earthflow and steeper landforms to estimate stream length and location in the rest of Jackson Creek. Sixty percent of streams, or 330 miles, are intermittent streams that do not flow all year. This is the "winter baseflow" network of streams showing signs of deposition or scour, that are likely to flow whenever streams rise in response to storms. We did not find the number of streams (5.6 mi/mi2 or 906 stream miles),that were estimated from topographic maps for Jackson Creek in the ROD (USDA and USDI, 1994). See Appendix L for stream class and miles in each watershed analysis area (WAA).

After comparing our estimated streams to those mapped in the field, we think project-level mapping of intermittent streams will identify 16% more stream length, for a total of 660 miles of stream or 4.1 mi/mi2 (Appendix L). Streams we did not locate in the field should be corrected on the GIS layer, when riparian reserves (USDA and USDI, 1994) are located during project design. Additional riparian reserves will be located around unstable areas and wetlands. Jackson Creek is approximately a 6th order stream.

Jackson Creek Estimated Winter Baseflow Stream Network		
Stream Class		Miles
CLASS I	Anadromous Fish	46.6
CLASS II	Resident Fish	25.4
CLASS III	Other Perennial	166.8
CLASS IV	Intermittent	331.2
Total Stream Length		570
Basin Area (Sq Miles)		159.9
Average Stream Density		3.6

Table 43. Jackson Creek Stream Class and Miles on GIS Stream Layer.

After landslides and debris flows above Lonewoman Creek, and down Falcon Creek (probably during floods in 1942 or 1945), Jackson Creek looked noticeably wider. The Jackson Creek road reached Two Mile Creek by about 1953 and reached Lonewoman

Creek by the early 1960's. Disruption of the channel and bigger floods from 1950 to 1974 kept the stream from building a flood plain in widened reaches. With no sites for trees to start to grow, the active channel and overhead canopy stayed wide. Road construction in the floodplain (about 5 of the 21 miles of road are built in the bankfull channel) constrained the annual floods and washed away bars where trees could grow and stabilize the banks. Logs were salvaged from the creek, and they were no longer available to build bars.

Streams get wider as the watershed area gets larger downstream and bankfull flow increases, especially in unconstrained reaches where bedload deposits and forms bars. Bedload size (gravel, cobble) changes, too, on the bars where deposits are building. Six bankfull crossections on Jackson, Lonewoman and Beaver Creeks showed channel width increased from 35 feet on Jackson above Lonewoman, to 45 feet at Two Mile Creek, and 85 feet both above and below Beaver Creek (Appendix M). Lonewoman Creek, without a streamside road, showed apparently higher flow and narrower width than Jackson Creek where they join. Lonewoman is much deeper for its narrower width, and looks like it on aerial photos. These widths are similar or less than widths on streams with the same bankfull flow in Northern California and Idaho (Leopold, 1994), but apparently wider today than visible on 1939 aerial photographs.

Some studies have found channel bed material smaller as you go downstream (Leopold and others, 1964). On Jackson Creek, mean particle diameter (d_{50}) was 64 mm (coarse gravel) at Lonewoman Creek, and larger (96 mm cobble) on Jackson at Two Mile and near the mouth.

There were fewer fine particles less than 6 mm on the downstream Jackson Creek cross-sections. The larger particle size downstream suggests higher stream power as a result of a more efficient channel. This may be because the channel was straightened when the road was built, wood was removed, and the stream scoured to bedrock in the 1964 and 1974 floods. Since we don't know what channel and bedload measurements were historically, bedload size may not have gotten smaller downstream. However, Dose and Roper (1994) estimated that Jackson Creek may have doubled in width since 1937, and stream surveys found large cobble today where gravel was present then.

Where bankfull flows are similar, Beaver Creek had almost twice as many fines as Jackson Creek. Flows in lower Beaver Creek are not constrained and the banks of earthflow tributaries have eroded to fill spaces between gravel and cobble with fine sediment.

Stream Temperature

We know that Jackson Creek is almost as warm as the South Umpqua near its mouth. Since 1978, the maximum summer water temperature, averaged over 14 days, has ranged from 68 to 75 degrees. Minimum temperatures are 5-8 degrees cooler, and can be over 70 degrees. Summer 1994 was one of the lowest flow, warmest water temperature years on record. We found Jackson Creek has a few large flow tributaries that affect its temperature (Upper Jackson, Lonewoman, Falcon, Squaw and Beaver Creeks). On July 21, Jackson and Lonewoman quickly warmed from a maximum temperature of about 65 degrees to almost 70 below Falcon Creek, where both streams show a wide channel with little shade. The stream was 76 degrees above Squaw, where lots of 66 degree water flows in and creates a cooler 70 degree reach downstream. Water temperature above and below Beaver Creek was 79 degrees around 3 pm, and only got down to 71 degrees the next morning (See Figure 20 and 21. Appendix N).

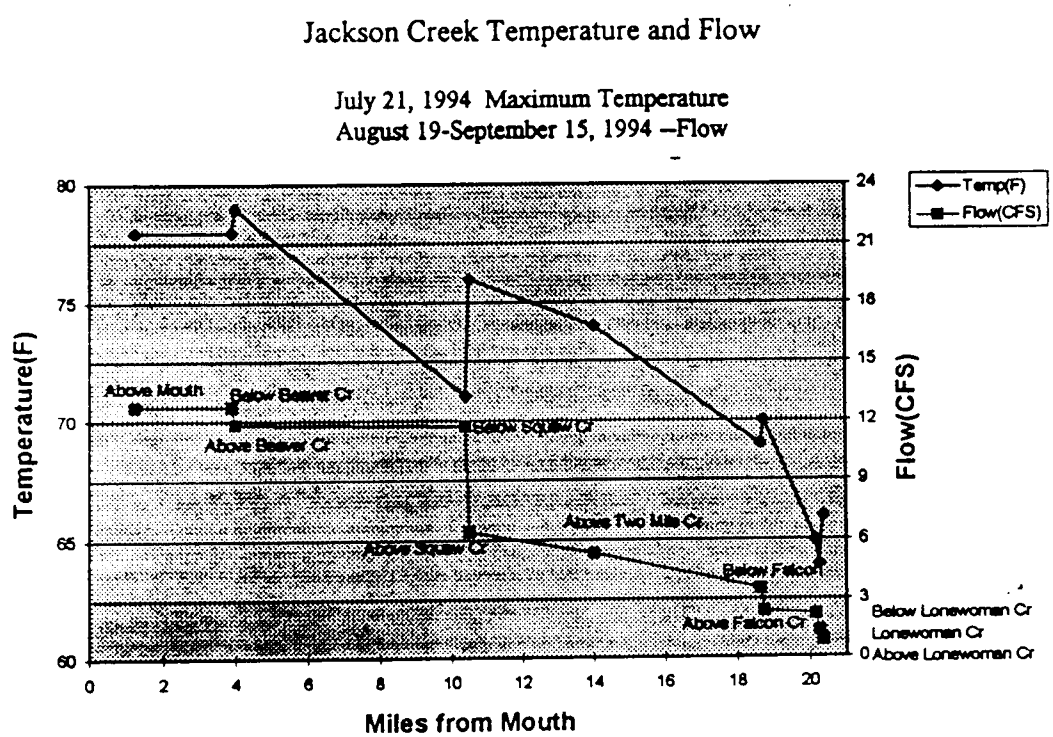


Figure 21. Maximum temperature for July 21, 1994 and flows August-Sept. 1994.

Lonewoman Creek is cooled by Triangle Creek, Squaw by Donegan Creek, and Devil's Knob Creek cools Beaver Creek. These are all very high flow creeks that supply most of the water of Jackson Creek's main tributaries. Donegan Creek, especially, flowed 4 cubic feet per second in August 1994, a third of Jackson Creek's flow coming mostly from springs below Donegan Prairie. Paradise Creek is a small creek that adds 2/3 cubic foot per second above Two Mile, and like those mentioned already, must provide a cool refuge for fish at its mouth.

None of the streams on the north side of Jackson adds any significant flow to either warm or cool the creek. There is little shade on most of the streams that still run in July, and it's likely that these streams are much warmer than before timber harvest began. That's very important to the fish, amphibians, aquatic insects and plants in these tiny streams. The only salmonid in many of them is cutthroat trout, a fish proposed for listing under the Endangered Species Act.

The perennial streams of Deep Cut, Ralph-Tallow-Two Mile, and Fawn-Maverick watershed areas (WAAs B,C and Q) have less than 20% of their length shaded like an old-growth forest (70% or greater canopy). Openings can occur because of timber harvest, meadows, wide channels, or fires. Except in parts of the Late Successional Reserve, the rest of the watersheds have less than 73% of their perennial stream length shaded, and some have less than 50% (Table 44). This is surprising, since plans to leave shade buffers on streams during timber harvest has been common practice since the mid 1970's. Unfortunately, much of the harvest occurred before then, even some timber cut recently was planned before then, and some planned buffers may have been cut or burned. Where not much timber has been cut in Lonewoman, Abbott, Cougar, and Squaw Creek (WAAs F, H, I, K, L, and X), more than 80% of perennial stream length is shaded(Class I, II, and III streams).