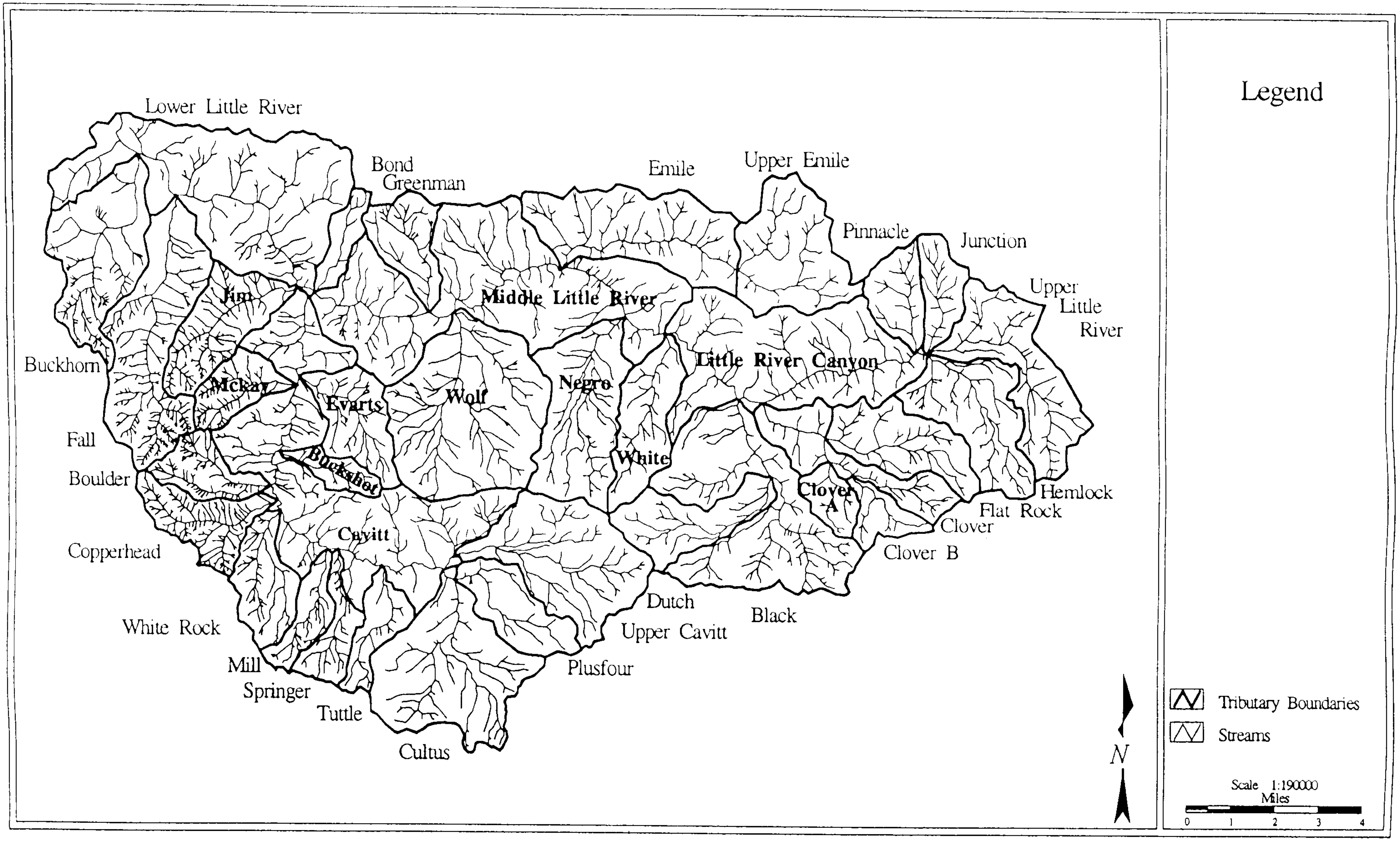
Figure 7. Tributaries Map



Landslide distribution and frequency by geologic map unit within the Little River AMA is portrayed in **Table 5**. The granitic terrain (KJg) of the Klamath Mountains province stands out clearly as having the highest frequency of landslides (both natural and management-related) at 12.1 occurrences per square mile. Within the Western Cascade physiographic province, the tuffaceous or ashy volcanic deposits of the Colestin Formation (Tfe) follow next at 7.9 landslide occurrences per square mile. The three major map units corresponding with the Little Butte Volcanic Group: basaltic lava flows and flow-breccia (Tub); welded and unwelded ash-flow tuff (Tut); and lava flows, mud flows, tuffs and breccias (Tus) are all closely grouped with respect to landslide frequency, reflecting a moderate potential for landslide frequency.

Table 5. Landslide frequency by geologic map unit.

PHYSIOGRAPHIC PROVINCE	GEOLOGIC MAP UNIT	MAP UNIT ACREAGE	NUMBER LANDSLIDES	FREQUENCY (per sq. mi.)	RANKING (Relative to KJg)
	Qal	1,067	0	0.0	0
Klamath Mountains	KJg	9,518	180	12.1	10
	KJm	1,285	9	4.5	4
	Ju	2,322	16	4.4	4
	Jv	615	3	3.1	3
Coast Range	Tmsc	6,089	13	1.4	1
	Tss	512	3	3.8	3
Western Cascades	Tfe	14,009	174	7.9	7
	Qef	13,190	131	6.4	5
	Tub	22,039	220	6.4	5
	Tut	22,449	209	6.0	5
	Tus	36,947	281	4.9	4
	Tsv	1,367	10	4.7	4
	Tib	438	1	1.5	1

A comparison of natural and management-related landslides by vicinity is shown in **Table 6**. Landslides that are not related to management activities can point out inherently unstable areas within the landscape. Natural landslide distribution and frequency by vicinity and subwatershed or Fish Watershed Analysis Area (FWAA) is contained in **Table 7**. The Black-Clover Vicinity has the highest rate for natural landslide frequency at 3.6 occurrences per square mile. Accordingly, the Clover Creek (CLV) and Clover Creek Tributary (CLB) subwatersheds within the Black-Clover vicinity have 5.1 and 4.9 landslide occurrences per square mile, respectively. The elevated frequency rates may reflect the high percent of steep terrain in these subwatersheds. The majority of this vicinity is in a high fire occurrence zone. The Clover Creek fire covered nearly 88 percent of the Clover Creek drainage in 1987. Higher natural landslide frequency rates can be expected in the granitic terrain underlying the Cavitt Creek and Lower Little River vicinities, however, the reference condition is unknown due to lack of aerial photo coverage.

The Wolf-Plateau vicinity has the highest management-related landslide frequency at 5.2 occurrences per square mile. Within this vicinity, the White Creek (WHT) subwatershed has the highest frequency rate at 9.3 occurrences per square mile. The high rate of management-related landslide occurrence within this vicinity is most likely the result of extensive roading and timber harvesting activities that took place during the decade of the 1950's and 1960's. Prior to 1970, road construction practices were poor and thus contributed to the later development of numerous road-related failures. Although the Cavitt Creek vicinity ranks moderately with respect to management-related landslide frequency, the Buck Creek Peak (PKP) subwatershed stands out clearly as having the highest overall rate of 17.7 occurrences per square mile. The very high frequency is attributed to extensive roading and clear-cut logging. Approximately 78 percent of this subwatershed lies within the granitic terrain. Similarly, the Fall Creek (FAL) subwatershed, which is mostly underlain by granitic bedrock (65 percent), has a high frequency rate of 9.9 occurrences per square mile. Management-related landslide frequency by vicinity and FWAA is depicted in **Table 8**.

Table 6. Landslide frequency by cause by vicinity. Frequency reported in occurrences per square mile.

VICINITY	NATURAL	MANAGEMENT-RELATED	COMBINED
Lower Little River	0.6	4.5	5.2
Emile	1.0	3.4	4.3
Middle Little River	1.3	3.3	4.6
Upper Little River	1.6	3.5	5.1
Wolf Plateau	1.1	5.2	6.2
Cavitt	1.6	3.8	5.4
Black-Clover	3.6	4.2	7.8

Stream buffers prescribed in the Northwest Forest Plan (tailored to the Little River AMA) are 360 feet for fish-bearing streams and 180 feet for non-fish bearing stream. Of 1134 total landslide occurrences identified within the watershed, some 829 occurrences or about 73 percent lie within riparian zones, and therefore can be considered to be a direct source of sediment yield. **(Table 9)**. The Black-Clover vicinity has the highest landslide frequency rate by stream class at 5.2 occurrences per square mile.

Table 7. Landslide within riprarian areas by stream class by vicinity.

VICINITY	CLASS 1 anadromous fish	CLASS 2 resident fish	CLASS 3 perennial non-fish	CLASS 4 intermittent non-fish	TOTALS	FREQUENCY (per sq. mi.)
Lower Little River	7	9	12	94	122	3.6
Emile	0	5	10	27	42	3.1
Middle Little River	15	6	32	46	99	2.9
Upper Little River	0	37	18	14	69	4.2
Wolf Plateau	7	2	50	44	103	4.5
Cavitt	20	21	77	137	255	4.3
Black-Clover	17	24	66	32	139	5.2
TOTAL LANDSLIDES	(66)	(104)	(256)	(394)	(829)	

Table 8. Natural Landslide Occurrence by Vicinity and Tributary within the Little River AMA.

Vicinity	Symbol	Tributary Name	FWAA Acreage	Natural Landslide Occurrences	Frequency per square mile	Ranking (Relative to CLV)
Lower Little River	LLR	Lower Little River	9199.5	7	0.5	1
	BKH	Buckhorn Creek	4334.2	3	0.4	1
	FAL	Fall Creek	5544.2	7	0.8	2
	JIM	Jim Creek	2756.4	3	0.7	1
			21834.3	20	0.6	1
Emile	UEM	Upper Emile Creek	3879.9	2	0.3	1
	EMI	Emile Creek	4836.6	11	1.5	3
			8716.5	13	1.0	2
Middle Little River	BON	Bond Creek	886.5	0	0.0	0
	GRM	Greenman Creek	1774.6	4	1.4	3
	MLR	Middle Little River	11312.3	18	1.0	2
	LRC	Little River Canyon	7659.2	23	1.9	4
			21632.6	45	1.3	3
Upper Little River	JNC	Junction Creek	1331.1	3	1.4	3
	PIN	Pinnacle Creek	1539.5	5	2.1	4
	ULR	Upper Little River	3984.3	8	1.3	3
	HEM	Hemlock Creek	3550.7	10	1.8	4
			10405.6	26	1.6	3
Wolf Plateau	WLF	Wolf Creek	7530.6	21	1.8	4
	NEG	Negro Creek	4420.1	3	0.4	1
	WHT	White Creek	2558.1	0	0.0	0
			14508.8	24	1.1	2
Cavitt	CAV	Cavitt Creek	10671.8	13	0.8	2
	MCK	McKay Creek	1434.9	3	1.3	3
	EVT	Evarts Creek	2261.6	5	1.4	3
	BKP	Buck Peak Creek	1559.1	3	1.2	2
	BKS	Buckshot Creek	839.6	0	0.0	0
	COP	Copperhead Creek	2214.7	0	0.0	0
	UCA	Upper Cavitt Creek	5198.8	18	2.2	4
	WRK	White Rock Creek	2007.1	1	0.3	1
	SPR	Springer Creek	1220.5	1	0.5	1
	MIL	Mill Creek	1205.2	6	3.2	6
	PLF	Plus Four Creek	2125.7	8	2.4	5
	TUT	Tuttle Creek	1328.6	7	3.4	7
	CUL	Cultus Creek	5622.2	27	3.1	6
			37689.8	92	1.6	3
Black–Clover	FRB	Flat Rock Branch	2870.5	17	3.8	7
	CLV	Clover Creek	2510.2	20	5.1	10
	BLK	Black Creek	7042.4	43	3.9	8
	CLA	Clover Creek Trib.	972.8	4	2.6	5
	CLB	Clover Creek Trib.	1041.6	8	4.9	10
	DUT	Dutch Creek	2618.9	3	0.7	1
			17056.4	95	3.6	7
		Totals	**131844.0**	**315**		
		Baseline Average			**1.5**	**3**

Footnotes:

Natural landslide frequency for all FWAA's within the Little River AMA is relative and reported as a percent of the Clover Creek FWAA which has the highest percentage of landslide occurrences per acre (e.g. 5.1 landslide occurrences per square mile).

The Black-Clover agmalgamated FWAA has the highest percentage of landslide occurrences (e.g. 3.6 landslide occurrences per square mile).

The Lower Little River landslide frequency is biased low due to lacking aerial photogrammetry for the 1946 flight year west of Cavitt Creek.

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GIS MOSS Area Summary for Map FISH.WAAS (Active Map No. 11)

Table 9. Management-Related Landslide Occurrences by Vicinity and Tributary within the Little River AMA.

Vicinity	Symbol	Tributary Name	FWAA Acreage	Mgmt-Related Occurrences	Frequency per square mile	Ranking (Relative to BKP)
Lower Little River	LLR	Lower Little River	9199.5	36	2.5	1
	BKH	Buckhorn Creek	4334.2	16	2.4	1
	FAL	Fall Creek	5544.2	86	9.9	6
	JIM	Jim Creek	2756.4	15	3.5	2
			21834.3	153	4.5	3
Emile	UEM	Upper Emile Creek	3879.9	3	0.5	0
	EMI	Emile Creek	4836.6	43	5.7	3
			8716.5	46	3.4	2
Middle Little River	BON	Bond Creek	886.5	2	1.4	1
	GRM	Greenman Creek	1774.6	18	6.5	4
	MLR	Middle Little River	11312.3	42	2.4	1
	LRC	Little River Canyon	7659.2	48	4.0	2
			21632.6	110	3.3	2
Upper Little River	JNC	Junction Creek	1331.1	5	2.4	1
	PIN	Pinnacle Creek	1539.5	12	5.0	3
	ULR	Upper Little River	3984.3	18	2.9	2
	HEM	Hemlock Creek	3550.7	22	4.0	2
			10405.6	57	3.5	2
Wolf Plateau	WLF	Wolf Creek	7530.6	59	5.0	3
	NEG	Negro Creek	4420.1	21	3.0	2
	WHT	White Creek	2558.1	37	9.3	5
			14508.8	117	5.2	3
Cavitt	CAV	Cavitt Creek	10671.8	78	4.7	3
	MCK	McKay Creek	1434.9	20	8.9	5
	EVT	Evarts Creek	2261.6	4	1.1	1
	BKP	Buck Peak Creek	1559.1	43	17.7	10
	BKS	Buckshot Creek	839.6	3	2.3	1
	COP	Copperhead Creek	2214.7	14	4.0	2
	UCA	Upper Cavitt Creek	5198.8	10	1.2	1
	WRK	White Rock Creek	2007.1	21	6.7	4
	SPR	Springer Creek	1220.5	8	4.2	2
	MIL	Mill Creek	1205.2	8	4.2	2
	PLF	Plus Four Creek	2125.7	12	3.6	2
	TUT	Tuttle Creek	1328.6	1	0.5	0
	CUL	Cultus Creek	5622.2	1	0.1	0
			37689.8	223	3.8	2
Black-Clover	FRB	Flat Rock Branch	2870.5	8	1.8	1
	CLV	Clover Creek	2510.2	20	5.1	3
	BLK	Black Creek	7042.4	65	5.9	3
	CLA	Clover Creek Trib.	972.8	8	5.3	3
	CLB	Clover Creek Trib.	1041.6	3	1.8	1
	DUT	Dutch Creek	2618.9	8	2.0	1
			17056.4	112	4.2	2
		Totals	131844.0	818		
		Baseline Average			4.0	2

Footnotes:

Natural landslide frequency for all FWAA's within the Little River AMA is relative and reported as a percent of the Buck Peak Creek FWAA which has the highest percentage of landslide occurrences per acre (e.g. 17.7 landslides occurrences per square mile).

The Wolf Plateau agmalgamated FWAA has the highest percentage of landslide occurrences (e.g. 5.2 landslide occurrences per square mile).

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GIS MOSS Area Summary for Map FISH.WAAS (Active Map No. 11)

Risk Assessment

Erosion potential and sediment delivery for the Little River AMA is expressed in terms of relative probability. Risk is based upon relative landslide frequency due to either episodic (catastrophic) or chronic sediment delivery to stream channels. Mechanistic approaches which attempt to quantify the amount of sediment delivery into stream channels from surface erosion and mass wasting processes was not considered feasible at the watershed scale. Such methods appear more suitable and useful at the project-level planning stage. This hazard rating does not consider erosion potential resulting from "at risk" to fail stream crossings, stream network extension, or gully or rill erosion on road surfaces, cut slopes, or fill slopes.

The relative potential (risk) for sediment delivery from mass wasting processes stemming from landslides has been determined utilizing a weighted ranking system. The ranking was based on the findings of the landslide analysis, and professional judgement which incorporated field observations and the review of the scientific literature. Criterion for this evaluation include: geologic map units grouped by landslide frequency, slope class, and geomorphic map units weighted by potential of sediment delivery. Relative potential was derived by the additive combination of coincident attributes **(Table 10)**. Based on Haskins and Chatoian (1993), geomorphic units portrayed on this map include; active earthflow terrain (Qefa), dormant earthflow terrain (Qef), debris slide basins (Dsb), and chronic hill slope erosion (Che).

Table 10. Criterion used to delineate areas of erosion and sediment delivery potential (risk). The weighted numerical attribute for each of the criterion is shown in parentheses.

GEOLOGIC MAP UNIT	SLOPE CLASS	GEOMORPHIC UNITS
(10) KJg - granitic rocks	(10) > 60%	(10) Dsb - debris slide basins
(7) Tfe - tuffaceous sediments	(5) 30-60%	(8) Qefa - active earthflow
(5) Tub - basaltic flows	(0) < 30%	(3) Qef - inactive earthflow
Tut - ash-flow tuff		(2) Che - chronic hillslope (surface) erosion
Qef - landslides and earthflows		(0) no units delineated
(4) Tus - tuff and lava flows		
Tsv - silicified vent deposits		
KJm - marine sediments		
Ju - gabbro, peridotite, and serpentinite		
(3) Jv - altered volcanic lava flows and sediments		
Tss - tuffaceous sediments		
(1) Tib - intrusions of basaltic andesite		
Tmsc - sedimentary rocks		
(0) Qal - alluvial (stream) deposits		

RANKING SYSTEM

24 - 30	high
18 - 23	moderate to high
12 - 17	moderate
6 - 11	low to moderate
0 - 5	low

The Erosion and Sediment Delivery Potential (Risk) Map for the Little River AMA is contained is contained in **Figure 8**. Relative frequency for erosion and sediment delivery potential by vicinity is portrayed in **Table 11**. The Emile and Lower Little River vicinities have the highest percent of acreage that falls within a high potential rating for erosion and sediment delivery, at 18.5 and 17.3 percent, respectively. The Black-Clover and Middle Little River vicinities follow next in this category at 11.7 and 11.3 percent.

Table 11. Erosion and sediment delivery potential by vicinity within the Little River AMA. Potential is expresses by percent acres.

VICINITY	LOW	LOW-MODERATE	MODERATE	MODERATE-HIGH	HIGH
Lower Little River	38.1	22.6	11.7	10.4	17.3
Emile	42.1	14.5	13.9	11.1	18.5
Middle Little River	25.2	36.2	20.6	6.7	11.3
Upper Little River	30.7	37.5	15.2	12.0	4.4
Wolf Plateau	51.6	35.2	9.3	2.5	1.5
Cavitt	30.8	36.2	22.4	4.4	6.3
Black-Clover	18.8	31.1	23.2	15.4	11.7

The frequency of landslide and debris torrents throughout the Little River watershed has increased substantially since the advent of intensive land management activities. Of the total number of landslides that have occurred within the basin since the 1940's, roughly 80 to 90 percent have been linked to management activities. While not all of the management-related activities delivered sediment directly into stream channels, the majority of them did. It is difficult to quantify the extent to which aquatic habitat and aquatic communities have been altered by this change in sediment regime due to the fact that the Little River and Cavitt Creek subbasins are likely to react differently. Future sediment delivery to streams should not be linked to past failures but rather to future potential sites in the landscape where erosion and mass wasting processes prevail.

SUMMARY OF LANDSCAPE PROCESSES AND RAMIFICATIONS TO THE AQUATIC ECOSYSTEM

Cavitt Creek and Lower Little River Vicinities

The Cavitt Creek and Lower Little River vicinities encompass parts of the Klamath Mountains, Coast Range, and Western Cascades physiographic terranes. Due to age differential amongst these geologic terranes and the diversity of rock types present within them, landscape physiography is fairly complex. Cavitt Creek and Lower Little River reflect a more mature stage of drainage development relative to other parts of the watershed due to the larger expanse of geologic time in which erosion has taken place.

Cavitt Creek is a system with a naturally high sediment load due mainly to chronic seasonal erosion of Idiot slide, a sizeable active earthflow situated within the Upper Cavitt Creek (UCA) subwatershed. Substantial sediment load is derived from this active earthflow landform due to lateral channel movement and incision. About 70 percent of the Cavitt Creek subbasin is underlain by altered tuffaceous volcanics that rapidly weather into fine-textured silty to clay-rich

Figure 8. Erosion Potential and Sediment Delivery (Risk) Map

soils. Debris avalanches, and slumps and earthflows, are the dominant mechanisms of mass failure throughout the volcanic terrain in the Cavitt Creek subbasin.

Another 13 percent of the Cavitt Creek subbasin is underlain by granitic bedrock of the Klamath Mountain province. Extensive areas of granitic terrain crop out within the MacKay (MCK), Buck Peak Creek (BKP), and Copperhead Creek (COP) subwatersheds. The granular crystalline texture inherent in granitic bedrock, combined with widespread fracturing and jointing, makes it highly susceptible to both mechanical and chemical weathering processes. Disintigration and decomposition of coarse-grained mineral constituents is rapid in the prevailing temperate humid climatic regime. Sediment influx from the highly erosive granitic landscape is coarse-textured, consisting mainly of silt and sand. The Klamath Mountain terrane is much more dissected and episodic debris avalanches and debris flows are the predominant mechanism for mass failure. Intensive management practices conducted in the Cavitt Creek vicinity, especially within the granitic terrain, has resulted in exceptionally high rates of landslide failure. Buck Peak Creek (BKP) has the highest frequency rate in the Little River watershed with 17.7 landslide occurrences per square mile. MacKay Creek (MCK) has the second highest landslide frequency within the Cavitt Creek subbasin at 8.9 occurrences per square mile.

The Lower Little River vicinity encompasses all the Coast Range province and a sizeable part of the Klamath Mountains province. Much of the terrain can be characterized as dissected lowlands where erosion has reduced mountainous relief to hummocky hills and broad valleys filled with alluvial sediments. Channel gradients are very shallow with meandering stream courses that reflect a maturing landscape.

Granitic bedrock underlies about 41 percent of the upper Fall Creek drainage. Intensive management practices conducted upon the granitic soils present has led to high frequency rates for landslide occurrence. Debris slide basins are ubiquitous throughout the steep highly dissected terrain. A closely-spaced drainage network has developed upon the highly erosive granitic landscape. Gully and rill surface erosion is rampant on many of the steep gradient roads constructed in the granitic terrain. The Fall Creek fire in 1987 also contributed much sediment load to stream channel via surface erosion processes.

Marine mudstones, siltstones, sandstones, and pebbly conglomerates of the Umpqua Formation accounts for another 30 percent of the bedrock geology in the lower Fall Creek drainage. These sediments produce fine-textured soils. Intensive management practices within the Fall Creek (FAL) subwatershed has resulted in a high frequency of landslides, with 9.9 occurrences per square mile.

Due to this naturally occurring sediment influx and shallow gradient profile of Cavitt Creek, it is virtually impossible to assess in-channel changes brought on by an increase in sediment contributions derived from intensive management activities. In this case, information collected on aquatic conditions, as well as information obtained from office investigations (aerial photo analysis), provides the best indication of linkage between stream condition and land management activities.

Wolf-Plateau Vicinity

Wolf-Plateau represents a gently-dissected volcanic upland surface within the Western Cascades physiographic province. Formation of this volcanic upland is the result of the highly resistant ash-flow tuff unit (Tuff of Bond Creek) which forms a rocky bluff along its northern, western, and southern periphery. This massive ash-flow tuff sheet has effectively slowed the headward advance of fluvial erosion processes. Drainage systems that have begun to breach through the resistant layer; such as Evarts, Buckshot, Live Oak, Withrow, and Wolf Creek have very steep gradients and numerous waterfalls which act as barriers to fish passage. The upland plateau is capped by a diversity of volcanic deposits including; lava flows, mudflows (lahars), flow-breccias, and tuffs and breccias of the Little Butte Volcanic Group. These volcanic deposits have weathered into fine-textured, clay-rich, relatively impermeable soils. Where water is present, earthflow terrain has developed.

An extensive area of earthflow terrain exists within the Negro Creek (NEG) subwatershed. This landform is the result of a sizeable volcanic mudflow (lahar) that flowed down the northern flank of Red Butte millions of years ago. The extensive lobate toe of this volcanic mudflow caused a major shift in Little River, as evidenced by the broad bend in the river between the confluence of Negro Creek and Egglestron Creek. Prolonged weathering upon this volcanic landform has resulted in the formation of fine-grained, clay-rich, impermeable soils. Mass failure processes are likely where channel incision has undermined the adjacent banks. During seasonal peak flows, chronic sediment is delivered from these channels. Localized debris avalanches, and slumps and earthflows are present upon the steeper hillslopes.

Although natural landslide frequency for Wolf-Plateau was amongst the lowest of all vicinities at 1.1 occurrences per square mile, it ranked as having the highest frequency of management-related landslides at 5.2 occurrences per square mile. White Creek (WHT) subwatershed was found to have the highest frequency rate of management related landslides at 9.3 occurrences per square mile. The high rate of management-related landslide occurrences within the Wolf-Plateau vicinity is considered to be the result of extensive roading and timber harvesting activities that took place during the decade of the 1950's and 1960's when road construction techniques prior to 1970 were poor. Approximately 70 percent of all management-related landslides occurred between the 1947-1966 time period. Of all the vicinities, Wolf-Plateau has received the most intensive timber harvest at 78.4 percent of the total acreage.

Upper Little River, Black-Clover, Emile, and Middle Little River Vicinities

The Upper Little River, Black-Clover, Emile, and Middle Little River vicinities are underlain by a diverse succession of interlayered andesitic and basaltic lava flows, tuffs and flow-breccias comprising the Little Butte Volcanic Group.

Although deep landscape dissection characterizes much of the Upper Little River, Black-Clover, Emile, and Middle Little River vicinities, large inclusions of gently-dissected upland volcanic surfaces and earthflow terrain form an integral part of this volcanic landscape. Drainage systems within the highly dissected terrain have steep gradients, narrow bedrock dominated channels, "stepped" profile, and numerous waterfalls. The valley walls are generally confining and very steep, forming "V-shaped" canyons. Emile, Clover, Pinnacle, Flat Rock Branch, Taft, and Little Taft are subwatersheds that reflect deep landscape dissection.

The Emile (EMI) subwatershed represents a prominent upland volcanic surface. A thick succession of basalt flows emanating from Taft Mountain form a resistent layer retarding the headward advance of Emile Creek. Extensive earthflow terrain exists within Dutch Creek (DUT) and Upper Little River (ULR) watersheds. The upper reaches of Hemlock Creek (HEM) subwatershed also lie within earthflow terrain. Volcanic mudflows (lahars) are thought to be the origin of these earthflow landforms.

In areas of gentle relief, the volcanic bedrock is highly weathered and forms fine-textured, clay-rich, residual soils. Because the soil mass is deep and relatively impermeable, surface water tends to be localized in concave topographic surfaces forming ponds and wet areas. Slumps and earthflow are the primary mechanism for mass failure upon the shallow gradient volcanic upland surfaces and earthflow landforms. Bank erosion and secondary landslide features tend to be located along incised drainage systems that flow through these landscapes. Sediment influx emanating from upland volcanic surfaces and earthflow terrain tends to be chronic in nature, being responsive to seasonal peak flows.

In the deeply dissected landscape debris avalanches and debris flows are the dominant form of mass wasting, debris slide basins are abundant, and sediment influx is episodic. Within the upper portion of the Little River drainage system there is visible evidence that large amounts of fine sediment are present within the spawning gravels, even though the high gradient channels within the Black-Clover and Emile vicinities normally tend to transport their sediment load downstream fairly rapidly. This is an indication that more fine sediment is entering the upper system than it is capable of flushing out. Sediment load derived from the Emile Creek (EMI) subwatershed is mainly fine-textured. Significant potential for the accumulation of fine-textured sediment is also identified within the Little River Canyon (LRC) subwatershed of the Middle Little River vicinity; as well as the Clover Creek (CLV), Black Creek (BLK), and Clover Creek Tributary (CLB) subwatersheds of the Black-Clover vicinity.

Natural landslide frequency is notably higher in deeply dissected terrain as opposed to the gently dissected terrain. Within the highly dissected Black-Clover vicinity, the Clover Creek (CLV) subwatershed has the highest frequency rate at 5.1 landslide occurrences per square mile. The Clover Creek Tributary (CLB), Black Creek (BLK), and Flat Rock Branch (FRB) follow next at 4.9, 3.9, and 3.8 landslide occurrences per square mile. None of the subwatersheds within the Emile, Middle Little River or Upper Little River vicinities have natural landslide frequency rates of this magnitude. Intensive road construction and timber harvesting conducted upon all four vicinities has accelerated their respective landslide frequency rates. Most severely impacted subwatersheds include Black Creek (BLK), Clover Creek (CLV), Clover Creek Trib (CLA), Pinnacle Creek (PIN), Greenman Creek (GRM), and Emile Creek (EMI).

RECOMMENDATIONS

General

1. That a geotechnical specialist be included in the district's initial "scoping" process or strategy sessions for any proposed internal or external projects that entail earth movement or timber harvest. This action would occur prior to the formation of an Interdisciplinary Team. Geotechnical input on the IDT would be required if such proposals were situated in areas of high erosion potential and/or high risk of slope mass failure, where sediment transport and

delivery may cause cumulative effects to aquatic ecosystems. Such areas of elevated risk are delineated on the hazard zonation map for the Little River AMA (a.k.a. the Soil Erosion and Sediment Delivery Risk Map).

2. That methods of mechanistic and probabilistic analysis be utilized, as appropriate, in geotechnical evaluations for landscape-level projects, such as timber harvest and road construction/reconstruction. Level 1 Stability Analysis (LISA) can be utilized to assess the relative probability of landslide failures in landscapes considered for various timber harvest prescriptions. The Watershed Erosion Prediction Project (WEPP) can be utilized to estimate sediment transport and quantify sediment delivery to stream channels from road surfaces or timber harvest units harvest. Modelling can determine effective buffer widths to protect riparian habitat. LISA and/or WEPP would be utilized in areas where sediment transport and delivery may cause cumulative effects to aquatic ecosystems. Such areas exist where there is high erosion potential and/or high risk of slope mass failure. Areas of risk are delineated on the Erosion and Sediment Delivery Potential Map. Within the Little River AMA, landforms that are at highest risk include debris slide basins (episodic sediment delivery), especially in granitic terrain, and active slumps and earthflows (chronic sediment delivery).

3. That as part of any project level analysis in areas of high potential for mass failure (landslides) and soil erosion, field work should include field verification and monitoring of landslides identified by aerial photo interpretation and delineated on the Forest GIS Landslide Layer. Landslide features identified during field investigations should be catalogued utilizing the Umpqua National Forest Active Landslide Inventory Form. The SO Soils Section has responsibility for maintaining and updating the Forest Landslide Inventory as part of Forest Plan Monitoring (FW121/NFSW Soil Productivity, Element No. 1; Ch. 5 - 10). The 5-year update is due in FY95.

4. Watershed restorations projects (decommissioning or reconstruction) should be prioritized based upon the Little River AMA Access and Travel Management document; "Guide To Transportation System Assessment and Planning" (formerly known as "Road Splitter's Guide" prepared by Miles Barkhurst).

Specific

This specific recommendation addresses sediment regime and peak flow functions.

Objective: Shift the sediment regime and peak flow functions towards that which existed during the reference condition.

Where: Landforms that are prone to chronic sediment delivery due to slump and earthflow movement into stream channels. Landforms most susceptible include; upland plateaus, landslide complexes, and earthflow terrain. Vicinities that have extensive landforms with these features include: Wolf Plateau, Cavitt Creek, Emile (Willow Flats), and Upper Little River (Upper Little River and Hemlock subwatersheds)

Strategy: Increase water infiltration and flow dispersal by reducing soil compaction, minimizing flow concentration, decreasing road density (stream network extension), and lessening the size of bare ground associated with very early seral stage development.

Methods: (1) increase number, and/or decrease spacing of cross-drains (relief culverts), especially in coarse-grained soils
(2) outslope roads, where appropriate
(3) decompaction by "subsoiling" and revegetation of roads identified for decommissioning
(4) reduce potential for stream diversion, fill wash-outs, and dam break floods
(5) locate roads to lessen potential for creating slope instability, or to increase stability on naturally unstable ground
(6) reduce density of very early seral stage patches through fragmentation of future harvest
(7) locate roads in such a manner as to minimize potential for gully and rill erosion on road surfaces and hillslope drainage structure outlets
(8) provide for vegetation and other buffer materials at cross drain outlets
(9) provide for ditchline armoring, where appropriate
(10) stabilize cutslopes which have a natural tendency to revegetate
(11) utilization of high quality aggregate surfacing or asphalt surfacing along critical segments to reduce surface erosion

Where: Landforms that are at high risk to episodic and catastrophic sediment delivery to stream channels due to debris avalanches and debris flows. Landforms affected include debris slide basins within steep dissected terrain. Vicinities that have extensive steep dissected terrain include: Lower Little River, "granitic terrain" within Cavitt Creek, Emile (excluding Willow Flats), and Black-Clover (except for Dutch Creek subwatershed)

Strategy: Reducing potential for mass failure and severe erosion associated with stream crossings, restoring altered drainage patterns, decreasing percentage of stream network extension, and modifying timber harvest practices on high risk terrain, identified on the Erosion Potential and Sediment Delivery Risk Map (Appendix A-9).

Methods: (1) hardening, armoring, or upgrading stream crossings that are predicted to be "at risk" to fail or plug

(2) special consideration should be given to both construction materials and existing ground conditions prior to design of fills on hillslopes exceeding 60 percent steepness.

Outcome: The outcome is difficult to monitor due to complex and intricate natural processes and large timeframes with respect to their interactive recurrence cycles. Management-related activities further complicate disturbance patterns.

REFERENCES CITED

Blake, M.C., Engebretson, D.C., Jayko, A.S., and Jones, D.L., 1985, Tectonstratigraphic Terranes in Southwest Oregon; in Howell, David G., ed., Tectonostratigraphic Terranes of the Circum-Pacific Region: Circum-Pacific Council for Energy and Mineral Resources, Earth Science Series, No. 1., p. 147-157.

Brenda, L. E., and Dunne, T., 1987, Sediment Routing by Debris Flows; in Bestchta, R.L., Blinn, T., Grant, G.E., Ice, G.G., and Swanson, F.J., eds., Erosion and Sedimentation in the Pacific Rim: International Association of Hydrological Sciences, Publication 165, Oxfordshire, United Kingdom, p. 213-223.

Burroughs, Edward R., Jr., Chalfant, George R., and Townsend, Martin A., 1976, Slope Stability in Road Construction - A guide to the Construction of Stable Roads in Western Oregon and Northern California: USDI Bureau of Land Management, Oregon State Office, 102 p.

Drake, Ellen T., 1982, Tectonic Evolution of the Oregon Continental Margin: Oregon Geology, Vol. 44, No. 2, p. 15-21.

Harper, Gregory D., 1984, Middle to Late Jurassic Tectonic Evolution of the Klamath Mountains, California-Oregon: Tectonics, Vol. 3., No. 7, p. 759-772.

Harris, D.D., Hubbard, Larry L., and Hubbard, Lawrence E., 1979, Magnitude and Frequency of Floods in Western Oregon: U.S. Geological Survey Open-File Report 79-553, 36 p., 2 pl., 1:1,000,000

Haskins, Donald M., and Chatoian, John M., 1993, Geology Data Standards for Ecological Unit Inventories for the Pacific Southwest Region; in USDA Forest Service, Pacific Southwest Region, Technical Paper, R5-05-008, 56 p.

Hayes, G.L., and Herring, H.G., 1969, Some Water Problems and Hydrologic Characteristics of the Umpqua Basin: USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, 22 p.

Leopold, Luna B., 1994, A View of the River: Harvard University Press, Cambridge, Massachusettes, 298 p.

MacLeod, Norman S., 1983-84, Unpublished Reconnaissance Geologic Map of the Western Cascades, Roseburg 1° by 2° Sheet south of the Willamette River to lat. 43° N.

Molenaar, C.M., 1985, Depositional Relations of Umpqua and Tyee Formations (Eocene), Southwestern Oregon: American Association of Petroleum Geologists Bulletin, Vol. 69, No. 8., p. 1217-1229.

Montgomery, David R., and Buffington, John M., 1993, Channel Classification, Prediction of Channel Response, and Assessment of Channel Condition: Timber, Fish, and Wildlife Report, TFW-SH10-93-002, 107 p.

Montgomery, David R.; Wright, Robert H.; and Booth, Thom, 1991, Debris Flow Hazard Mitigation for Colluvium-Filled Swales: Bureau of the Association of Engineering Geologists, Vol. XXVIII, No. 3, p. 303-323

Naiman, Robert J., Beechie, Timothy J., Benda, Lee E., Berg, Dean R., Bisson, Peter A., MacDonald, Lee H., O'Connor, Matthew D., Olson, Patricia L., and Steel, Ashley E., 1992, Fundamental Elements of Ecologically Healthy Watersheds in the Pacific Northwest Coastal Ecoregion, p. 127-187.

Orr, Elizabeth L., Orr, William N., and Baldwin Ewart M., 1992, Geology of Oregon: Fourth Edition, Kendall Hunt Publishing Co., 254 p.

Packer, Paul E., and Christensen, George F., 1977, Guides for Controlling Sediment from Secondary Logging Roads: USDA Forest Service, Intermountain Forest and Range Experimentation Station, Ogden, Utah and Northern Region, Missoula, Montana, 42 p.

Peck, Dallas L., Griggs, Allan B., Schicker, Herbert G., Wells, Francis G., and Dole, Hollis M., 1964, Geology of the Central and Northern Parts of the Western Cascade Range in Oregon: U.S. Geological Survey Professional Paper 449, 56 p., pl. 1:250,000

Perttu, R.K., and Benson, G.T., 1980, Deposition and Derformation of the Eocene Umpqua Group, Sutherlin Area, Southwestern Oregon: Oregon Geology, Vol. 42, No. 8, p. 135-140.

Sherrod, David R., 1986, Geology, Petrology, and Volcanic History of a portion of the Cascade Range between latitudes 43° and 44° N., central Oregon, USA: Ph-D dissertation, University of California, Santa Barbara, 320 p.

Sherrod, David R., and Smith, James G., 1989, Preliminary Map of the Upper Eocene to Holocene Volcanic and Related Rocks of the Cascade Range, Oregon: U.S. Geological Survey Open-File Report 89-14, pl. 1:500,000

Swanston, F.J., Fredrickson, R.L.,and McCorison, F.M., 1982, Material Transfer in a western Oregon forested watershed; in R.L. Edmonds, ed., Analysis of Coniferous Forest Ecosystems in the Western United States, Huctchinson Ross, Stroudsburg, Pennsylvania, USA, p. 233-266

Swanston, D.N., 1991, Natural Processes; in Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats, p. 139-179, William R. Meeham, ed., U.S. Department of Agriculture, Forest Service: American Fisheries Society Special Publication 19, 751 p.

Varnes, D.J., 1978, Slope Movement Types and Processes: in Landslides-Analysis and Control, Schuster, R.L., and Krizek, R.J., eds., National Academy of Science, Washington D.C., Chap. 2, p. 11-33.

Wellman, Roy E., Gordon, Janice M., and Moffatt, Robert L., 1993, Statistical Summaries of Streamflow Data in Oregon: Vol. 2 - Annual Low and High Flow, and Instanteneous Peak Flow: U.S. Geological Survey Open-File Report 93-63 (Prepared in Cooperation with the Oregon Water Resources Department)

Walker, George W., and MacLeod, Norman S., 1991, compilers, Geologic map of Oregon, U.S. Geological Survey, pl. 1:500,000 (two oversize sheets)

APPENDIX B

APPENDIX B
FIRE AND FUELS

Contents

FIRE HISTORY SUMMARY

The fire history study methods are summarized in the following pages. The Umpqua Forest ecologist aided in setting these standards for all fire history studies on the forest.

Another important aspect of this study is the methods used to determine fire events with the data collected. Guidelines from Augusta Fire History (K.Connelly and J.Kertis, 1991) with some minor adjustments.

1 Both fire scar and tree origin dates had to exist for each fire episode.

2 Each episode must include at least five sites with fire evidence or tree origins dating from a particular fire.

3 Only reliability counts from 3 to 5 were included in the analysis.

4 Data was collected on all fire scars and pitch rings. However, only fire scars dated before 1939 were used for analysis of the reference period. Pitch rings were used only to support fire scar evidence.

5 A cluster of sites had to have spacial and temporal similarities.

The fire history summary table (Table 1) displays fire episodes and scare year. The scar year is the fire event determined with the above guidelines. The fire episode is the years the scar evidence was clustered in. The fire return interval is calculated using the time since previous fire column. The scar, pitch ring and number of tree origins column are there to show supporting evidence needed to meet the Augusta guidelines.

The historical fire statistics were determined with the fire history survey data.

METHODS FOR ESTABLISHING FIRE HISTORY

Introduction

The fire history of an area is a characterization of the frequency, size, and intensity of fire. Fire effects are evident as scars on trees, different age classes of trees or shrubs, and species composition. These effects can often be detected for hundreds of years.

Fires can be started by native Americans, European man, or lightening and other "nonhuman" causes. If your objectives include determining history of only one or two of these ignition sources, then some background in human use of the area is in order. For example, if European man did not enter the area until after 1900, fires that occurred before then will be the result of native American activity or nonhuman caused. If fire is frequent along a documented trail, it might be the result of native Americans. Background information will be helpful in piecing this information together.

Methods

Study area

Recall that fires can vary in size from less than 1 acre to 100,000's of acres. The size of your study area should be large enough to encompass one complete fire in order to make conclusions about natural sizes. Smaller sample sizes will give information on fire frequency and intensity only.

Sampling area

In the climate of SW Oregon, clearcut units up to 10 years old are generally useful. After that time stumps become rotten and tree ages are difficult to determine. Begin by choosing clearcut units distributed evenly throughout the study area (as data is collected it will become evident whether or not more units need to be sampled). Within each clearcut unit, place 3-4 plots, covering different aspects and slopes. Plots are placed by doing reconnaissance over the area and choosing stumps with obvious fire scars. Stumps with multiple scars are best. If the unit has no stumps with obvious scars, data collection is still valuable, and plots should be randomly placed.

If part of the area has never been harvested, it is possible to age fire scars using an increment borer and recontruct stand ages. This method is more difficult then using stumps because only a small portion of the bole is being viewed and in large trees, where the increment borer does not reach the center, total age must be estimated.

Sampling method

The fire-scarred stumps are used as plot centers. Plots are variable sized, and each plot must have at least eight stumps. All sizes of stumps are counted, no matter how small. Plot size should be recorded. A suggested plot size is .25 acre (58 ft radius).

If the tree rings are dificult to count, the top of the stump may be cut off with a chainsaw.

Number each stump. Examine the top of the stump. Identify fire scars, pitch rings, and areas of suppression or release. Count the rings from the bark inward, noting how many years since harvest the scars, pitch rings, or suppression-release event occurred. Continue counting to determine total tree age. For both age of disturbance and total age give an estimation of reliability. 5=sure within 10 years; 4=sure within 20 years; 3=sure within 30 years, 4=sure within 40 years; and 1=sure within 50 years.

For each stump also record species, height, and diameter. Record whether the disturbance event was on the uphill, downhill, or sidehill side of the stump. Record what percentage of the circumference (at the time of disturbance) was effected by the event. Record the radius from the center of the stump to the disturbance. Also record the number of rings per inch closest to the pith, and the number of the scar or pitch ring on each tree (i.e., 1 if there is one scar or pitch ring, 2 if there are two scars, etc.).

Assign and record an identifying code or number for each unit, the stand number from GIS is one possibility. Record plot number, date, observers, plant series or association (may be determined from an adjacent stand), elevation, aspect, slope, microslope position, harvest date, plot radius, and macroslope position. Data sheets have been developed and are available on request.

Diane White
Ecologist
Umpqua NF

Fire History Information

Plots throughout FS managed public land (63,575 acres). 46 plots tallied, 3258 total stumps, 673 fire scars and 1128 pitch rings.

Historical data uses 1613 to 1938 as the reference period.

The cumulative mean fire return interval for the reference period was 13 years.
This was calculated using methods documented in the 'Augusta Fire History' a report by Connelly and Kertis 1991.

The following formulas were used in Table 1. Fire History Data Summary

$$\text{Mean fire return interval} = \frac{\text{Sum 'Time Since Previous Fire'} + \text{52 years to present}}{\text{Total number of scar years}}$$

The range for the fire return interval for the area was calculated using the standard deviation of 'Time Since Previous Fire' values. The range is 9 to 17 years.

The percent of the area over a 200 year period affected by fire totaled 21% (25,332 acres). This does not take into consideration the mature stands that may have experienced underburning activity.

Table 1. Fire History Data Summary

Scar Year	Fire Episode		Length of Episode	Time Since Previous Fire	Scar Sites	Pitch Ring Sites	Tree Origins within Plots
1613	1612	1615	3	0	3	3	22
1625	1623	1629	6	12	3	5	16
1635	1632	1638	6	10	1	7	23
1646	1641	1648	7	11	3	8	31
1654	1651	1656	5	8	2	14	44
1667	1664	1671	7	13	2	11	35
1692	1674	1693	19	25	5	2	104
1700	1700	1705	5	8	3	9	37
1710	1708	1713	5	10	4	10	59
1724	1720	1726	6	14	5	2	61
1734	1730	1737	7	10	3	8	41
1746	1739	1747	8	12	9	15	66
1759	1749	1761	12	13	13	30	78
1767	1763	1770	7	8	13	17	32
1775	1771	1780	9	8	14	26	69
1787	1782	1790	8	12	7	18	52
1797	1793	1803	10	10	15	28	60
1808	1804	1813	9	11	11	25	60
1818	1817	1823	6	10	18	36	60
1829	1824	1833	9	11	14	20	67
1839	1835	1843	8	10	25	33	65
1849	1844	1853	9	10	42	61	78
1859	1854	1863	9	10	28	59	94
1870	1864	1873	9	11	34	53	101
1878	1874	1883	9	8	39	48	69
1889	1884	1893	9	11	35	55	76
1898	1894	1903	9	9	30	62	90
1911	1904	1913	9	13	35	56	74
1919	1914	1923	9	8	27	44	34
1930	1924	1933	9	11	24	37	16
1938	1934	1943	9	8	25	21	6
		Time to Present		SUM 325			
		Years	52	MEAN 12.16129	SD	3.686651	

Probacre is a program that utilizes fire frequencies and the Poisson distribution. The Poisson model is a statistical distribution tool that fits events with rare occurrences. The inputs and outputs are summarized in the tables below.

Table 2. Probacre inputs

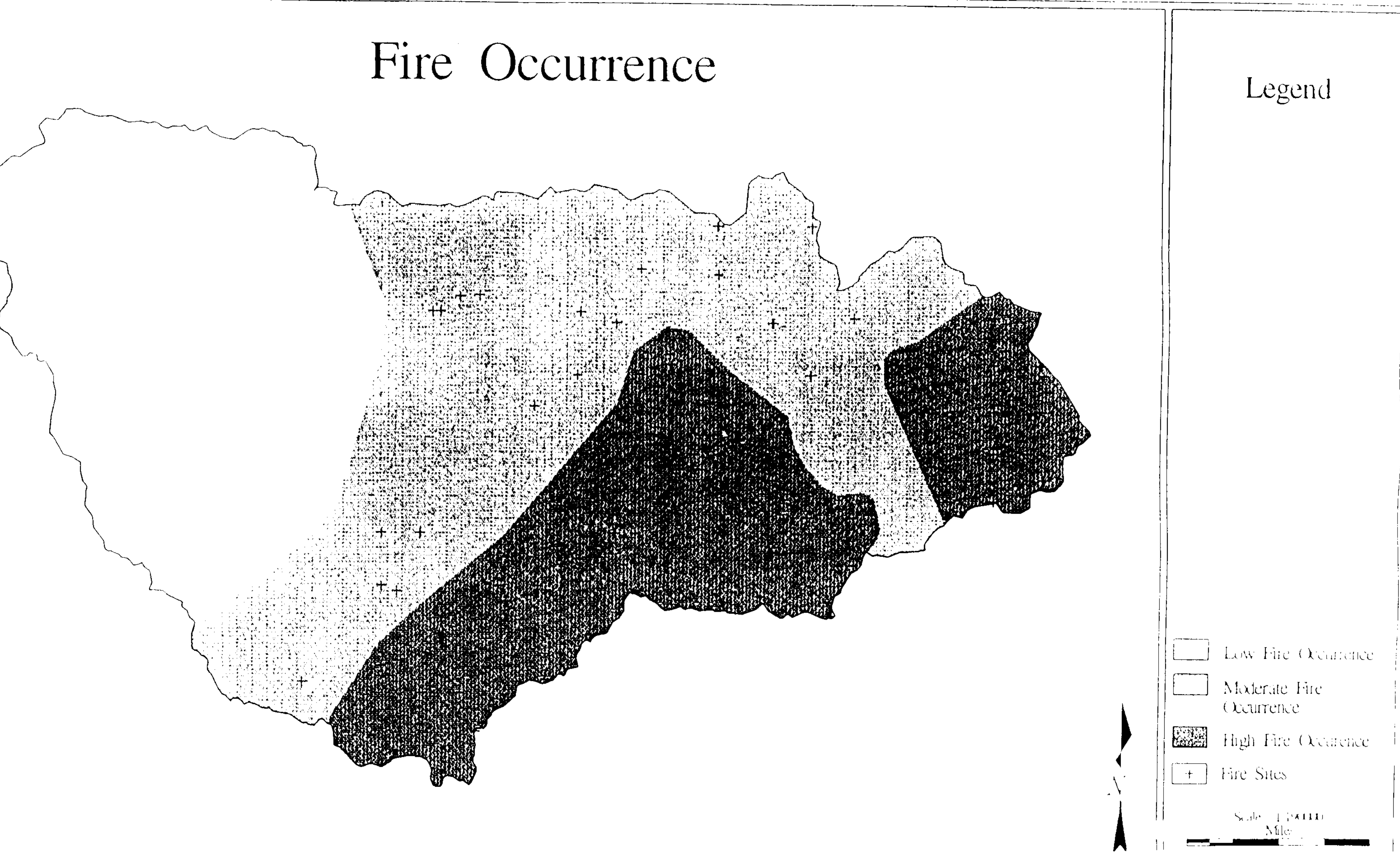
Size Class	Annual Frequency	Period Frequency
0-1/4 acre	12.4	1488
1/4-10 acres	4.4	528
10 + acres	1.2	144

Table 3. Probacre outputs

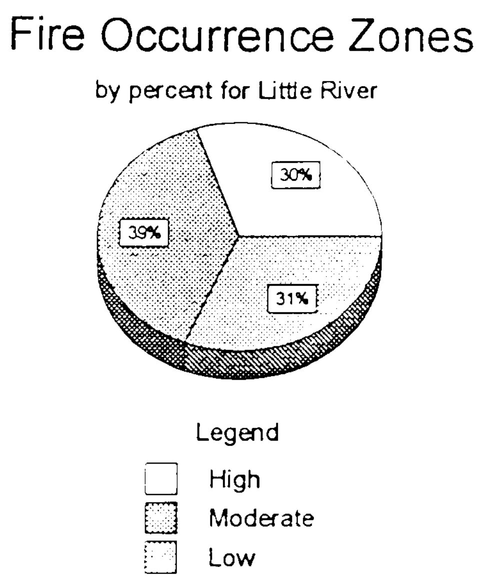
Acre Threshold	Period Length	Probability
16,500 acres	120 years	100%
66,000 acres	120 years	.20%
132,000	120 years	.20%

Probabilities for a 50 year period were also calculated. The same acre thresholds identified above with all inputs the same came up with a .012% chance of occurrence.

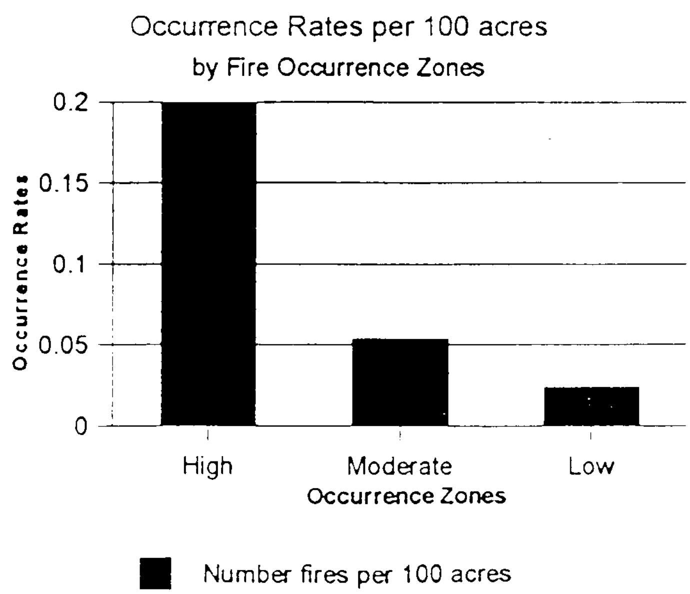
MAP 1


Fire Occurrence
Legend
Low Fire Occurrence
Moderate Fire Occurrence
High Fire Occurrence
Fire Sites
Mile

Graph 1. Percent of Occurrence Zones within the Little River Watershed



Graph 2. Rate of Fire Occurrence for 100 acres by Occurrence Zones



Land Units and Fire Effects Considerations for the Reference Period

Moist/Cool

The majority of this land unit is in areas that have gentle to moderate sloping ground. This has direct effects on the fire intensities the areas experience. High intensity stand replacement fire would not be the norm for these sites it would take extreme conditions to bring this type of fire behavior. However fires effects in general would infrequently visit these sites. When ignitions occur the low intensity fires do not cover large areas and the high intensity fires would have to be associated with extreme conditions. The fire effects associated with these areas are two fold. Their juxtaposition on the landscape to areas of more intense fire activity would effect the amount of edge associated with these stands. The effects in the stand itself would produce multiple layers of vegetation, some of the oldest overstory trees with an understory of shade tolerant, fire intolerant species. These sites are more likely to display the full range of stand characteristics associated with old growth forest. The Hemlock Lake area is an example.

The openings found within this land unit are larger than normal and are related to high water tables or soil conditions. These openings are not solely dependant on fire. Yellow Jacket Glade and Willow Flat are examples. Smaller openings present are a result of a successional process described as shifting gap.

Wet/Dry, Warm

These sites are present with predominately gentle slopes. There has been extensive stump surveys for fire evidence in portions of these areas. There are numerous scars from past fires present in on the stumps.

When ignitions occurred they burned with a low intensity yet cover large areas. The warm/dry parts have mature stands. These stands are simple in structure, two layers. The overstory and understory composition have fire tolerant species present. The stand structure lacks some of the typical old growth characteristics such as large woody debris, small openings and thick duff. Natural openings do not occur frequently. The wet/warm portions might act as fire breaks and slow the spread or contain the fire. The stand structure for these inclusions carry more old growth elements. The species composition includes moist site species that are more adapted to fire with age and bark thickness. Fire intolerant species are present in the understory for time intervals that are determined by the intervening disturbance patterns.

Warm/Moist

These areas have limited openings associated with them. The openings that do occur are typically small and are due to high intensity fire. These openings would be transitory on the landscape over periods of time determined by growth rates for the sites and disturbance patterns. The slopes are mainly moderate to gentle. Intense fire behavior would be attributed to fuel accumulation, slopes approaching 60% or extreme weather conditions.

Low to moderate intensity fire shapes the stand structure. Two storied or single storied stands are the norm . The simplified structure is due to frequent fire that cleaned out understory vegetation. The makeup of the stand is fire tolerant species in the overstory with shade tolerant species in the understory that are present for short periods of time. The fire intensity is related to fuel accumulation and slope position. Steeper slopes experience higher overstory mortality in the upper slope position. Moderate slopes have less mortality and more open stands. The gentle slopes have park like stands present. The mature successional stage would be prolonged in most locations. The frequent fires slow the successional progress towards old growth.

The excellent productivity of these sites would make them accumulate fuel at a faster rate than other sites. This growth is what allows for frequent fires of a moderate intensity. These would be areas to look at for accumulations that would be outside of the natural range in the present .

Dry/Warm

This area is composed of moderate and steep slopes. There are frequent small openings present. These openings are associated with the upper position of the steep slopes and are areas of stand replacement fire. The natural openings associated with this land unit are very transitory on the landscape.

When ignitions occur they are very likely to result in a moderate intensity fire that covers a large area. The intensity is directly related to slope since available fuel would be limited. The progress from an early seral stage to a mature stage is slow due to site conditions and frequent fire. These sites will rarely support stands with old growth features. The stand structure would be open with little litter or large wood accumulation. The understory (possibly overstory also) would have a large hardwood component. The overstory would be dominated by conifers that are adapted to fire. Species that are not adapted to fire would be present in the riparian areas and the lower portions of the slopes.

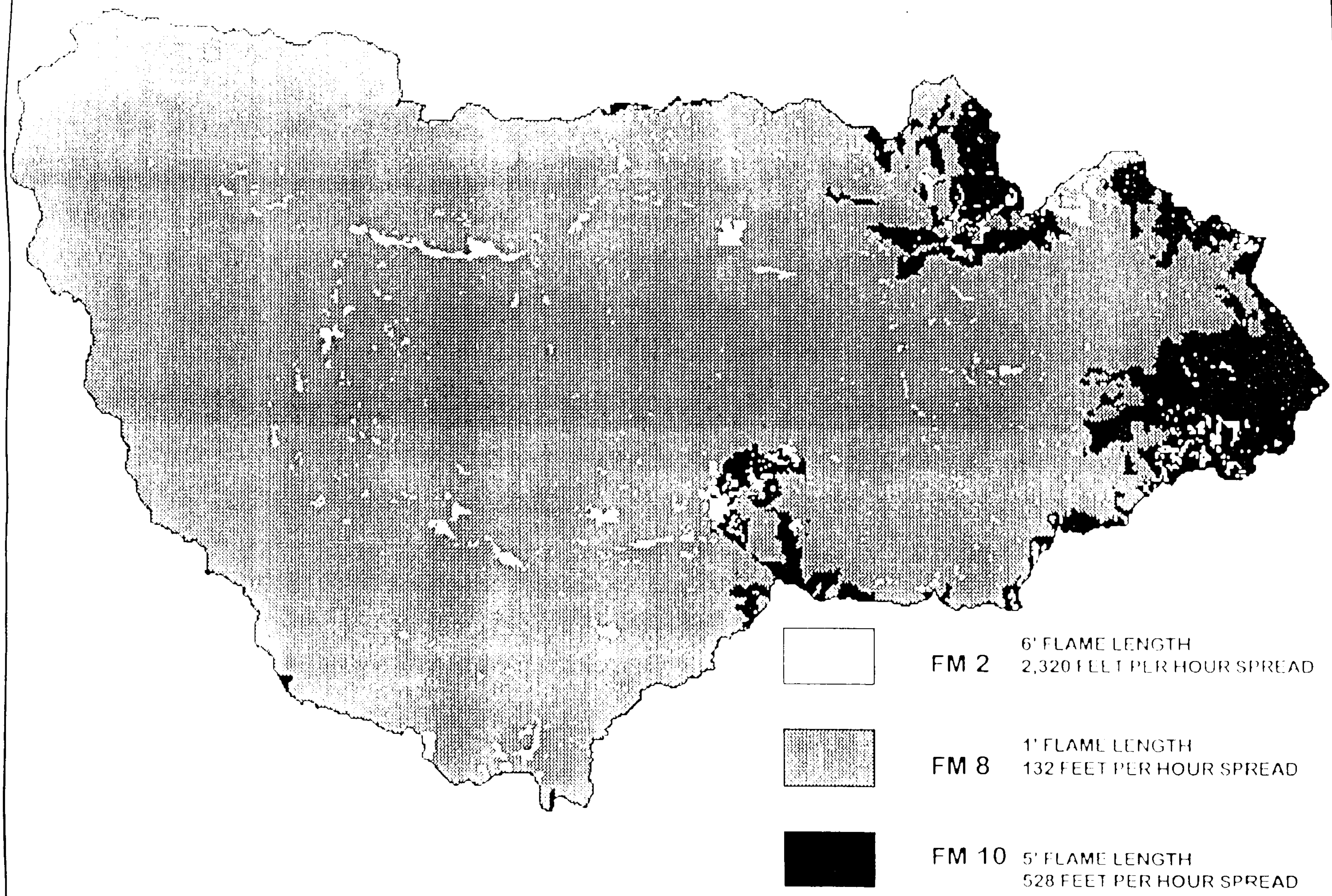
The fuel models for the landscape were mapped using the land unit information and seral structure. The existing condition had more detailed information on seral structure in the form of Brown's structure classes. The reference period only had early, mid and late for seral stages available. The fuel model interpretations were based on expected fire behavior in the vegetation classifications within the specific land units. Table 4 summarizes the stratification used for the reference period and table 5 addresses the existing condition.

Table 4. Reference Condition Fuel Model Stratification for Little River

STRUCTURE	**LAND UNIT**	**FUEL MODEL** *NFFL Fire Behavior Fuel Models*	**FUEL LOADS** *0-1/4" size class, dead and down, tons/acre*	***FIRE INTENSITY** *Flame Length, feet Rate of Spread, ch/hr*
Early	all	FM 2	2.0	6.0 feet 35 ch/hr
Mid	all	FM 8	1.5	1.0 feet 2 ch/hr
Late	wet/dry,warm	FM 8	1.5	1.0 feet 2 ch/hr
	moist/warm			
	dry/warm			
Late	moist/cool	FM 10	5.0 live&dead	5.0 feet 8 ch/hr

**Fire intensities based on dead fuel moisture content of 8%, live fuel moisture 100% and windspeed at 5 mi/hr.*

REFERENCE CONDITION - FIRE BEHAVIOR FUEL MODELS



MAP 3

EXISTING FIRE BEHAVIOR FUEL MODELS

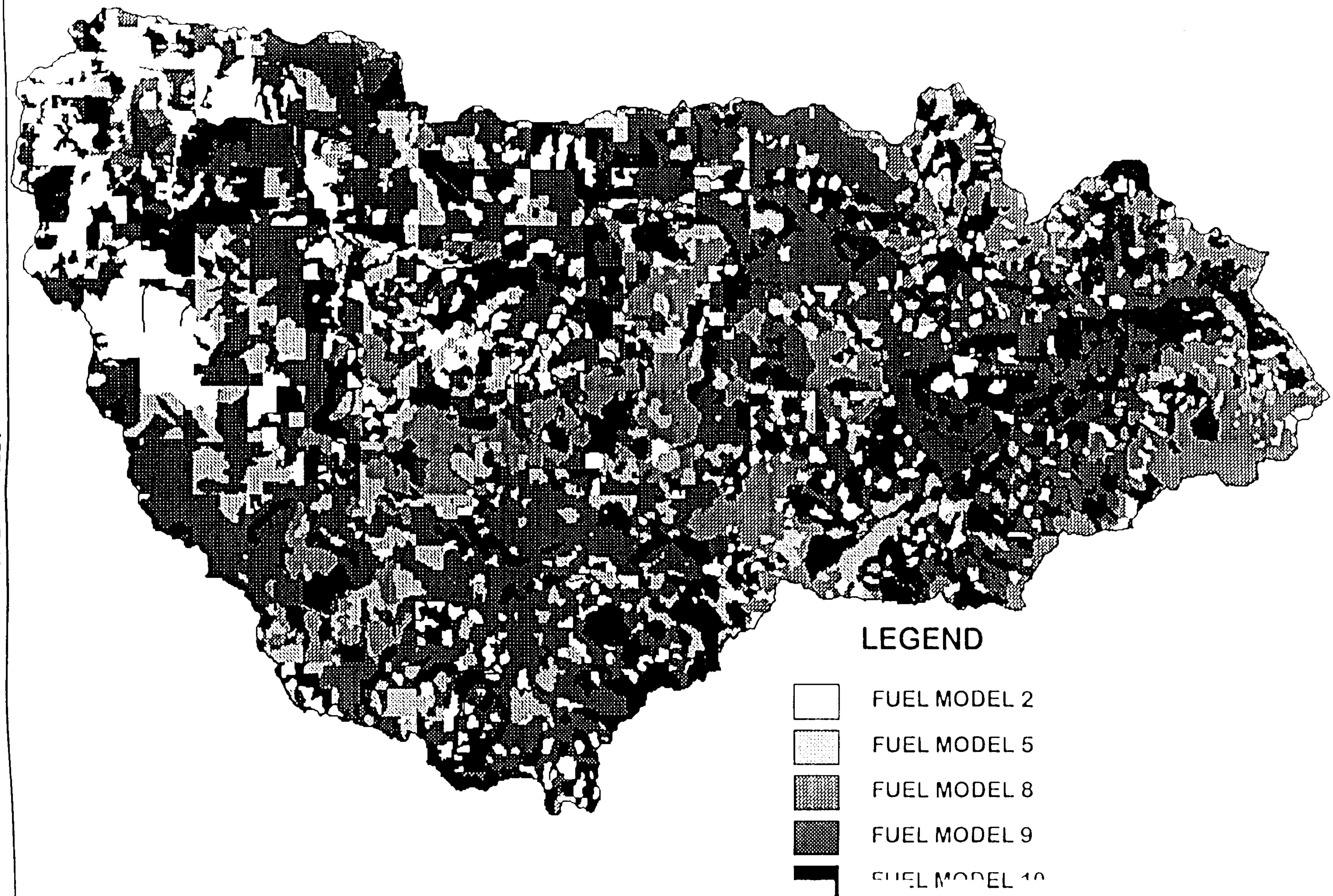


Table 5 Existing Condition Fuel Model Stratification for Little River

STRUCTURE	**LAND UNIT**	**FUEL MODEL** *NFFL Fire Behavior Fuel Models*	**FUEL LOADS** *0-1/4" size class, dead and down, tons/acre*	***FIRE INTENSITY** *Flame Length, feet Rate of Spread, ch/hr*
Grass/Forb	all	FM 2	2.0	6.0 feet 35 ch/hr
Shrub (Seed/Sapling)	all	FM 5	1.0	4.0 feet 18 ch/hr
Open Sapling/Pole	wet/dry,warm moist/cool	FM 8	1.5	1.0 feet 2 ch/hr
Open Sapling/Pole	moist/warm dry/warm	FM 9	2.9	3.0 feet 8 ch/hr
Closed Sapling/Pole	wet/dry,warm moist/cool	FM 8	1.5	1.0 feet 2 ch/hr
Closed Sapling/Pole	dry/warm moist/warm	FM 10	5.0 live&dead	5.0 feet 8 ch/hr
Mature	wet/dry,warm moist/cool	FM8	1.5	1.0 feet 2 ch/hr
Mature	dry/warm moist/warm	FM9	2.9	3.0 feet 8ch/hr
Old Growth	wet/dry,warm moist/cool	FM 8	1.5	1.0 feet 2 ch/hr
Old Growth	moist/warm dry/warm	FM 10	5.0 live&dead	5.0 feet 8 ch/hr

**Fire intensities based on dead fuel moisture content of 8%, live fuel moisture 100% and windspeed at 5 mi/hr*

Fuel Modeling Assumptions

Fire Behavior Fuel Models were used to describe the fuel condition for the watershed. The conditions they represent are summarized below;

Fuel Model 2 represents a fuel condition dominated by grass. The grass is the main fire carrier and is generally less than two feet in height.

Fuel Model 5 is a shrub model. Early regeneration areas are well represented with this fuel model. The main fire carrier is surface fuel. The surface fuel consists of litter cast from shrubs and grasses or forbs in the understory.

Fuel Model 8 is a timber stand that has little downed wood present. Closed canopy stands of short needle conifers support fire in the compact litter layer. The litter consists mainly of needles, leaves and some twigs. Limited undergrowth is present in the stands.

Fuel Model 9 is also of the timber group. This model represents stands that are collecting more dead and down woody material than a fuel model eight. The expected fire behavior is different from that expected in a fuel model eight or ten. This is due to the concentration of woody material that can contribute to possible torching, spotting and crowning. The accumulations are in concentrations within the stands and not spread throughout the timber stand as in a fuel model ten.

Fuel Model 10 represents the timber stands that have the greatest amounts of dead and down woody accumulations. A greater quantity of three inch or larger limbwood due to over maturity of the stand is indicative of a fuel model ten. This results in more frequent torching of individual trees, spotting and crowning. This type of fire behavior can create potential fire control problems.

('Aids to Determining Fuel Models for Estimating Fire Behavior', General Technical Report INT-122, 1982)

Air Quality

Air quality standards are administered in cooperation with the State of Oregon through the Oregon Smoke Management Plan Federal Clean Air Act regulations also govern management activities. Most air quality issues on the Umpqua National Forest and Roseburg BLM District deal with smoke emissions from prescribed burning related to forest management activities Smoke emissions from prescribed fire continue to decline in FY 93 and 94 because the majority of acres were burned under cool spring conditions and fewer acres were burned Estimated particulate emissions were 88 percent below the target levels set with the State of Oregon.

Diamond Peak Wilderness and Crater Lake National Park are the closest Class I airsheds Class II airsheds exist in Boulder Creek, Mt Thielsen and Rogue-Umpqua Divide Wilderness Areas Community airsheds in the Willamette Valley, greater Roseburg and Oakridge are also monitored for smoke intrusion from forest practices. There have been no intrusions into these designated areas for the past 8 years. Aerial smoke monitoring is conducted for the Forest Service and BLM by Douglas Fire Protective Association.

Historic records show that smoke levels from forest management activities today are much lower than the natural levels resulting from uncontrolled wildfires common in the 1800s. This means that the air today has lower particulate levels from forest fire smoke in summer months than when western Oregon was settled in the mid-1800s

This information is documented in the 'Umpqua National Forest Monitoring and Evaluation Report for FY93 and FY94'

Little River Adaptive Management Area: Insect and Disease Considerations

Don Goheen Entomologist/Plant Pathologist
Southwest Oregon Forest Insect and Disease Technical Center

INSECTS

1) Currently, mountain pine beetles (Dendroctonus ponderosae) are causing substantial amounts of mortality of sugar pines and western white pines throughout Southwest Oregon. Beetle-caused mortality is quite noticeable in most five-needle pine stands in the Little River AMA. Like other bark beetles, mountain pine beetles rarely infest healthy vigorous trees. Rather, they prefer or are most successful on trees that are under some degree of stress. Diseased or wounded sugar pines and western white pines are predisposed to attack, but healthy-appearing pines in heavily stocked stands where competition for water is a weakening factor are also highly vulnerable. Heavy stocking should be a particular concern in the AMA. In general, sugar pines and western white pines growing in stands with basal areas of 140 square feet per acre or more are at high risk of mountain pine beetle attack. Most stands in the Little River AMA appear to have basal areas of 200 square feet per acre or greater. Large (14 inch DBH +), old (140 years old +) trees are particularly prone to infestation in overstocked stands, and beetle activity is most evident on these hosts during droughty periods when moisture competition is especially intense. The past 9 years of much drier than normal weather have contributed to accelerating beetle activity. Mountain pine beetle infestation of sugar pines and western white pines can be largely prevented by promoting tree health and, especially, by reducing stand densities in high risk areas. Entire stands can be thinned or areas directly around large trees with still-healthy- appearing crowns can be cleared. Any amount of thinning will be beneficial to the trees, but, if it is desired to really minimize beetle activity, it is recommended that basal area be reduced sufficiently so that it will not increase to 140 square feet per acre before the next treatment opportunity. When clearing around individual large trees, preferred treatment would involve removing all competitors (including large and small conifers, hardwoods, and shrubs) from under each tree and an area extending at least 10 feet beyond the drip-line of its crown. Treatments suggested should mimic the effects of the ground fires that regulated stocking in historic stands. In the absence of treatments, the future prognosis for five-needle pines in the AMA, particularly the large old ones, is not good.

2) Mountain pine beetles, western pine beetles (D. brevicomis), and pine engraver beetles (Ips spp.) are causing extensive mortality of ponderosa pines in drier parts of Southwest Oregon. In the Little River AMA, ponderosa pines are currently not being impacted by bark beetles to nearly the degree that ponderosa pines further south are. So far, they are also faring much better than the five-needle pines. However, the potential for future beetle activity in ponderosa pines in the AMA is great. The major factor that predisposes ponderosa pines to infestation by either mountain or western pine beetles is overstocking. On good sites like those in the Little River AMA, ponderosa pines become vulnerable to beetle infestation when basal areas exceed 180

square feet per acre. Unfortunately, most stands in the AMA with ponderosa pine components have basal areas of 200 square feet per acre or more. As in stands with five-needle pines in the AMA, density reduction treatments would be extremely beneficial in areas where retention of ponderosa pines is desired. Either thinning entire stands or clearing areas directly around individual pines would be appropriate treatments. Slash treatment should be considered in any thinnings since pine engraver beetles can build up populations in large pieces of slash (3 inch diameter or greater), emerge, and attack nearby ponderosa pines. Pine engravers kill small trees and cause top mortality of large trees. To prevent pine engraver build-ups, large diameter slash generated in thinning should either be destroyed or scattered in areas exposed to the sun. It should never be piled in the shade. In the absence of density reduction treatments, the probability of substantial future beetle-caused mortality of ponderosa pine in the Little River AMA is high. Opportunities to apply proactive treatments should not be missed.

3) Douglas-fir beetles (D. pseudotsugae) can cause substantial mortality of Douglas-fir in Southwest Oregon. Stands on the Little River AMA have not suffered significant impacts from Douglas-fir beetles in recent decades, but stands in nearby areas on the Umpqua National Forest have. Douglas-fir beetles prefer very low vigor hosts. When in endemic populations, they infest windthrown, root-diseased, or severely injured Douglas-firs. Episodic outbreaks occur, however, when large amounts of preferred host material becomes available, beetles successfully produce large broods, and epidemic populations emerge and attack standing, green trees. This usually happens after major storms have caused substantial amounts of windthrow (especially for 2 years or more in a row). Outbreaks subside rapidly (usually in 2 to 3 years), but many trees can be killed, often in groups, before beetle populations return to normal. Concern about Douglas-fir beetles should be triggered whenever windstorms cause large amounts of windthrow in the AMA. The threshold for considering action should be when 4 or more Douglas-firs per acre of 10 inch diameter or greater are blown down. Outbreaks can be prevented by removing windthrown trees before April of the year following that in which they are blown over. Douglas-fir beetle populations may also build up in trees injured in large fires. Outbreaks usually do not develop in this kind of situation, though, unless beetle populations are already high in the year of the fire.

DISEASES

1) White pine blister rust, caused by the fungus Cronartium ribicola, causes substantial damage to 5-needle pines throughout the Northwest. It is common in sugar pine and western white pine stands in the Little River AMA. The pathogen girdles and kills branches, tops, and stems. Saplings and poles are frequently killed outright by blister rust; larger trees are damaged and in some cases predisposed to attack by mountain pine beetles. C. ribicola has a complex life cycle with 5 different spore stages. Two occur on pines and 3 on alternate hosts in the genus Ribes. Infection on both hosts is greatly favored by moist conditions at the time of spore production, especially in summer and fall. C. ribicola is believed to be native to Asia. It was introduced into western North America in 1910 and spread rapidly in natural stands where there was little resistance to the fungus. Early attempts to control the disease by eliminating the alternate host

were singularly unsuccessful. Today, deployment of screened and tested resistant pine nursery stock is the most promising control strategy. Pruning and thinning treatments in young stands may also help minimize disease impacts by removing sites for infection, by eliminating already-existing branch infections before they can spread to the main stem, and by altering the microclimate to make it drier and less favorable for the blister rust fungus. In the Little River AMA, if maintenance of 5-needle pines is important, a program that combines planting resistant stock from the Dorena tree Improvement Program and other blister rust treatments with thinning prescriptions to minimize mountain pine beetle infestation is in order.

2) Laminated root rot (caused by the fungus Phellinus weirii) is the most common and widely distributed root disease in the Pacific Northwest. It is estimated to occur on 7 to 10 percent of the area occupied by host types in western Oregon. The disease is found in the Little River AMA but at much lower levels than in many surrounding areas. It appears that the disease occurs on less than 1 percent of the area in the AMA and is distributed in small, widely scattered pockets. Laminated root rot is a disease of the site. The causal fungus survives for long time periods (50 years or more) in roots of infected snags and stumps. It infects new hosts established on the site via root contacts. Subsequently, it spreads across root systems to adjacent hosts forming gradually expanding infection centers. The pathogen spreads at a rate of about one foot per year. Within infection centers, the disease preferentially kills highly susceptible hosts (Douglas-fir, true firs, mountain hemlock) creating openings in stands where less susceptible conifers (western hemlock, pines, cedars) and immune hardwood trees and shrubs are favored. It acts as an agent for diversity that either advances succession or resets it to earlier seral stages depending on proximity of individual disease-created openings to seed sources or vegetative propagules of climax or seral species. Concern about laminated root rot should be related to extent and intensity of the disease in an area and to management objectives. Where the disease is widely distributed and severe and where timber production is the major management objective, active management of the disease by removing susceptible hosts from infection centers and 50 foot buffers and replanting the diseased areas with less damage-prone tree species is in order. Where the disease is not intense and wildlife habitat, visual quality, or watershed protection are the major management objectives, laminated root rot may be considered innocuous or even beneficial. Effects of the disease such as openings in stands, areas of species diversity, and groups of dead and down trees are often quite desirable if not too extensive. In such situations, the disease should be monitored but not treated. The two scenarios described represent opposite ends of a continuum. Situations between those described may require intermediate levels or kinds of treatment. Fortunately, in the Little River AMA, the small amount of laminated root rot present makes treatment needs minimal.

3) Black stain root disease (caused by the fungus Leptographium wageneri var. pseudotsuga) is especially common in Southwest Oregon Douglas-fir plantations. Surveys on the Siskiyou National Forest and the Medford and Coos Bay BLM Districts indicate that the disease occurs in about 25 percent of all plantations between 10 and 30-years old in those areas and causes extensive mortality in some situations. Black stain occurs in the Little River AMA but, to date, appears to be less common and causes much less mortality there than in areas further west or

further south. Black stain root disease is a vascular-wilt type disease that kills its host by blocking water conducting vessels. It is vectored over long distances by root-feeding bark beetles and weevils. New infection centers appear in areas with compacted soils or numerous wounded trees reflecting vector preference for stressed trees. Once established, the disease creates rather rapidly expanding infection centers. The causal fungus spreads across closely associated root systems at a rate of 3 to 6 feet per year. Tree mortality due to black stain subsides dramatically when stands reached ages of 30 to 35 years. In the Little River AMA, efforts to prevent establishment of new black stain root disease centers by avoiding creation of conditions favorable for the insect vectors are in order. Keeping the disease from intensifying beyond its current low level in the AMA is a good goal. Site disturbance should be minimized, tractor logging and associated soil compaction should be carefully regulated or avoided, efforts should be taken to avoid wounding of young Douglas-firs during harvest operations, road building, and road maintenance, and precommercial thinning operations should be done between June 1 and September 30 when possible. Such measures would be particularly worthwhile in areas within 1 mile of already existing black stain centers.

4) Fungi that cause stem decay of wood in living conifers are widely distributed in all Pacific Northwest forests. Many species of fungi are involved but those that have the greatest effects in Southwest Oregon are Heterobasidion annosum, Phellinus pini, Echinodontium tinctorium, and Phaeolus schweinitzii. In the Little River AMA, there are two main concerns with stem decays: a) older (150 year +), non resinous conifers (especially western hemlock and true firs) are greatly affected by decay organisms. Management regimes that favor these late seral species will foster substantial amounts of decay, especially if stands are managed for long rotations and if intermediate entries resulting in tree wounding are made. As stands of this type age, decay will cause considerable stem breakage, growth impacts, and loss of wood. This may or may not be desirable depending on management objectives; b) amounts of decay that may develop in intensively managed, young Douglas-fir stands, especially those that are treated with heavy machinery have not been well documented for the area. An evaluation to determine affects of stem wounding and root and root crown damage associated with machine thinning and ripping old skid trails in young Douglas-fir stands in the AMA should be done. The SWOFIDTC is willing to cooperate on such a project.

5) Hemlock dwarf mistletoe (Arceuthobium tsugense) is the only dwarf mistletoe that is widely distributed in Westside stands in most of the Pacific Northwest. It is common in the Little River AMA. It mainly affects western hemlock, though true firs are also hosts on occasion. Hemlock dwarf mistletoe causes decreased growth, formation of witches' brooms, stem malformations, top and branch dieback, and tree mortality. Hemlock dwarf mistletoe generally does not have as severe impacts on its host as do many other dwarf mistletoes. Nevertheless, effects can be very significant on heavily infected, old trees (those with Hawksworth DMRs of 4-6 that are over 150 years old). Young trees may also be severely impacted if they have numerous infections in their very tops. Where hemlock dwarf mistletoe is severe, it, along with stem decays, contributes to a "pathological rotation" for western hemlock by causing substantial decline and mortality of old infected trees. Where timber production is the major objective, hemlock dwarf mistletoe can be

eliminated via regeneration harvest, non-hosts can be favored, or infected stands can be managed on short rotations (40 to 120 years). Where there are multiple management objectives including promotion of wildlife habitat, some level of dwarf mistletoe infection may be desired or at least accepted. In this situation mistletoe represents a significant planning challenge. How can stands be managed so that some mistletoe is maintained but not so much that long term impacts are too severe? Some combination of treatments will probably have to be used. Prescriptions that promote non-hosts, make use of strategically placed group selection cuts, and that maintain low levels of infection in even-age stand components may hold promise.

APPENDIX C

Appendix C
Vegetation and Silviculture/Timber Analysis

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Table #1: Acres of Regeneration Harvest by Administrative Unit*

Regeneration harvest by Administrative Unit						
	Acres by Admin.	% regen. harvest by Admin	Acres of regen. harvest	% of regen. harvest total (75623 ac)	Acres of tractor harvest	% of regen. harvest by Admin by tractor
FS	63575	37%	23489	31%	6853	29%
BLM	19802	55%	10863	14%	1313	12%
PVT >40	44795	87%	39182	52%	27147	69%
Total Acres	128172		73534 (57%)		35300 (27%)	

* includes Industrial land base and private holdings >= 40 acres size
* includes FS O&C (7,829 acres) and BLM O&C (10,735 acres)
* for BLM harvest records: regeneration harvest = a stand birth year >= 1920
* PVT <40 totals not included: 2,089 acres of regeneration harvest of 3681 total acres

Table #2 Total tractor harvest by Vicinity:

Total tractor harvest in acres the Little River A.M.A.				
Vicinity	Tractor	Cable & Tractor	Total Tractor	Vicinity Size
Black/Clover	1296	167	1463	17057
Cavitt	11859	201	12060	37693
Emile	1941	0	1941	8716
Lower LR	7273	0	7273	21835
Middle LR	5020	229	5249	21636
Upper LR	1082	0	1082	10405
Wolf Plateau	4912	1319	6231	14512
Total	33383	1917	35300	131853
Percent	94.57%	5.43%	100%	
Percent of total	25.32%	1.45%	26.77%	100%

Table #3 Tractor Harvest by Land Unit

Acres of Tractor Harvest by land Unit			
Land Unit	Tractor	Cable/Tractor	Combined
dry/warm	12965	351	13316
moist/warm	9990	804	10794
moist/cool	2355	0	2355
wet-dry/warm	8073	762	8835
Totals	33383	1917	35300

Findings, Trends and Opportunities

Companion findings, trends and recommendations are listed in Chapter 6.

1) Major findings:

* Root disease impacts from laminated root rot and black stain root disease have abnormally low incidence in the AMA (Goheen 1995) at less than 1% average cover. It is estimated that disease incidence at levels less than 5% will not appreciably impact intensive forestry schedules.

* If the maintenance of historical cover of sugar and white pine is important, a combination of planting resistant stock, other blister rust treatments, and thinning prescriptions to minimize competition and mountain pine beetle infestation is in order (Goheen 1995). Blister rust has had the most impact to the white pine populations and initial efforts in stopping that impact can be found in the moist/cool and moist/warm land units.

* Trees of all ages and types have shown the ability to respond to thinning treatments within the Little River drainage. A key factor in this statement is the amount of live crown ratio existing on residual stems. It appears that live crowns >35% are critical for attaining thinning responses. Ages did not seem to be a prime factor as stems 20, 40, 70, 110 and 170+ years of age exhibited increased growth rates consistent with their age classes when density has been reduced. These patterns are evident in all land units.

* Light levels necessary to regenerate sugar pine and Douglas-fir can be attained with

thinning and group selection treatments. Control of shade-tolerant species ingrowth and associative high shrub densities are key to securing needed growing space. Sugar pine is mainly located within the dry/warm and moist/warm land units, but also occurs in the wet-dry/warm land unit.

* Sugar pine diameter ranges seen in stands approximately 100 years of age averaged between 24-40" d.b.h. compared to Douglas-fir stems within the same stands which averaged 14-24" d.b.h. (Baumann 1995, white papers on file).

2. Major Trends:

* Harvest patterns indicate that approximately 47,000 acres of private and federally managed lands were harvested prior to 1970; commercial harvest opportunities will soon be available over large areas of the watershed, particularly in the lower Little River, Wolf Plateau and Cavitt creek vicinities.

* Harvest since 1980 in the watershed has totalled over 11,000 acres on public land and these sites are, or will soon be, in need of precommercial thinning. Funding for these activities has been *reduced* over the last few years and will need to be restored to accomplish these needs and to avoid both *new backlog totals* and concurrent forest density problems. In the 1970's and 1980's, public land agencies have dealt with backlog reforestation and timber stand improvement activities so this would be a reoccurring trend but one that is not desirable.

* Grazing allotments were historically used in the watershed, but recent history has seen allocation use drop to non-use levels, with that trend expected to continue.

* Fertilization activities reached a peak level in the late 1980's, particularly within Wolf Plateau and the middle and upper Little River vicinities. Release activities with herbicide peaked in the 1970's on public lands, and has maintained a low-use rate since 1983. It is unknown what utilization these treatments have had in the past or will be given in the future by private industry.

3. Other opportunities:

* Emphasize treatments on *landscape scales of all sizes* including fine-scale one tree length openings and coarse-scale manipulations covering hundreds to thousands of acres.

* Utilize the *Silviculture by Land Unit* section as reference material for general site guidelines when planning activities in certain land units.

* Resting surface areas of above and below-ground biotic communities should be considered for portions of the landscape. This can occur even during harvest activities by keeping intact surface logs in their locations on the forest floor during and after disturbance.

* Monitoring of spring burning should be expanded to include viability of wildlife habitat for neotropical birds, reptiles, and small mammals.

* *Interagency activities* like inventory, data collection and storage, and resource activities should be encouraged.

* *Partnership activities with private landowners* (timber, recreation, wildlife, fisheries, and fuels projects) should be encouraged.

* Alternative harvest techniques, including horse logging, should also be encouraged.

* Attempt new ideas like establishing harvest sorting and auction yards. New ideas in marketing firewood for disabled individuals could include special distribution areas and access opportunities. Specific hardwood sites could be established for permanent firewood collection sites for the general public.

Stand priority lists for Silvicultural activities

1) Stands in the White Creek area:

Stand (exam #)	Main considerations
86117- 145 acres	Streams with low vegetation cover
86141- 35 acres	low growth, poor crowns and vigor
86355- 136 acres	Height/diameters; riparian cover
86118- 157 acres	density and blowdown pockets
88014- 111 acres	compaction; stream channels
87466- 23 acres	density and height/diameters
89108- 56 acres	diversity, growth, crown ratios
86349- 47 acres	diversity, growth, crown ratios
88017- 75 acres	diversity, growth, crown ratios
87347- 74 acres	diversity, growth, crown ratios
86353- 14 acres	diversity, growth, crown ratios
86352- 13 acres	diversity, growth, crown ratios
88015- 78 acres	diversity, growth, crown ratios
86354- 78 acres	diversity, growth, crown ratios
86116- 146 acres	diversity, growth, crown ratios

Totals: **1188 acres**

2) Lowest measured young stand growth rate sites:

Stand exam #	BH age (When examined)	KD	ASD	CTPA	GRW
87456	21	96	5.74	350	.18
89135	15	113	4.81	171	.28
89137	15	100	5.00	113	.29
89143	17	84	6.61	250	.30
89152	15	100	3.61	273	.25
89158	15	94	4.55	179	.28
89161	18	82	6.75	109	.30
89162	17	62	4.35	234	.17
89166	15	86	3.77	184	.28
89169	14	102	5.06	133	.30
89172	14	128	4.49	375	.28
89176	15	76	3.41	123	.26
89178	14	94	4.51	156	.30
90242	13	108	4.50	253	.29
90244	11	100	4.11	267	.29
90258	11	108	4.26	229	.30
91420	22	120	7.68	400	.28
92484	14	82	4.25	133	.30
92492	13	102	3.84	233	.28

* BH= breast height (4.5'); KD= King's-Douglas 50-yr. site index; ASD= Average stand diameter; CTPA= crop trees per acre; GRW= annual diamer growth

Monitoring and Research needs

* Please refer to the terrestrial team recommendations for monitoring and research.

Structure Stage Development by Land Unit for Douglas-fir

* This development table depicts average dominant Douglas-fir growth for each of the land units. These are averages and represent conservative rates based on management prescriptions developed for the land units with average stocking levels. The numbers reflect data taken from the Western Cascades geologic province from field examinations of young, mature and old-growth forests. The data is supported by projections run in Prognosis adjusted for site class variance within each land unit under a thinning regime that maintains stocking levels within 25-50% of maximum (see Silviculture by land unit section and the young growth yield tables # 5-7)

Douglas-fir is modeled to represent all the land unit types to keep analysis consistent. This table does not increase growth by including a fertilization schedule nor does it decrease growth for deductions from harvest site impacts such as potential compaction. The table reflects total stand age and not breast height age.

The first column in the table depicts the length of time necessary for a planted seedling to reach 4.5 feet tall (or breast height age of 1).

Table #4 Structure stage development

DOUGLAS-FIR STRUCTURE STAGE DEVELOPMENT BY LAND UNIT											
W. Cascades Province Land Unit.	Grw	Age Range	Grw	Age Range	Grw	Age Range	Grw	Age Range	Grw	Age Range	Age
Moist/Cool	4.5'	0-15	40/20	15-25	35/20	25-45	27/20	45-75	15/20	75-141	141+
Moist/Warm	4.5'	0-10	40/20	10-20	46/20	20-35	32/20	35-60	19/20	60-112	112+
Dry/Warm	4.5'	0-12	31/20	12-25	26/20	25-52	13/20	52-112	17/20	112-172	172+
Wet-dry/warm	4.5'	0-11	40/20	11-21	41/20	21-38	36/20	38-60	24/20	60-102	102+
	DBH.	0-1"		1-5"		5-12"		12-20"		20-30"	30+"
	grass-forb		*shrub*		*open pole*		*closed pole*		*mature forest*		*old growth*

The stages of structure development as used by Brown(1985) are listed to portray associated time frames for successional stages for each of the land units.

Recommendations of Silviculture strategies for Land Units

Dry/Warm land unit

Site Characteristics:

- Growth limited by competition for water and by heat stress
- Succession through stages is slower than moist sites
- Regeneration is affected by more severe environments
- Regeneration conditions harsh for both planted and natural regeneration
- Mature forests develop slower but then sustain good growth
- Shrub fields common in early seral stages
- Very diverse species of trees, forbs and shrubs

Preharvest considerations:

- Identify strategies for decreasing competition from shrubs and grasses
- Observe stand density and spacing distributions

Silvicultural Systems:

- Small patch cuts adjusting size to species needs
- Two-story stands with patchy group openings included
- Single-story stands for shade- intolerant species

Regeneration:

Planted species: Douglas-fir, sugar pine, incense-cedar
Natural species: white fir, bigleaf maple, Oregon white oak, Douglas-fir
: Pacific madrone, golden chinquapin, sugar pine, incense-cedar
Genetic stock: sugar pine resistant (for blister rust)

Early stand treatments:

Pruning: lifting in a series to 10 feet for sugar pine to help resist blister rust
Release: manual release where shrub, grass densities high

Precommercial thinning: vary densities and tree distribution

Douglas-fir guidelines @ 14x14 foot spacing
Sugar pine guidelines @ 20x20 foot spacing (or 18x18)
True fir and hemlock @ 12x12 spacing or clumped distribution

Managed stand densities:

Basal area ranges: 120-190 sq.ft. vary by aspect with more on N &E aspects

Additional site recommendations:

Live crown ratios (LCR's): Maintain at 40-60%..ave. 50%
Ponderosa pine communities: keep <180 sq.ft.. basal areas
Sugar pine communities: keep <140 sq.ft.. basal areas
Height diameter ratios: maintain ranges @ 60-80

Wet-Dry/Warm Land Unit

Site Characteristics:

Very productive sites but limited in microsites- heat and moisture limitations
Sites are warm, but the forest floor is generally cool and damp
Higher water tables with western redcedar habitat
Both low and high shrub cover alternately expressed
Tends to link different land units and seral stages together with a relatively stable yet diverse environment
There are many tree species and high stem densities

Preharvest considerations:

Consider western redcedar shallow roots characteristic of the species
Limit heavy equipment operation in vicinity of redcedar

Silvicultural Systems:

Silvicultural systems with single and two-story stands
Small group openings with sizes up to 2 hectares for shade-intolerant species

Regeneration:

Planted: sugar pine (resistant stock for blister rust)
: incense-cedar (warm sites), Douglas-fir

Natural: white fir (cooler sites), western redcedar, western hemlock, Douglas-fir and sugar pine; expect high densities of hemlock if slash is abundant

Early stand treatments:

Pruning: a series of lifts up to 10 feet for sugar pine blister rust
:a series of lifts to 16 or 32 feet for structural quality goals for Douglas-fir, sugar pine

Release: manual release where shrub, grass densities high

Precommercial thinning:

Douglas-fir guidelines @ 14x14 foot spacing
Sugar pine guidelines @ 20x20 foot spacing (perhaps 18x18)
True fir and hemlock @ 12x12 spacing or clumped distribution

Managed stand densities:

Basal area ranges- South and West aspects: 150-200 sq.ft.
Basal area ranges- North and East aspects: 200-290 sq.ft.

Additional site recommendations:

Live crown ratios (LCR's): Maintain at 40-60%.ave. 50%
Ponderosa pine communities: keep <180 sq.ft. basal area
sugar pine communities: keep <140 sq.ft.. basal area
Height/diameter ratios: maintain ranges @ 60-80
Control slash with grapple-piling in association with burning
Shallow rooted redcedar is susceptible to root rot from being over-stressed if ground-skidding occurs nearby
Moisture generally limits annual growth and temperature generally limits the range of western redcedar

Moist/Warm Land Unit

Site Characteristics:

Generally riparian connections; low & mid slope positions
Species and habitat diversity associated with rock outcrops and meadows
Most productive association; greatest decomposition rates
Sugar pine areas indicative of better sites
A broad mix of species (hardwood and conifer) provides for structural and compositional diversity
Early seral growth rates are rapid
Gaps within a stand fill in quickly

Preharvest considerations:

No outstanding regeneration difficulties
Opportunities to use a wide range of conifers and hardwoods
Extended periods of understory reinitiation on warm sites

Silvicultural Systems:

Two-story stands with Douglas-fir and sugar or Ponderosa pine in large group openings
Multi-story stands for wettest sites
Single story stands for south and west aspects and for structural quality growth on some north aspects carrying high tree densities

Regeneration:

Planted species: sugar pine (resistant stock), Douglas-fir, western redcedar
Natural species: western hemlock, Pacific yew, white fir, incense-cedar, bigleaf maple, sugar pine, Douglas-fir, western redcedar

Early stand treatments:

Release: manual release where shrub cover densities are high
Pruning: a series of lifts up to 10 feet for sugar pine (blister rust)
:lifting to 16 or 32-foot heights for structural quality with Douglas-fir, and sugar pine

Precommercial thinning: vary density and tree distribution

South aspects: true fir and hemlock @ 12x12 foot; Sugar pine @ 20x20 foot; and Douglas-fir @ 14x14 foot
North aspects: true fir, hemlock and Douglas-fir @ 12x12 foot

Managed stand densities:

South and West aspects: 120-190 sq.ft. of basal area
North and East aspects: 200-290 sq.ft. of basal area

Additional site recommendations:

Maximize the cover of sugar pine to stabalize species cover in watershed
Encourage uneven spacing and distribution on south aspects
Maintain uniform cover and even growth on north aspects
Avoid height/diameter ratios >90 because of structural stability concerns, especially on north aspects
Anticipate increased blowdown in stands with height diameter ratios > 90.
Increases in Douglas-fir bark beetle populations above endemic levels are predicted if stem sizes in blowdown patches exceed 10" d.b.h; particularly if blowdown occurs in two successive years.
Plan for more frequent stand entries on north aspects (4-6 per 100 years on northerly aspects compared to 2-3 per 100 years on southerly aspects due to different density management strategies)

Moist/Cool Land Unit

Site Characteristics:

Shorter growing season; generally lush and diverse shrub and herb layers
Development of multi-story stands with mosaic vegetation patterns of all-aged regeneration
Openings can experience delayed revegetation
Transition to dry/warm and moist/warm land units
Fog forming areas in landscape with impacts from frost
Decomposition cycles slower with more nutrients in litter
Natural regeneration potential is high
Small group openings with mixed species common
Even to slow early establishment and growth

Preharvest considerations:

Note where fog forms and hangs on slopes
Identify cold pockets where regeneration is often delayed

Silvicultural Systems:

Multi-story systems with small patches of two-story stands
Heavier densities with grouped shelterwood areas for shade intolerant species

Regeneration:

Planted species: blister-rust resistant western white pine, Douglas-fir (because of infrequent cone crops), western redcedar on warm microsites
Natural species: Pacific yew, western hemlock, Shasta red fir, white fir, Pacific silver fir

Early stand treatments:

Release: manual release for heavy shrub cover pockets
Pruning: for boughs and other special products
: lifts on white pine stock up to 10-feet

Precommercial thinning:

Keep white pine if blister rust not on bole and stem > 8"d.b.h.
All species: 12x12 foot spacing

Managed stand densities:

Basal area ranges: <200 sq.ft. with single-story stands
Basal area ranges: 200-300 sq.ft. for multi-story stands

Additional site recommendations:

Site prep with an excavator by grapple-piling slash
Prescribe burn only with adequate soil moisture
Keep openings off of the exposed ridge lines
Capture potential of true fir frequent cone crops

Monitor dense stands for increases in populations of true fir bark beetles (like Scolytus) that can increase insect-induced natural thinning on true fir
Well-spaced Pacific silver fir can maintain moderate and uniform growth rates
Wildfire can be impactive to these sites by removing litter that stores nutrients at higher levels compared to lower elevation sites
Restrict heavy equipment access on fragile soils
Leave a variety of species for hard and soft snags to increase niche diversity
Leaving an abundance of litter and forest floor vegetation can reduce soil erosion potential

Young Growth Yield Tables

* Young growth stands, generally between 15-25 years BH age, were grouped by land units and run on the Forest Vegetation Simulator (Prognosis-Western Cascades variant) to approximate future stand development. There were three density groups stratified : *low stocked sites with <170 ctpa; medium stocked sites with 170-269 ctpa; and, densely stocked stands with >=270 ctpa.* All of the sites were clearcut acreage harvested previous to 1970. As a group, they represent a set of stands which defined a common type of management and reforestation consistent in Little River across management boundaries. These stands are Forest Service sites only and represent approximately 11,000 acres of analyzed stands cut prior to 1970.

* Silvicultural prescriptions have been generated to represent potential stand management levels by land unit. The yield table represents plausible future development based on actual stocking levels. The regeneration harvest programmed in the yield tables for the year 2095 is set, to compare standing volumes expected from each average site one hundred years from now, and, does not necessarily recommend that particular treatment. The stand examinations followed the Region 6 protocol for intensive examination levels of detail and are stored on electronic file at the District. These runs model the variability within real stands and are not assumed stocking numbers based on projections from a TSI activities data base. The stands analyzed follow general Silvicultural prescription guidelines which recognize that harsher sites naturally carry more variable distribution of stems on the landscape, and, also that product quality goals will be different for areas of uniform and non-uniform tree distribution.

* The three different density groups are separated to compare potential productivity differences between land units of similar stocking. The first table represents dense stocking; the second represents medium stocking and the third represents low stocking. The table numbers represent yield in BF/Acre by decade. Individual stands will vary from these averages, but a thinning was not programmed unless a stand in a group had a removal of at least 2500 board feet per acre (using 7"dbh x 4"small diameter standards). One caution note: Hidden defect or breakage was not calculated but is generally assumed with District experience to be minimal (<5%) from small log sales previously accomplished in Little River.

* The following yield tables are based on stand management in the range of 25-50% of maximum stand density. *One can apply the factors below to the total acres in each stratification to arrive at an estimate of thinning yield in any one decade*. The dry/warm and wet-dry/warm land units were managed at a maximum stand density of 550. The moist/cool and the moist/warm land units were managed at a maximum stand density of 590. The decade represents the time period of harvest modeled.

Table # 5 Densely stocked managed stands cut before 1970

YOUNG GROWTH YIELD [BF/ACRE] BY LAND UNIT BY DECADE-USFS							
Year	dry/warm dense 1950's	dry/warm dense 1960's	wet,dry /warm dense 1950's	moist/warm dense 1950's	moist /warm dense 1960's	moist /cool dense 1950's	moist /cool dense 1960's
1995	3270		2805	1548			
2005			9516	6131	542	4025	
2015	9546			2117	1005		2956
2025		5059	3207	2373	1007		225
2035					4619	9264	937
2045					1731		9402
2055		11727			6897		
2065					2333		
2075							
2085							
Total Int. Harvest	12816	16786	15348	12169	18134	13289	13520
2095 Reg. Vol.	62794	31190	84095	72761	58122	43032	38644
2095 Ave. Age	132	128	142	138	133	131	128
Total MBF	75610	47976	99443	84930	76256	56321	52164
Ave. BA/AC	112-265	107-216	154-264	181-267	169-261	119-206	121-193
Ave Site Index (Curtis-100 yr)	140	110	150	140	150	120	120

Table # 6 Moderately stocked managed stands cut before 1970

YOUNG GROWTH YIELD [BF/ACRE] BY LAND UNIT BY DECADE -USFS							
Year	dry/warm moderate 1950's	dry/warm moderate 1960's	moist /warm moderate 1950's	moist /warm moderate 1960's	moist /warm moderate 1970's	moist /cool moderate 1950's	moist /cool moderate 1960's
1995							
2005			598			404	
2015		333	565	240		359	
2025	3337	127	3323	1242		1417	1136
2035	4791	1561	940	1183	2796	546	2108
2045		3734		2232	3429	1907	1274
2055		2464		768	3892	1322	1244
2065		1076		1706		2705	2088
2075			154	1706		1732	973
2085		420	2186	437			2296
Total Int. Harvest	8168	9715	7766	8403	10117	10392	11119
2095 Reg. Vol.	50280	45568	50856	49430	41572	38425	35098
2095 Ave. Age	134	131	134	130	125	134	130
Total MBF	58448	55283	58622	57833	51689	48817	46217
Ave. BA/AC	144-222	171-229	142-235	169-230	153-227	129-205	161-192
Ave Site index (Curtis- 100 yr)	125	125	125	130	120	110	125

Table # 7 Low stocked managed stands cut before 1970

YOUNG GROWTH YIELD [BF/ACRE] BY LAND UNIT BY DECADE- USFS						
Year	dry/warm low 1950's	dry/warm low 1960's	moist /warm low 1950's	moist /warm low 1960's	moist /cool low 1950's	moist /cool low 1960's
1995						
2005						
2015						
2025		1065		314		399
2035	886	1048	1820	815	464	533
2045		1306	1731	648	341	1141
2055	3516	409	313	1607	2337	1681
2065	1384	3188	995		1957	767
2075		498		767	3356	255
2085				2485	1604	4220
Total Int. Harvest	5786	7514	4859	6636	10059	8996
2095 Reg. Vol.	38598	36920	51649	34202	38200	34490
2095 Ave. Age	134	129	136	129	134	130
Total MBF	44384	44434	56508	40838	48259	43486
Ave. BA/AC	173-211	153-206	213-251	148-209	190-234	147-211
Ave Site Index (Curtis-100 yr)	110	110	120	110	115	115

Trends and patterns to note:

* There are immediate thinning opportunities in the densely stocked young stand group for the next 4-5 decades and then there will be a 3-4 decades where these stands are left generally alone. This type of entry schedule may be important for wildlife and other resource concerns.

* In the moderately stocked areas thinning opportunities are generally not available for the next two decades, but then are available over the next 8 decades from acreage cut in the 1960's. The 1950's acreage will likely have a pattern of harvest followed by a period of rest.

* The low stocked stands will not generally support a commercial thinning entry for the next 4 decades, but then will be available over the next 5-6 decades.

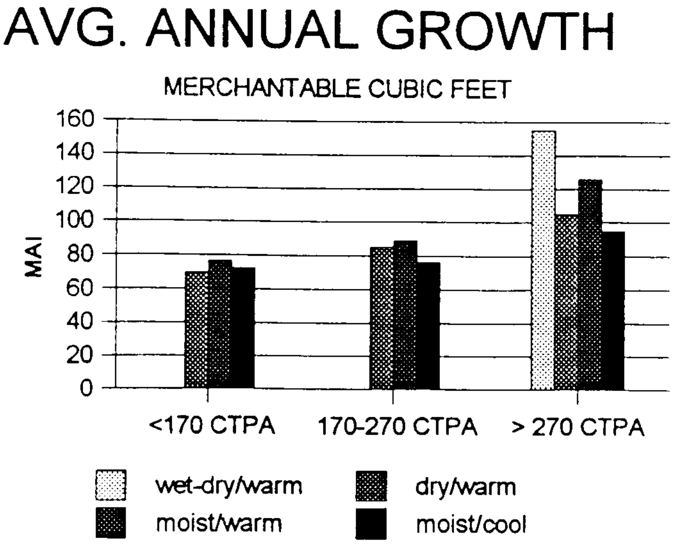
* Total harvest volume available from these land units reflect a downward trend from dense to low stocked sites and also from the moist/warm to dry/warm to moist/cool land units.

* Differences between the four main analyzed land units for total merchantable cubic foot growth has been calculated. The wet-dry/warm land unit is highest: followed by the moist/warm; then by the dry/warm; and then by the moist/cool. This pattern is consistent for both the moderate and densely stocked stands. For low stocked stands the moist/warm, the moist/cool, and dry/warm land units are very similar in cubic foot production totals.

Mean Annual Increment Projections for Land Units

* The potential mean annual increment (MAI) is the average yearly increase in volume computed for the total age of a stand at any period of its life. On this graph the measure is in cubic feet. The numbers presented are averages of stands harvested in the 1950's and 1960's by each land unit and calculated on the Forest Vegetation Simulator (Prognosis) for potential future yield under similar thinning regimes. The potential cubic foot yield depends on the number of stems on an acre, their average stem diameter and the growth rate of those stems. Stands with fewer stems will have a lower net "yield" per acre. A reduction of individual stem diameter growth will also lower possible total stand growth or MAI.

* Stands at three stocking densities were analyzed from intensive stand examinations on over 230 USFS public harvest sites cut prior to 1970:



* Managed Stand Growth (MAI) is calculated for merchantable cubic feet and assumes an active thinning regime. It is averaged for stands harvested with regeneration cuts in the 1950's & the 1960's. The wet-dry/warm sites will produce the maximum growth and had so few stands with low and moderate stocking that analysis was not done at those levels.

* Thinning a stand acts to delay the point where a stand reaches the culmination of mean annual increment (CMAI) which is the point in a stands life where the *maximum average annual growth* accretion is attained. The greatest CMAI for these projected managed stands is within the wet-dry/warm and the moist/warm land units. The graph above represents growth *after* projecting a thinning to the wet-dry/warm land unit during the current or first decade. Thinning the wet-dry/warm component soon may address the growth rate concerns on individual stems those sites now have. Similarly, many of the densely stocked acres in the other land units were projected to be thinned within the first or second decade (1995-2005 or 2005-2015). What is unknown is the degree that soil compaction will play in altering potential thinning growth response.

Mature Forest Yield Tables

* Yields have been modeled for naturally regenerated mature stands existing on Continuous Forest Inventory (C.F.I. plots) within the AMA. Six different stand types were identified, grouped as run numbers #101-#105 plus run #304. Each group represented the mature structure stage, but with differing levels of retained residual components. Two groups are presented for review.

* The first group analyzed (group #102) included four even-aged stands whose average stand age in 1995 was 105 years. Two stands were located within the dry/warm land unit; one at 2500 feet representing low elevation sites, and one at 4,000 feet for high elevations. The third stand was in a moist/cool land unit (@4800 feet) and the last stand was in a moist/warm land unit (Upper Cavitt) at 2500 feet. Stand aspects ranged from southeast to southwest.

Comments from 1980 Timber Inventory Plot cards:

* Stand #654: An even-aged Douglas-fir stand. Trees are generally healthy and vigorous. Conks are present in the stand. Past fire is indicated on old-growth trees with their ages estimated to be greater than 250 years. Ground vegetation is canyon live oak and ocean spray. No logging has occurred on this site.

* Stand #655: This stand consists of immature Douglas-fir with some scattered white fir near the top of Flat Rock peak. It has no understory and few saplings or seedlings.

* Stand #676: A fire caused this stand of even-aged Douglas-fir. The stand is very dense and trees often have slow growth rates. There is a minimal understory of vine maple, golden chinquapin, and dwarf Oregon grape cover.

* Stand #694: This stand consists of young Douglas-fir with an understory of hemlock saplings and seedlings. Salal, Oregon-grape, Pacific rhododendron and vine maple provide ground cover.

Table #8. Group #102 Current species and size class

Group #102 Species Distribution by size class in 1995 Trees per acre by size class						
Stand #	Elevation	Aspect	Species	<5 " dbh	5-9 " dbh	>9" dbh
654	2500	SW	Douglas-fir; Live oak	55 825	27 27	144
655	4800	SE	Douglas-fir white fir	4 92	70 22	180 41
676	4000	S	Douglas-fir white fir chinquapin	136 55 327	170	204
694	2500	SE	Douglas-fir w.hemlock w.redcedar	0 254 534	19 7 39	183

* Analysis is based on the following scenarios; one with thinning and one without thinning to simulate no treatment. The stands were further stratified into runs that evaluated thinnings in just the high elevation (with an associated no treatment) and runs that evaluated thinnings in the lower elevation (with an associated no treatment).

* The commercial thinning scenarios are presented first and the set of tables showing the no treatment alternatives are shown second.

* The Stand Density Index (SDI) values at year 2045 slightly exceeds 50% of maximum 590 for this set of four stands. The site could be approaching full occupancy; however, the stands should still be vigorous at this point and there is an option to carry them for several more decades in a healthy condition.

* The stands could also be regenerated at the second entry (2015), at which time SDI would approximate 55% of maximum SDI for the group; however, the opportunity to thin and extend stand vigor exists.

* The 1995 size class distribution on the tables is *preharvest*. Stands were grown from the 1981 plot data to 1995. 75% of the <5" trees were killed (FIXMORT in FVS) at the first commercial entry. There was no more logging induced mortality at the second entry and no re-initiation of seedlings was allowed during the life of the stand. In essence, this modeling simulated some level of understory management and concentrated basal area on the larger residual trees.

* Thinnings were done *from below to 180 sq.ft.* basal area in 1995 and to *160 sq.ft.* basal area in the year 2015 (roughly a 40% reduction in basal area). Board foot volume is measured in 7"x 4" Scribner with a 21% defect factor, as taken from the 1981 timber inventory data for these particular stands.

Table #9 Group #102 Thinnings

Commercial thinnings in 1995 and 2005								
Thinning all four stands (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average stand diameter >21" dbh	Avg. Hgt.
1995	10.3		563	102	164	25	25	
2005		194	148	10	73	27	26	120
2015	5.2	29.3 if regenerated						
2025		171	131	8	33	29	26	
2045	30.4	190	118	7	29	33	27	126
50-year yield	45.9 MBF stand volume							
High elevation thinning (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average stand diameter >21" dbh	Avg. Hgt.
1995	7.0		293	144	205	9	25	
2005		195	95	8	129	12		96
2015	4.2	21.9 if regenerated						
2025		172	82	7	67	19		
2045	22.8	192	72	8	52	29	25	105
50-year yield	34.0 MBF stand volume							
Low elevation thinning (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average stand diameter >21" dbh	Avg. Hgt.
1995	13.6		834	60	123	41	25	
2005		193	200	12	17	43		144
2015	6.5	36.7 if regenerated						
2025		170	181	9	<1	39		
2045	38.5	188	164	5	6	37	30	147
50-year yield	58.6 MBF stand volume							

* Thinning from below greatly *simplified stand structural diversity* and conversely *increased stand resiliency* to a severe stand disturbance from fire.

Table #10 Group #102 No treatment

No treatment Group #102								
All four stands no treatment (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average stand diameter >21" dbh	Avg. Hgt.
1995	35.2	299	563	102	164	25	25	117
2005	36.7	303						
2015	37.9	304						
2025	39.2	305	413	83	147	24		124
2045	*41.6*	306						
High elevation no treatment (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average stand diameter >21" dbh	Avg. Hgt.
1995	25.6	289	293	144	205	9	25	94
2005	27.0	296						
2015	28.1	298						
2025	29.2	300	206	86	200	15		100
2045	*30.8*	303						
Low elevation no treatment (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average Stand Diameter >21" dbh	Avg. Hgt.
1995	44.4	309	834	60	123	41	25	141
2005	46.2	311						
2015	47.4	311						
2025	48.9	311	620	80	95	43		148
2045	*52.2*	310						

* There are significant differences between the low and high elevation groups in the volume per acre and the number of t.p.a. over 21"d.b.h. in the stands. Stratification reflects the differences in site quality. Both high elevation sites had lower site quality (60-90 McArdle SI) versus the low elevation sites (100-130 McArdle SI).

* *The second group of stands* analyzed ranged in age from 93-122 years and included a residual overstory component. The stands were located on south and west aspects at elevations between 2500 and 300 feet. The residual overstory component averaged over 200 years of age in individual or small clumps adding complexity to these sites. It is consistent to note that these stands were in the dry/warm land unit on the upper 1/3 slope positions near ridgelines. This group was also associated with past fire disturbances; but the difference between groups one and two is that group two stands are *associated with smaller historical openings*. It is perhaps this reason, that these stands carry a greater residual component into the next regeneration cycle.

* In the second set, stand #259 consists of young Douglas-fir on top of a ridge. It borders a clearcut located to the south of the stand. No logging has occurred. Stand #269 is located on a steep, rocky slope with a young stand of Douglas-fir coming up under an older Douglas-fir stand with some scarring evident from past fire. There is a dense cover of vine maple, canyon live oak, and poisonoak.

Table #11 Group #104 Current species and size class

Group #104 Species Distribution by size class in 1995 Trees per acre by size class						
Plot #	Elevation	Aspect	Species	<5 " dbh	5-9 " dbh	>9" dbh
259	3000	S	Douglas-fir chinquapin & other hardwoods	133 308 366	28 20	121
269	2800	W	Douglas-fir Pacific yew bigleaf maple	217 28 28	91	114

* Site class for these stands averaged site class four. Analysis is based on three runs; one to evaluate removing the overstory in 1995, the second run to evaluate commercially thinning the 60-90 year old understory, and the third run to evaluate letting the stand grow over the next several decades with no treatment.

* With the overstory removal modeling run, there does not appear to be a commercial thinning opportunity until about decade 6 (at year 2035), well after the overstory removal. In heavier stocked stands, this would be a possibility at an earlier date. The overstory removal effect on the understory damage was modeled to reflect; a 50% reduction in stocking of trees <5" d.b.h., a 20% reduction in stocking of trees 5"-9" d.b.h., and a 10% reduction in trees from 9"-21"d.b.h.

* In the understory thinning run, trees (5"-21" dbh) were commercially thinned to about 110 sq.ft. basal area per acre with the legacy old-growth managed over time. These legacy trees were allowed to die over time until about decade 6 when other trees began to exceed 29" d.b.h.. At this time, there would be >180 sq.ft. of basal area not counting the legacy old growth. With the understory thinning, 50% of the trees <5" d.b.h. were modeled as logging mortality. Trees over 5" d.b.h. were in the thinning.

* A board foot defect factor of 25% was used in these simulations. This was an average from the inventory plots, and may be high for the understory stand.

Table #12 Group #104 Thinnings and no treatment

Commercial thinnings in 1995 and 2005								
Overstory removal (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average Stand Diameter >21" dbh	Avg. Hgt.
1995	7.7		568	70	107	10	32	
2005	(15.7)	155	253	68	114	14	25	105
2015	(18.5)							
2025	(20.9)	188						
2045	26.0	215	189	30	119	19	25	119
50-year yield	33.7 MBF stand volume							
Under-story thinning (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average Stand Diameter >21" dbh	Avg. Hgt.
1995	3.1		568	70	107	10	32	
2005	(21.7)	189	378	67	103	10	30	110
2015	(21.4)							
2025	(21.7)	182						
2045	(23.7)	199	294	35	115	15	26	118
50-year yield	26.7 MBF stand volume							
No treatment (year)	Harvest MBF	BA/AC	TPA <5" dbh	TPA 5-9" dbh	TPA 9-21" dbh	TPA 21+" dbh	Average Stand Diameter >21" dbh	Avg. Hgt.
1995	21.7	189	568	70	107	10	32	
2005	24.0	205	485	96	123	12	32	112
2015	26.2	218						
2025	27.9	229						
2045	32.0	248	360	64	120	18	30	122
50-year yield	32.0 MBF stand volume							

Riparian Development rates to large size

* It is of interest and importance, to know how long trees established in riparian areas need to attain certain size structure. Large woody material specifications for Region 6 call for a small diameter end of 24" with a length of 50 feet for desired channel structure. Different densities will influence stand and individual stem development. For the following table, five common riparian species were modeled on Prognosis as a mostly pure stand of one species and grown to attain a size of 30"d.b.h..

* In the first run, 100 tpa was a stand density chosen to approximate a thinning strategy with the objectives of controlling density to get the largest diameter size tree the quickest. In the second run, a more normal density of 300 tpa was chosen.

Table #13 Riparian structure development

Summary- Riparian Coarse Wood Analysis						
Species with **100 t.p.a** stocking	Age when first tree >=30" dbh	Average Stand Diameter	Average Height tallest 40 trees	Age when 10% of trees >=30" dbh	Average Stand Diameter	Average Height tallest 40 trees
Douglas-fir	80	15.9	120	130	20.9	143
western hemlock	170	21.7	138	200	24.4	149
western redcedar	140	19.9	133	180	24.9	147
bigleaf maple	180	23.4	82**	200	23.4	83**
red alder*	largest tree at 27.9 "dbh stand died during the 11th decade			10% of stand over 23.7 " dbh when stand dies in decade #11		
	** means used red alder heights			* means killed red alder stand by decade #11		
Species with **300 tpa** stocking	Age when first tree >=30" dbh	Average Stand Diameter	Average Height tallest 40 trees	Age when 10% of trees >=30" dbh	Average Stand Diameter	Average Height tallest 40 trees
Douglas-fir	120	17.6	138	180	21.7	159
western hemlock	180	20.7	146	28.4 " dbh at age 200 *end of analysis run		151
western redcedar	160	20.4	143	180	22.6	149
bigleaf maple	28.9 " dbh at age 200 *end of analysis run					
red alder	red alder died by decade #11					

* Note that with additional density, it took trees more years to reach target size. The Douglas-fir was the fastest species to attain target size, bigleaf maple made target size at the lower density only and red alder never did. .

* Note that there is a 40 year difference in age time needed to get the first stem to 30" d.b.h. between the 100 and 300 t.p.a. density levels for Douglas-fir. There is a related 50 year difference between getting 10% of the Douglas-fir in the stand greater than 30" d.b.h. when compared at these two densities.

* It is noted that redwood, Sequoia sempervirens, has been outplanted within the watershed at various locations, many of them in riparian areas. These trees have yet to reproduce in their pole-size managed stand environments. The growth potential they have so far exhibited indicates that large structure of the Region-6 standards can be generated with this species at time periods of 40-50 years. The following field data, though very limited, displays this progression. *It may be advantageous to consider a role for this tree or determine a policy to remove it from the watershed.* It's localized environment is secured as Douglas-fir is subordinate to it in close association. The following information was gathered at a single site that averaged a breast height age of 24 to 27. Codominants of paired redwood and Douglas-fir were analyzed.

Tables # 14-17 Redwood and Douglas-fir development

Table #14 Diameter development redwood & Douglas-fir				
Douglas-fir	9.7" d.b.h.	14.5" d.b.h.	13.5" d.b.h.	11.7" d.b.h.
redwood	24.7" d.b.h.	19.4" d.b.h.	21.3" d.b.h.	20.3" d.b.h.

Table #15 Height development redwood & Douglas-fir				
Douglas-fir	59 feet	65 feet	65 feet	62 feet
redwood	55 feet	57 feet	63 feet	68 feet

Table #16 Live crown ratios redwood & Douglas-fir				
Douglas-fir	72%	81%	75%	74%
redwood	78%	75%	55%	64%

Table #17 Diameter growth rates redwood & Douglas-fir		
Douglas-fir	42/20's	40/20's
redwood	60/20's	62/20's

Light levels and the effects on Douglas-fir and Sugar Pine establishment

* Foliage density (sq.meters foliage per cubic meter canopy) index **(FDI)** measurements take only a fraction of the time required to directly measure leaf area with a plant canopy analyzer. A scientific tool called the LAI-2000, accurately measures both the above and below canopy light readings, determining the interception at 5 different angles, thereby computing an reading sensitive of light levels. In essence, it measures the probability of seeing the sky looking up through the vegetative canopy in different direction. These readings can provide accurate estimates of the canopy structure (the amount of foliage per volume of canopy and foliage orientation) and hence the levels of infiltrated light that generate growing conditions for various kinds of vegetation including tree, shrub and forb communities.

* The North Umpqua Ranger District has been using such an analyzer for the last two years trying to determine the light levels that, specifically, Douglas-fir (DF) and sugar pine (SP) need to both establish and grow in a forest stand or opening. The use of a lens with a "fish-eye" field-of-view assures that LAI-2000 calculations are based on a large sample of foliage canopy. A control unit with an internal microcomputer performs the calculations, stores data and later transfers the data to a PC.

* LAI-2000 readings are displayed for many sites, some old-growth and some managed stands, both in the Little River area and elsewhere.

#	Date	Area	FDI	Stand Descriptor & regen.
1	3/7/95	Plusfour	0.57	opening (1-acre) within stand
2	3/7/95	Plusfour	1.92	under thinned stand no DF/ SP
3	3/7/95	Plusfour	*1.44*	small group opening DF & SP
4	3/7/95	Plusfour	3.08	unthinned 110 yr. site no DF/SP
5	3/7/95	Plusfour	1.08	small clearcut; multi-species reg.
6	3/7/95	Plusfour	3.11	light thin 110 yr. site no DF&SP
7	3/7/95	Plusfour	*0.93*	small gap; multi-species regen.
8	3/7/95	Plusfour	1.95	under thinned stand no DF & SP
9	3/11/95	Alpine	*1.29*	light thin 90+ yr. site DF/SP reg.
10	3/12/95	White Crk.	2.05	45 yr. stand no DF or SP
11	3/28/95	White Crk.	2.32	45 yr. stand w/120+b.a. no reg.
12	3/28/95	White Crk.	1.73	45 yr. stand w/210 b.a. no reg.
13	3/28/95	White Crk.	2.30	40 yr.stand w/270 b.a. no reg.
14	3/28/95	White Crk.	2.67	40 yr. stand w/200 b.a. no reg
15	3/28/95	White Crk.	*0.51*	opening w/in road DF reg
16	3/28/95	White Crk.	1.05	40 yr. site 270.b.a.
17	3/28/95	White Ck..	2.00	40 yr. site road uphill no reg.
18	3/28/95	Sum. Home	*1.21*	open area w/OS SP & DF
19	3/28/95	Sum. Home	2.83	dense group wf reg no SP/DF
20	3/28/95	Sum. Home	*1.38*	Thinned O/Story SP reg.
21	3/28/95	Sum. Home	*1.01*	160 b.a. O/story holes SP/DF reg

#	Date	Area	FDI	Stand Descriptor & regen.
22	4/4/95	Alpine	5.18	30 yr. y-growth stand no DF/SP
23	3/9/94	Cedar Ck.	3.89	30 yr. mg'd stand no DF/SP
24	3/9/95	Cedar Ck..	1.63	Riparian floodplain open areas
25	5/11/94	Little log #4	2.92	unthinned 40 yr. site
26	5/11/94	Little log #4	1.27	thinned in *1994* to 130-140 b.a.
27	5/11/94	Little log #4	4.43	unthinned area with >200 b.a.
28	6/29/94	Little log #4	5.29	unthinned area dense no reg.
29	6/29/94	Little log #4	4.90	unthinned area 40 yr. stand
30	6/29/94	Little log #4	0.66	road location full sunlight
31	7/18/94	Gypsy camp	3.75	riparian site old-growth
32	7/18/94	Gypsy camp	1.61	old-growth riparian site
33	7/18/94	Gypsy camp	1.52	open areas/riparian/ w.hem. reg.
34	7/18/94	Gypsy camp	2.06	riparian old-growth area
35	7/19/94	Gypsy camp	1.95	small 1/10 acre gap in old-growth
36	7/19/95	Gypsy camp	0.32	1/4 acre gap in old-growth DF
37	7/19/94	Gypsy camp	1.45	area outside gap w.hem. reg
38	7/25/94	Honeytree #9	2.20	West aspect no DF reg
39	7/25/94	Honeytree #8	1.62	blowdown patch w/in old-growth
40	7/25/94	Honeytree #8	1.57	in u/story area within gaps/stand
41	7/25/94	Honeytree #1	1.99	fully stocked mature stand no reg
42	7/26/94	Honeytree #7	*1.49*	gaps in old-growth SP/DF reg.
43	9/13/94	Little log #4	2.22	unthinned area 40 yr. stand no reg
44	9/13/94	Little log #4	1.28	thinned 1994 130 b.a.
45	9/13/94	Little log #4	0.83	road opening full sunlight DF reg

* *Note: Low numerical values indicate higher levels of light are reaching the forest floor.*

* The readings listed represent only a very small sample of sites. Trends noted will need to be monitored closely and followed through a variety of stand treatments. It appears that on this cursory level of analysis, that levels of light (**FDI <= 1.50**) have supported both the establishment and growth of both Douglas-fir and sugar pine regeneration.

* There also appears to be a difference between openings in old growth stands and young growth stands where smaller sized openings in old growth have more infiltrated light levels. Young growth stands that are fully-stocked are often limited in light to expect successful regeneration of Douglas fir or sugar pine until the average stand height is such that light can penetrate into a stand underneath the live tree crowns or group openings occur within the stand structure. A future objective may be to write thinning prescriptions to residual light levels. These light levels will have some correlation to residual basal areas.

FOREST ECOPLOT INFORMATION

* Using Umpqua N.F.ecoplot information, residual levels of important biotic components such as large woody material (LWM), snags, decay classes, fuel loadings, moss cover, plant lists, tree cover, and shrub and forb occurrence are part of the information base collected from inventory plots. Utilizing stratifications for plant associations, based on the Umpqua NF ecographs of moisture and temperature levels, analysis was generated by land unit.

* Information generated from pooling Forest-wide data may not exactly reflect Little River conditions. Information is extrapolated from places adjacent to Little River. Still, the information represents our most current and accurate measure of these variables. This data gap illustrates the need to expand this type of information gathering and monitoring across the watershed.

* This table represents characteristics (not quantities) of dead and down material measured on the forest floor. An active salvage and firewood program has altered many of the forest floor areas under residual mature and late seral stands across the drainage. Natural levels and their ranges need study.

* Maximum and minimum diameter averages in measures of both inches and feet are listed along with average piece length. The decay classes are also averaged using ratings consistent with the Umpqua NF 1990 L.R.M.P (Land Resource Management Plan) which lists six decay classes. Dead and down material can be an important functioning ecological bridge within the nutrient cycling loop for centuries. It acts to maintain critical above and below-ground connections between soil organisms and structure and above ground flora and fauna.

Table #18 Dead and down material by Land Unit

Dead and Down Material by Land Unit Ecoplot information- Umpqua NF (measures in inches and feet)				
Land Unit	max. avg. diameter (in.")	min. avg. diameter (in.")	avg. length (feet)	avg. decay class
dry/warm	15	9	*37*	3
moist/cool	16	10	31	3
wet,dry/,warm	*17*	*12*	29	3
moist/warm	16	*11*	31	3

TABLE # 19 ACRES OF YOUNG STANDS BY SITE CLASS AND LAND UNIT			
W.Cascades Province	LOW (<=94 KD)	MED (KD 96-114)	HIGH (KD >=116)
wet-dry/warm	39	255	274
dry/warm	413	1201	685
moist/warm	999	2430	727
moist/cool	1162	927	124
TOTALS	2612	4812	1810

Young stand site classes were measured using King's 1965 Douglas-fir tables (KD) and are on a 50-year base. During stand examinations, average dominant tree stems were bored for heights and ages and averaged together as a group to assign a site class for any individual stand. There is a +- 5 confidence interval associated with each stand listing. For this age class group and their associated BH age, there was usually 6-8 trees required to assess a site class with this confidence interval.

APPENDIX D

Appendix D
Socio-economics

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ARCHAEOLOGICAL CONTEXT

The limited amount of ethnographic information available for the upper North Umpqua region attributes use of the area to the Southern Molalla and the Umpqua (Berreman 1937; Beckham 1986). The principal homeland of the Southern Molalla was the Western Cascades and the main Cascade Range. They resided along the North Umpqua, Little River, and the South Umpqua deep into the Western Cascades. The Umpqua Indians resided in the main Umpqua River valley with their territory reaching to the foothills of the Western Cascades (Beckham and Minor 1992).

Little is known about the Southern Molalla. At contact the population was limited. The small population may merely be do the wide range in their home territory. The Southern Molalla traded with the low land valley peoples. Jesse A. Applegate described an event about the year 1849:

> Halo, a Yoncalla headman who lived near the Applegate farm, approached with a half dozen Molallas. "They were shy, almost wild," recalled Applegate, "and could not be persuaded to come into the house. Mr. Halo humorously introduced them to us as the Lamoro tilikum, wild people, Haluima Tilikum, strangers, and Pishkak tilikum, bushmen (Applegate 1907:4, Beckham and Minor 1992).

Population size has been variously described. Joel Palmer, the Superintendent if Indian Affairs in the 1850's described the population as "supposed to be two hundred" (Palmer 1854, Beckham and Minor 1992). In 1854 Indian Agent William J. Martin described 15 bands in the Umpqua watershed. The "Mountain Band" is assumed to be Southern Molalla with a population of 54 people. In 1856 during the signing of the treaty with the United States Joel Palmer numbered 28 Southern Molalla and estimated 30 resided in the mountains (Beckham and Minor 1992).

The Umpqua resided in the main Umpqua valley which provided a rich and diverse landscape. Samual Parker wrote of the Umpqua in 1838:

> South of the Calapooah is the Umbaqua nation, residing in a valley of the same name. They are divided into six tribes: the Sconta, Chalual, Palakahu, Quattamya, and Chasta. Their number is about seven thousand (Parker 1838, Beckham and Minor 1992).

Beckham suggests that Parker's enumeration of the Umpqua reached into the Rogue Basin providing a larger population estimate (Beckham and Minor 1992). In 1851, Sub-Agent Henry Spalding numbered the population at 125. He reported the people lived in polygamy, possessed nine horses, six saddles, and had one shaman. In 1854 Martine numbered the Umpqua at 216 (Beckham and Minor 1992).

David Douglas encountered the Umpqua in June of 1826. Beckham (1992) describes the encounter:

> He found a village of two lodges containing about 25 persons. The men wore shirts and

trousers of undressed deerskin, some decorated with marine mollusks, while the women wore cedar bark shirts covered with a garment of dressed leather more open at the sleeves than the shirts of the Men (Douglas 192:140-141). Henry Eld, an American artist sketching in the Umpqua Valley in 1841, depicted a figure standing near the river in what appeared to be leather trousers and a shirt (Beckham 1971a: 93-93). Douglas further noted: "I observed that the women are mostly all Tat[t]ooed, principally the whole of the lower jaw from the ear, some in lines from the ear to the mouth, some across, some spotted, and some completely blue; it is done by a sharp piece of bone and cinder from the fire". The women also used both red and green facial paints (Douglas 1972:140-144, Beckham and Minor 1992).

The settlement/subsistence pattern practiced by both groups is described as a seasonal round utilizing the lowland valleys for winter villages and uplands for task-specific campsites. The seasonal round allowed for the exploitation of the anadromous fish runs and large game animals and the utilization of various plant foods (Beckham 1986). This type of settlement/subsistence pattern has been generally substantiated by archaeological investigations in the area. However, Baxter (1989) argues that "for the Molalla, the area above the Narrows would have been attractive" for a winter village locality. He suggests that the area could have been utilized year round; by the Molalla in the fall and winter and by the Umpqua in the spring and summer.

Two cultural chronologies have been developed for the region. O'Neill (1989b) suggests three temporal groups, one consisting of two phases. The Early Archaic, period from approximately 8,000 to 6,000 years, is dominated by large leaf shaped points. The Middle Archaic period dates from about 6,000 to 2,000 years ago and is dominated by broad-stemmed points. The Late Archaic period falls within the last 2000 years. O'Neill further divides the Late Archaic period into two phases. The Falls phase is present in both the North and South Umpqua River drainages and persists until historic times in the South Umpqua River drainage. The assemblages of this phase include Coquille Series projectile points. The Narrows Phase, dominated by Gunther Series projectile points, is found in the North Umpqua drainage within the last 400 years. This change in the archaeological record is thought to reflect the appearance of immigrant Athapaskans who occupied the basin at contact.

Connolly (1986, 1988, 1990) defines the region's prehistory with three patterns. The Glade Tradition is found throughout the Pacific Northwest from 9,000 to 300 years ago. The assemblages are dominated by large side-notched and stemmed points and foliate and shouldered points. The Siskiyou pattern beginning about AD 450, has assemblages dominated by narrow-necked and barbed points and small side-notched points. The Gunther pattern is primarily a coastal pattern appearing about AD 900. Gunther barbed projectile points are the diagnostic artifact.

Both cultural chronologies have been criticized by Pettigrew (1990) who suggests that the radiocarbon dates used by Connolly and O'Neill were uncritically accepted, shifting "the stages of cultural change forward in time, especially with regard to the introduction of the bow-and-arrow and its associated narrow-necked points." Pettigrew argues that their chronologies are based on the "radiometric dating of charcoal that is not demonstrably cultural." He believes the chronology of southwestern Oregon should follow the sequence and timing of other parts of the west and that narrow necked points should first appear 2000 years ago as they do in adjacent areas.

Although no systematic archaeological survey has been completed of the Little River drainage, 56 archaeological sites have been recorded during federally mandated cultural resource surveys. Surveys have often been in conjunction with timber sales and, as such, may not reflect the intensity of use in the Little River area.

Information in the site record is limited. Generally archaeological sites are located on relatively flat ground. Only two of the sites recorded within the Little River drainage are located on slopes of 20 to 30%. Aspect has been recorded for 51 of the sites. Forty nine percent (n=25) of the sites have a southern aspect. Twenty-two percent (n=11) have an easterly aspect. Almost twenty percent have a westerly aspect and ten percent have a northerly aspect. Landforms on which archaeological sites are found include ridge (n=28), bench (n=18), stream terrace (n=3), bluff (n=1), hill (n=1), and intermittent stream terrace (n=1).

Five types of archaeological sites have been recorded within the Little River drainage. These include quarry, cairn, rockshelter, lithic scatter, and village site. Surface characteristics of the sites include the following:

> Quarry sites are found where extrusions of usable tool stone can be located. These sites contain nodules of tool stone (often jasper) and evidence of tool manufacture. Surface indications can include flakes, blanks, and preforms. These sites often contain evidence of fire treatment of cryptocrystalline material.

Seven quarry sites have been recorded in the study area. These sites are located within 1760 to 3920 feet in elevation on ridges.

> Cairn sites are usually a pile or mound of piled rocks. Cairns may have been built for a number of reasons. Trail markers or spirit quests are considered common reasons. These sites are usually associated with a ridge crest or vista.

In the Little River drainage two cairns sites have been recorded. One site is recorded at 2560 feet in elevation on the a canyon bluff while the other site is recorded at 5100 feet in elevation on a ridge crest.

> Rockshelters are rock overhangs or shallow caves which served as shelters. The openings may have been covered with woven mats, bark, or boughs. Stone tools, flakes, and faunal remains are often found within the cultural deposits.

One rockshelter has been recorded in the Little River drainage. This rockshelter is located on a ridge at 2640. Rockshelters located at this elevation are usually used intermittently as temporary campsites. Rockshelters often provide faunal information that is generally lacking in open lithic scatters.

> Chipped stone tools and waste flakes are found within lithic scatters. These sites may be temporary camp sites associated with hunting and processing of game. Activities include manufacture and repair of chipped stone tools. Lithic scatters associated with ground stone indicate a broader range of activities. Ground stone includes manos, metates, bowls, hopper mortars, pestles, and grinding slabs. Activities include plant food processing, tool manufacture and repair, and game processing.

Forty-four lithic scatter sites have been recorded within the Little River drainage. These sites are found in a variety of elevations and settings. Those sites found on stream terraces and benches often contain denser deposits then those associated with ridges.

> Village sites usually contain house pit depressions, burials, large quantities of chipped stone and ground stone tool, waste flakes, bone, and fire cracked rock. They may have been inhabited during the winter months.

One possible village site is recorded within the study area on a tributary of Little River. Excavations at the site indicate a semi-permanent occupation by people using atlatl and dart technology and a highly developed wood working technology. The site has not been radiometrically dated. However, the artifacts recovered during excavation indicate a possible date of 5000 years before present.

Archaeological information for the watershed is limited. No systematic inventory has been completed. However, 56 archaeological sites have been recorded. Archaeological evaluation of one site in the watershed indicates the site would be eligible to the National Register of Historic Places.

Explorers and Hudson's Bay trappers entered the interior of southwestern Oregon around the 1820's through the 1840's. Little information was written on what became of Forest Lands during this period. Hudson's Bay policy during this time was to "trap out" beaver in the remote streams of southwestern Oregon on the edge of their territory. A number of French-Canadian and Meti ("mixed blood") trappers working for the Hudson's Bay Company took Indian women as wives. The fur trade lost impetus in the 1840's as Euro-American settlers began to filter into the lower valleys of the Umpqua Basin. However, their was little impact to areas such as Little River until after the 1850's.

During the 1850's and 1860's Euro-Americans established small farms and livestock ranches in suitable areas under various homestead laws. Glide was settled in 1852 (Barner 1979). Settler's villages were established at Peel and Nofog during the late 1800's. A wagon road linked these sites becoming a county road at a later date. The Little River drainage was probably first settled for livestock ranches.

Suitable area for settlement included those areas already burned (cleared) and otherwise occupied by the Indians previously. The bottom lands of Little River include open meadows fringed with oaks which were ideal for pioneer agriculturalists who wanted both stock pasture and farmland. It was normal for ranchers to burn in the late summer and fall to promote grass on the lower slopes and eliminate brush and small trees. This burning followed the pattern established by the Indians.

REFERENCES CITED

Baldwin, Ewart M.

1981. Geology of Oregon, 3rd. Kendall/Hunt Publishing Co., Dubuque, Iowa.

Baxter, Paul W.

1986. Archaic Upland Adaptations in the Central Oregon Cascades. Ph.D. Dissertation on file with the Department of Anthropology, University of Oregon, Eugene.

1987. Archaeological Testing at Limpy Rock Shelter: An Upland Hunting Camp in the North Umpqua Valley. Report to the Umpqua National Forest by Heritage Research Associates, Eugene, Oregon. HRA Report No. 65.

1988. Analysis of the Artifact Collection from the Calf Ridge Site (35DO408), Upper North Umpqua Basin, Oregon. Report to the Umpqua National Forest by Heritage Research Asssociates, Eugene, Oregon. HRA Report No. 70.

1989. Archaeological Testing at the Canton Creek Site, Douglas County, Oregon. Report to the Umpqua National Forest by Heritage Research Associates, Eugene, Oregon. HRA Report No. 88.

Beckham, Stephan Dow

1986. Land of the Umpqua: A History of Douglas County, Oregon. Douglas County Commissioners, Roseburg, Oregon.

Beckham, Stephen Dow and Rick Minor

1992. Cultural Resource Overview of the Umpqua National Forest, Southwestern Oregon. Report to the Umpqua National Forest by Heritage Research Associates, Eugene, Oregon.

Berreman, Joel

1937. Tribal Distribution in Oregon. Memoirs of the American Anthropological Association, No. 47, Menasha.

Berryman, Judy A.

1987. Archaeological Evaluation of the Little Oak Site, Umpqua National Forest, Roseburg, Oregon. Report to the Umpqua National Forest by TMI Environmental Services, San Diego, California.

Berryman, Stanley R.

987. Archaeological Site Evaluation of 35DO265, the Apple Creek Site, Umpqua National Forest, Roseburg, Oregon. Report to the Umpqua National Forest by TMI Environmental Services, San Diego, California.

Brauner, David and William Honey

1977. Cultural Resource Evaluation of the Steamboat Creek Drainage, Douglas County, Oregon. Report to the Umpqua National Forest by the Department of Anthropology, Oregon State University, Corvallis.

Churchill, Thomas E.

1986. Archaeological Investigations of the Reynolds Site (35-DO-58). Report to the Umpqua National Forest by Coastal Magnetic Search and Survey, Salem, Oregon.

Connolly, Thomas J.

1986. Cultural Stability and Change in the Prehistory of Southwest Oregon and Northern California. Ph.D. Dissertation on file with the Department of Anthropology, University of Oregon, Eugene.

1988. A Prehistoric Culture-Historical Model for the Siskiyou Mountain Region of Southwest Oregon and Northern California. Paper presented at the Society for American Archaeology, 53rd Annual Meeting, Phoenix, Arizona. April 27 - May 1, 1988.

Eisele, Judith

1994. Survival and Detection of Blood Residue Analysis on Stone Tools. Department of Anthropology Technical Report 94-1, University of Nevada, Reno, Nevada.

Keyser, James D and Kathryn Toepel

1987. Projectile Points . In Archaeology of the South Umpqua Falls Rockshelters, Douglas County, Oregon. Repot to the Umpqua National Forest by Heritage Research Associates, Eugene, Oregon. HRA Report No. 64.

O.Neill, Brian L. and Laura C. White

1994. Cultural Resource Inventory of the North Umpqua Hydroelectric Project, Douglas County, Oregon (Volume 1). State Museum of Anthropology, University of Oregon, OSMA Report 94-2, Eugene, Oregon.

Pettigrew, Richard M.

1990. New Pathways for Research in Southwest Oregon Archaeology. In Living with the Land: The Indians of Southwest Oregon. Proceedings of the 1989 Symposium on the Prehistory of Southwest Oregon, N. Hannon and R. K. Olmo (eds), pp 56-62 Southern Oregon Historical Society, Medford, Oregon. p 56-62. Southern Oregon Historical Society, Medford, Oregon.

Pettigrew, Richard M. and Clayton G. Lebow

1987. Data Recovery at Sites 35JA27, 35JA59, and 35JA100, Elk Creek Lake Project, Jackson County, Oregon. Report to the Portland District U.S. Army Corps of Engineers by Infotec Research, Inc., Eugene, Oregon.

Snyder, Sandra L.
1978. An Archaeological Evaluation of Several Sites in the Steamboat Ranger District, Douglas County, Oregon. Report to the Umpqua National Forest prepared by the Department of Anthropology, Oregon State University, Corvallis.

Snyder, Sandra L. and William Honey
1979. Cultural resource Evaluation of Three Recreation Area Sites, Bureau of Land Management, Roseburg District, Oregon. Department of Anthropology, Oregon State University, Corvallis.

Toepel, Kathryn A.
1985. The Flanagan Site: 6000 Years of Occupation in the Upper Willamette Valley, Oregon. Unpublished Ph.D. Dissertation, Department of Anthropology, University of Oregon.

Winthrop, Kathryn
1989. Bogus Creek Data Recovery Project (35-DO-278). Report to the Umpqua National Forest by Winthrop Associates, Ashland, Oregon. On file at the Supervisor's Office, Umpqua National Forest, Roseburg, Oregon. Umpqua National Forest by Winthrop Associates, Ashland, Oregon.

Zalunardo, Ray
1991. Personal Communication.

Estimated historic volume removals from the Little River watershed:

The following figures are estimations of the board feet of timber removed from the Little River watershed from the 1940's till the early 1990's. Estimates are made by multiplying the number of acres regeneration harvested by 60,000 board feet (BF) per acre. Sixty-thousand BF was chosen as an estimated average after perusing old harvest records. This number may even be low for an average, as some of the largest trees were harvested first. North Umpqua Ranger District harvest records show that some stands carried up to 100,000 board feet per acre.

Table 1. Acres of harvest by decade by administrative unit and estimated volume removed from those acres by decade and by year.

Decade of Harvest	**US Forest Service - North Umpqua Ranger District**			**Roseburg BLM - Mt. Scott Resource Area**			**Private Land - Ownerships greater than 40 acres**		
	Acres cut by decade	Decade total (MMBF or BBF)	Yearly average (MBF or MMBF)	Acres cut by decade	Decade total (MMBF or BBF)	Yearly average (MBF or MMBF)	Acres cut by decade	Decade total (MMBF or BBF)	Yearly average (MBF or MMBF)
1940	1451	87.1 MMBF	8.71 MMBF	21	1.2 MMBF	126 MBF	1007	60.4 MMBF	6.0 MMBF
1950	4987	299.2 MMBF	29.2 MMBF	1023	61.4 MMBF	6.14 MMBF	9641	578.4 MMBF	57.8 MMBF
1960	4294	275.6 MMBF	27.6 MMBF	2076	124.6 MMBF	12.5 MMBF	16,791	1.0 BBF	100.7 MMBF
1970	4764	285.8 MMBF	28.6 MMBF	2908	174.5 MMBF	17.5 MMBF	6134	368 MMBF	36.8 MMBF
1980	6605	396.3 MMBF	39.6 MMBF	2526	151.6 MMBF	15.1 MMBF	4639	278.3 MMBF	27.8 MMBF
1990	1385	83.1 MMBF	8.31 MMBF	2018	121.1 MMBF	12.1 MMBF	180	10.8 MMBF	1.08 MMBF
Total	23,486	1.4 BBF	--	10,572	634.4 MMBF	--	38,392	2.3 BBF	--
Total acres in admin unit	63,575			19,802			44,795		
Total acres uncut	40,089			9,230			6403		
Percent harvested	37%			53%			86%		

MBF = Thousand Board Feet; MMBF = Million Board Feet; BBF = Billion Board Feet

Special Forest Products

The Little River watershed has been used as a source for many products besides timber. Some of these are listed below.

PRODUCTS	BLM	FOREST SERVICE
Firewood	X	X
Christmas Trees	X	X
Cedar Posts, Rails	X	X
Yew Posts	X	X
Corral Poles	X	X
Shake Bolts	X	X
Burls		X
Sugar Pine Cones		X
Beargrass	X	X
Swordfern	X	X
Conifer Boughs	X	X
Oregon-grape	X	
Landscaping Plants	X	X
Moss	X	
Wildflower Seeds		X
Mushrooms	X	
Fiddleheads	X	X
Wildings	X	
Rock		X

Records on quantities of materials removed and dollar value for these materials have not been systematically kept until recently. BLM records are available from 1989 through 1995, although they are not be broken down beyond the Resource area level. Forest Service records are available from 1993 through the present. These can be broken out by township and range (Appendix 2). These records indicate a consistent interest in beargrass, salal and boughs, posts, and firewood.

POTENTIAL PRODUCTS

Besides those items listed above, potential exists for interest in liverworts, lichen, and various medicinal herbs.

POSSIBLE LOCATIONS

Moss and liverworts reach their highest density in the warm moist temperature and climate regime. Lichens may be found throughout. Habitat needs tend to vary widely between the species.

CONCERNS

For many of the species being harvested as special forest products, little is known about the effects that repeated harvesting has on their life cycle. Beargrass is a species that is repeatedly harvested, but has not been studied at the local level. A need exists to study these species and the effects that harvest has on them.

Several Research Natural Areas (RNA's) have been subject to gathering of special forest products, especially beargrass. Although these areas are off limits to gathering, harvesting continues and is likely to do so in the future. Additional posting of no entry and law enforcement presence during harvesting periods may be necessary in order to protect these areas.

OPPORTUNITIES

Opportunities exist for gathering fireweed and honey as special forest products.

RECOMMENDATIONS

1. Conduct botanical surveys in an inclusive manner that includes all vascular species. Manage this information so that it is easily available and queriable as well as site specific.

2. Include non-timber products in management plans. Specify particular areas where these will be priority management concerns.

3. Issue permits after harvest levels that allow for sustainability of the product have been determined.

4. Issue no permits for mosses, lichens or liverworts until watershed-wide sampling has been completed.

5. Issue beargrass permits on a basis that is consistent between agencies. Close harvest from March 1 to September 30 to protect the plant's reproductive cycle.

6. Produce a Forest Service Environmental Impact Statement to address product issues management.

7. Monitor all species harvested on a regular basis for sustainability.

8. Clearly identify Research Natural Areas as areas excluded from harvest. Educate permitees on

the importance of not collecting in Research Natural Areas. Monitor such areas for signs of abuse.

9. Coordinate consistent multi-agency policy for administering permits for beargrass and other major products.

APPENDIX E

APPENDIX E
- WILDLIFE HABITAT ANALYSIS -

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LANDSCAPE PATTERN ANALYSIS

The seven vicinities within the watershed were analyzed for changes in landscape patterns. To begin, the watershed was mapped into three seral stages (early, mid and late) for three separate time periods (late 1800's, late 1930's and 1995). Aerial photography from 1946 was used as the basis from which this mapping was conducted. The mappings for the two earlier time periods were used to express a "reference range" for landscape patterns. This reference range was assumed to depict, more or less, natural landscape pattern dynamics through time as a result of natural disturbances. The mapping from the 1995 time period represents current conditions.

Table 1. Criteria used to initially define seral stages from the 1946 photos and current vegetation GIS coverage.

SERAL STAGE	CRITERIA
EARLY	0-25 years old;openings in canopy
MID	25-100 years old;small trees
LATE	100+ years old;large trees

Once the mapping was completed, it was digitized and converted into raster data of 0.5 acre resolution. This raster data was then processed using the FragStats (version 2.0) spatial pattern analysis program developed by McGarigal and Marks (1994).

Certain indices were selected to quantify changes landscape components. These values ranged from what percent of the total vicinity area a landscape component took up to values that correspond to patch shape and landscape diversity. The indices used are described by each landscape component group below:

Matrix Indices

Percent Interior Habitat = This index shows what percent of the landscape that contains interior late seral habitat. For this analysis, a buffer of 180 meters from the edge of late seral patches was used..

Diversity Index = Shannon's Evenness Index was used for this analysis. This index represents the amount of diversity within the landscape by measuring the distribution of area among patch types. It ranges from 0 to 1. A landscape with only one single patch type will have a value of 0. Maximum diversity for any level of patch richness is based on equal distribution among patch types (McGarigal and Marks 1994). A value of 1 indicates maximum diversity with perfect evenness.

Contagion Index = This index is a measure of the relative patch sizes within the landscape. Its value ranges from 0-100 percent. A landscape with only a few large patches has a higher value than one with many small patches scattered throughout. Low values indicate a more contiguous landscape. Higher values indicate a more fragmented, patchy landscape. The term "Fragmentation Index" was used in the main document and the inverse of the value was applied to the results shown in Table 2.

Patch Indices

Number of Patches = The number of patches of the same habitat type

Largest Patch Size = The largest patch size (in acres) among patches of the same type

Mean Patch Size = The average patch size (in acres) among patches of the same type.

Mean Fractal Dimension = This index is a measure of the average patch shape. The value ranges from 1-2. The more complex the patch shape is the higher the index value gets. A circle or square would represent a value of "1" . As the boundary of the patch gets more complex the index value increases.

Mean Nearest Neighbor = This index is the average distance (in meters) between patches of the same habitat type with a landscape. It is important when considering isolation effects caused by fragmenting the matrix.

The changes in landscape patterns, as seen in the reference range, resulted in changes in wildlife population composition and abundance. Although, this range only extends to the late 1800's, this team feels that it more or less represents changes which may have occurred over the last couple of centuries. By comparing the current conditions to the reference range, land managers have some indication of how to design future landscape shaping activities. The intent should be to design projects which will move current conditions closer to the reference range for ***all*** indices.

For example, in the Wolf Plateau vicinity, the intent should be to reduce the amount of early to mid seral and increase late seral habitat. Interior habitat also needs to be increased, diversity and fragmentation lowered. One method to achieve this would be to focus thinning on the large patches of mid seral to accelerate the development of late seral as well as interior habitat. Avoid creating future large patches of early seral larger than 19 acres. Small openings of less than 3 acres in size may be appropriate in the right locations. Figures 4-25 show values and maps of reference conditions to aid in project design.

NOTE: Current conditions reflected in following figures are based on seral stage mapping using criteria from Table 1. Subsequent mapping of current seral stages was performed by combining mature conifer and old growth using land unit and stand age criteria defined in Appendix C. The two mappings are very similar but do have portions that differ slightly.

Landscape Patterns
(A Bird's-eye View)

Landscape patterns were analyzed for each individual vicinity. Vicinities encompassed areas of similar topography, geology and other natural features. Boundaries were along ridges to encompass groups of subwatersheds.

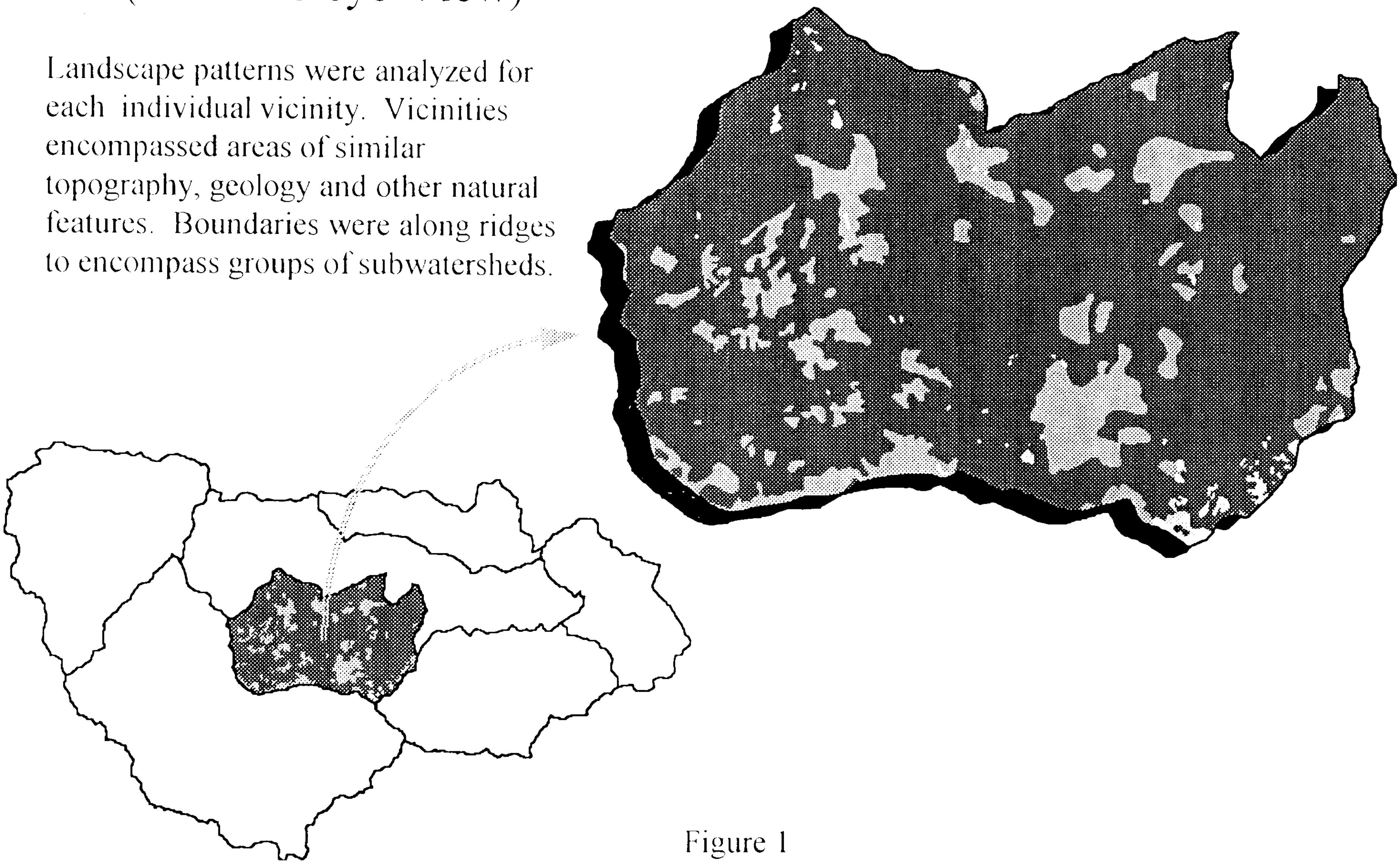


Figure 1

Matrix and Patches

The patterns analyzed consisted of patches of various seral stages within a larger matrix of a single seral stage. Patch size, shape and densities are among some of the characteristics analyzed.

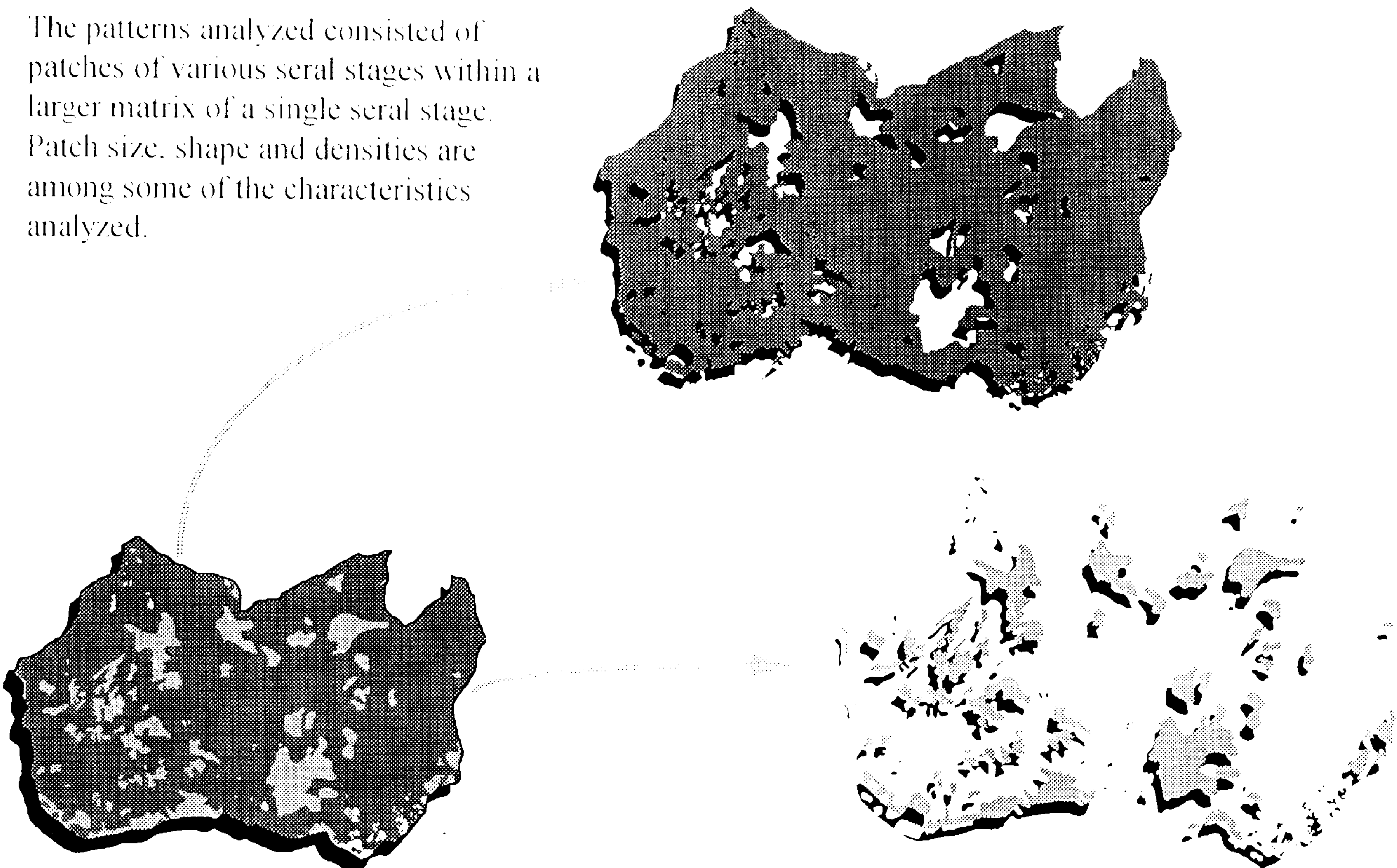
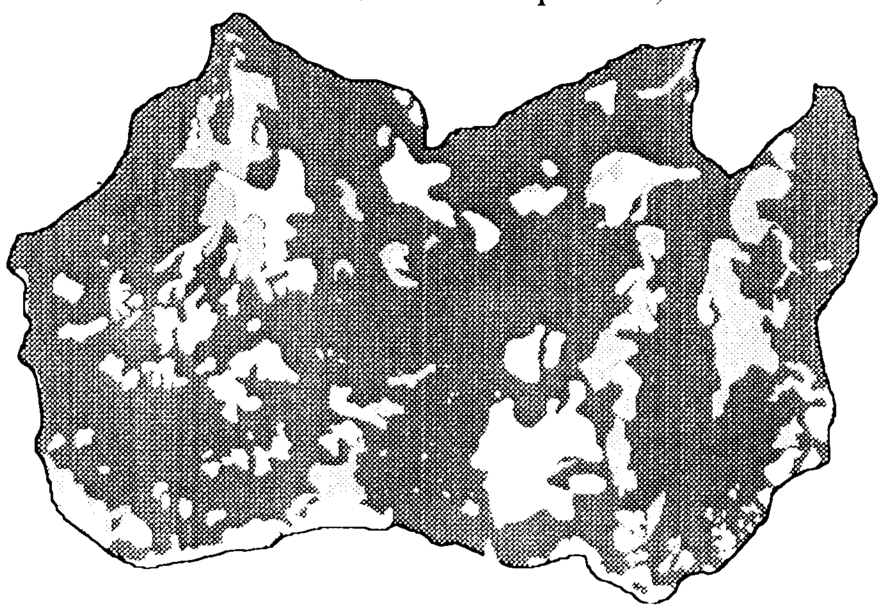
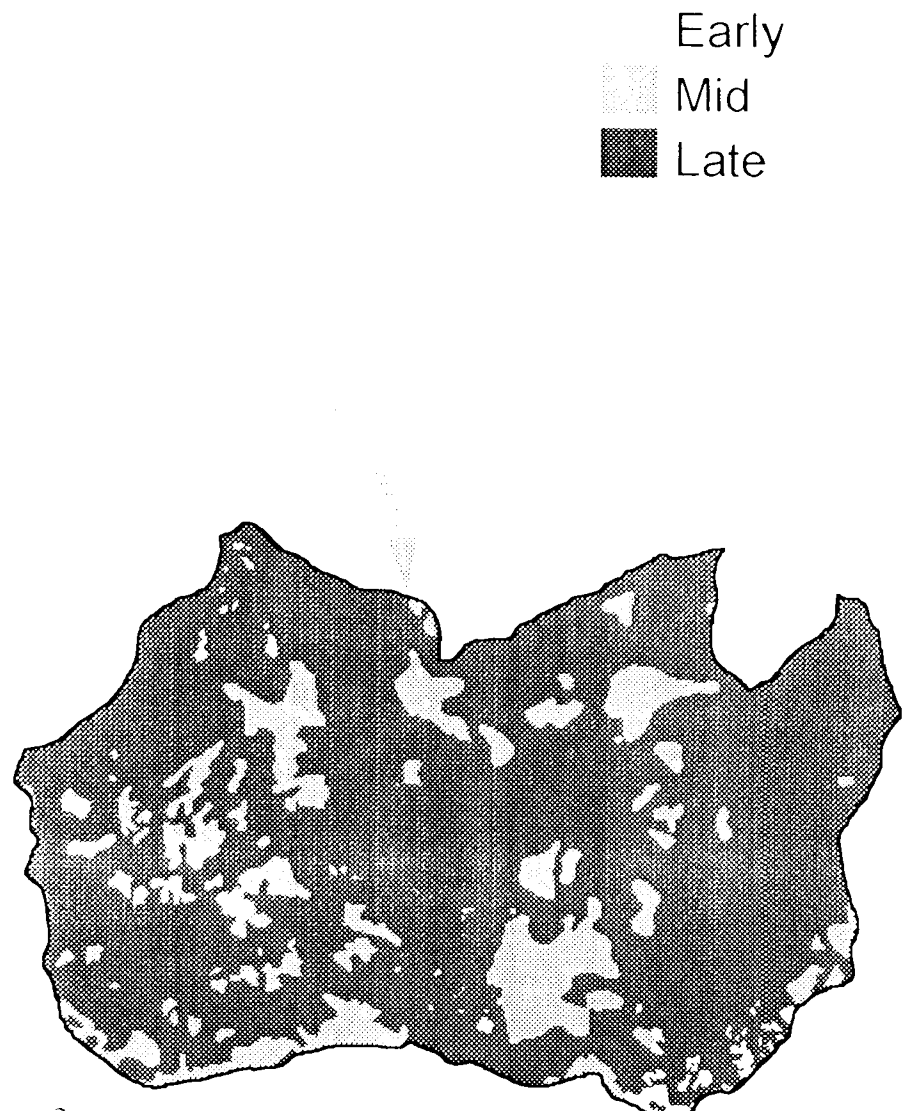


Figure 2

Changes Through Time

(And Space)





The 1946 mapping of seral conditions was used to develop two reference points in time. Landscape patterns were quantified for these two periods to develop a "range" of conditions for the watershed.

Figure 3

TABLE 2. Reference ranges and current conditions for landscape patterns and seral conditions within the seven vicinities of the Little River AMA. The reference range was based on landscape conditions from the late 1800's to the late 1930's.

Vicinity Name	Percent Seral Conditions	Matrix Conditions	Early Seral Patches	Mid Seral Patches
Lower Little River	**Early** 0–100 **Mid** 0–100 **Late** 0–100	**% Interior Forest** 0–100 **Fragmentation** Low–High **Diversity** Low–High	# Patches = 59 - 81 Avg size = 4 - 53 ac Max size = 1,475 ac	# Patches = 57 - 71 Avg size = 18 - 72 ac Max size = 1,028 ac
Middle Little River	**Early** 0–100 **Mid** 0–100 **Late** 0–100	**% Interior Forest** 0–100 **Fragmentation** Low–High **Diversity** Low–High	# Patches = 148 - 194 Avg size = 3 - 25 ac Max size = 311 ac	# Patches = 60 - 74 Avg size = 28 - 84 ac Max size = 2,220 ac
Upper Little River	**Early** 0–100 **Mid** 0–100 **Late** 0–100	**% Interior Forest** 0–100 **Fragmentation** Low–High **Diversity** Low–High	# Patches = 131 - 141 Avg size = 6 - 10 ac Max size = 504 ac	# Patches = 23 - 25 Avg size = 35 - 40 ac Max size = 593 ac
Emile Creek	**Early** 0–100 **Mid** 0–100 **Late** 0–100	**% Interior Forest** 0–100 **Fragmentation** Low–High **Diversity** Low–High	# Patches = 141 - 159 Avg size = 3 - 13 ac Max size = 848 ac	# Patches = 13 - 24 Avg size = 94 - 143 ac Max size = 1,620 ac
Cavitt Creek	**Early** 0–100 **Mid** 0–100 **Late** 0–100	**% Interior Forest** 0–100 **Fragmentation** Low–High **Diversity** Low–High	# Patches = 212 - 273 Avg size = 5 - 25 ac Max size = 692 ac	# Patches = 137 - 156 Avg size = 28 - 40 ac Max size = 554 ac
Wolf Plateau	**Early** 0–100 **Mid** 0–100 **Late** 0–100	**% Interior Forest** 0–100 **Fragmentation** Low–High **Diversity** Low–High	# Patches = 56 - 112 Avg size = 3 - 19 ac Max size = 418 ac	# Patches = 36 and 61 Avg size = 34 - 36 ac Max size = 425 ac
Black Clover	**Early** 0–100 **Mid** 0–100 **Late** 0–100	**% Interior Forest** 0–100 **Fragmentation** Low–High **Diversity** Low–High	# Patches = 163 - 199 Avg size = 3 - 25 ac Max size = 524 ac	# Patches = 45 - 72 Avg size = 54 - 99 ac Max size = 1,875 ac

▒ = Reference Range   ⬮ = Current Condition

Figure 4

Landscape Pattern Changes

– Lower Little River –

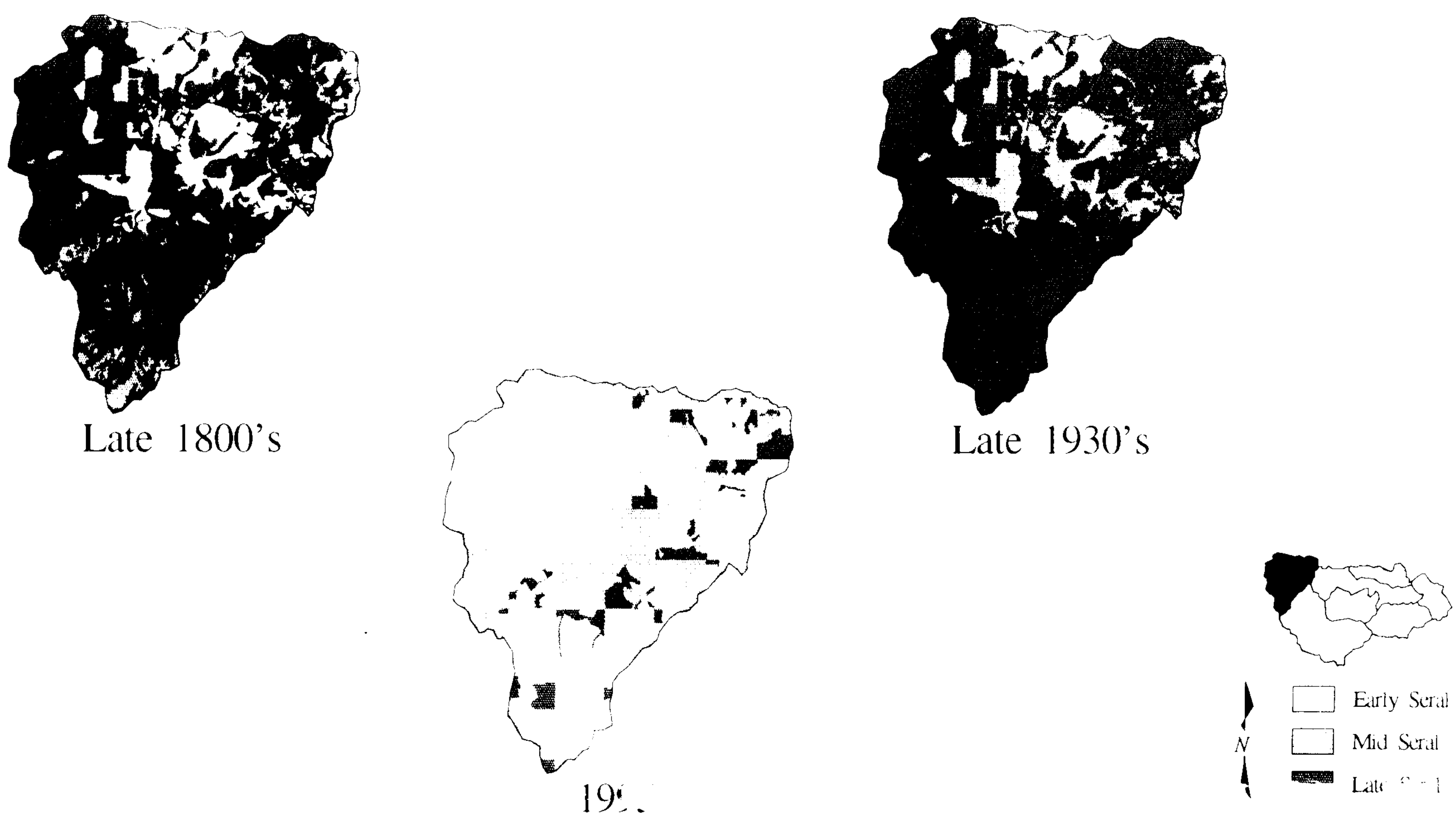


Figure 5

Landscape Pattern Changes

– Middle Little River –

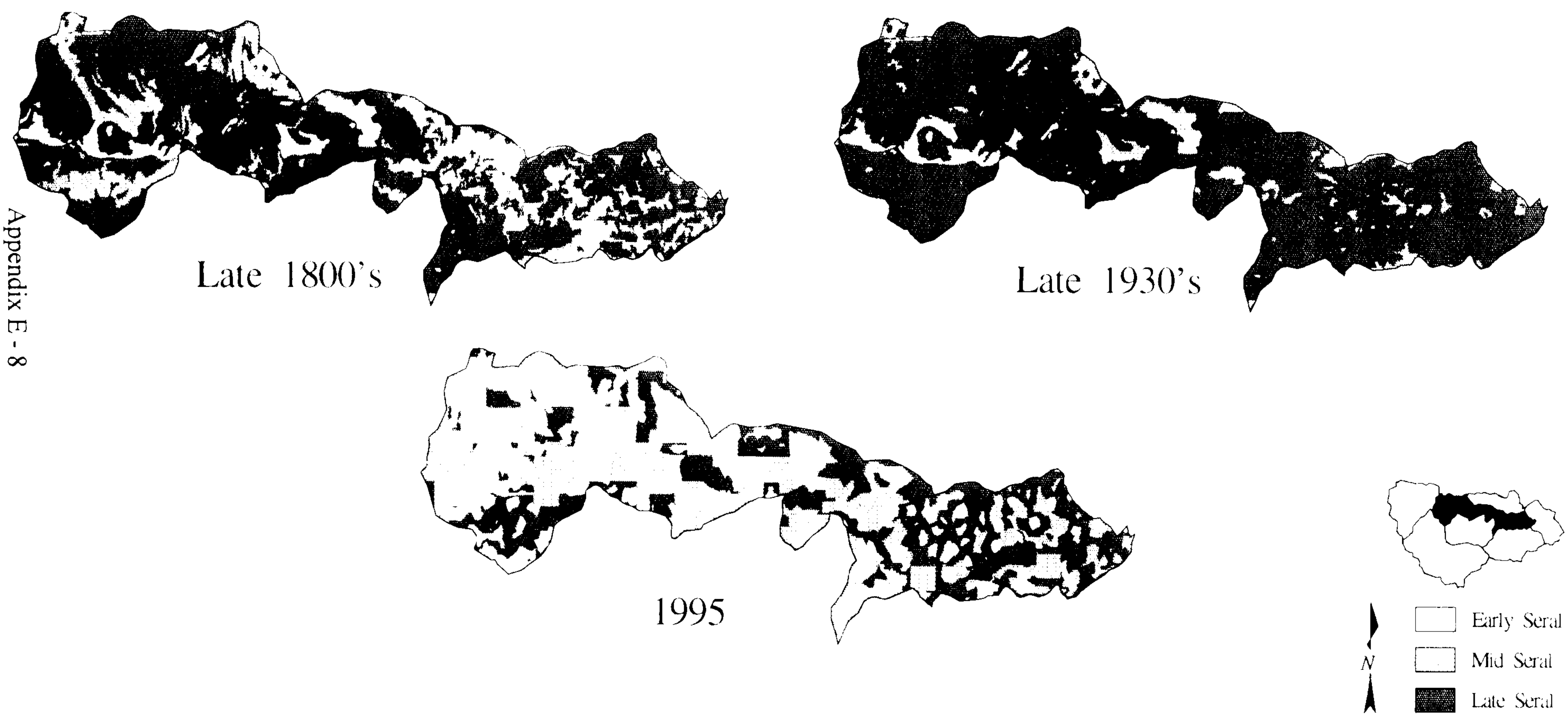


Figure 6

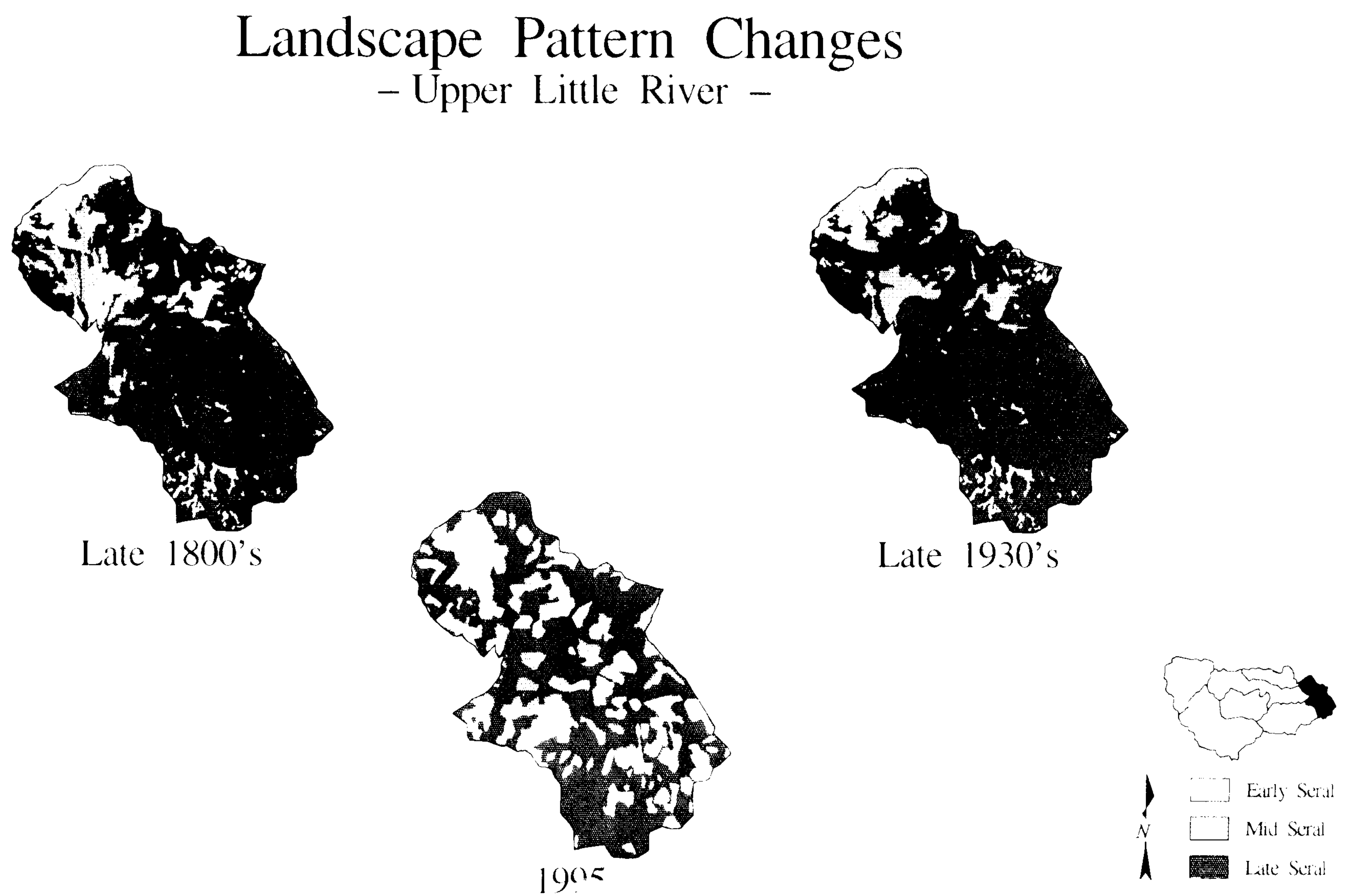

Landscape Pattern Changes
– Upper Little River –
Late 1800's
1995
Late 1930's
Early Seral
Mid Seral
Late Seral
N

Figure 7

Landscape Pattern Changes

– Emile Creek –

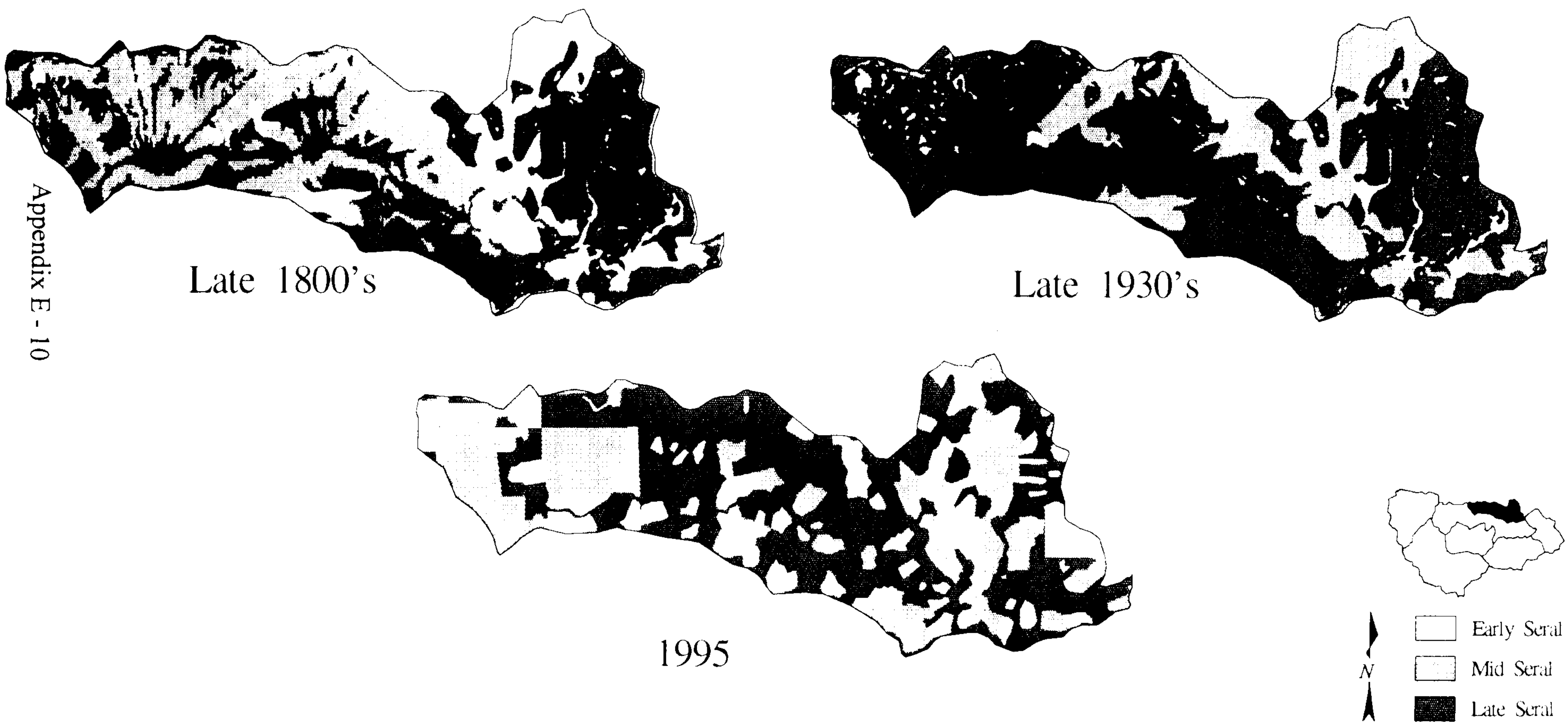


Figure 8

Landscape Pattern Changes
– Cavitt Creek –

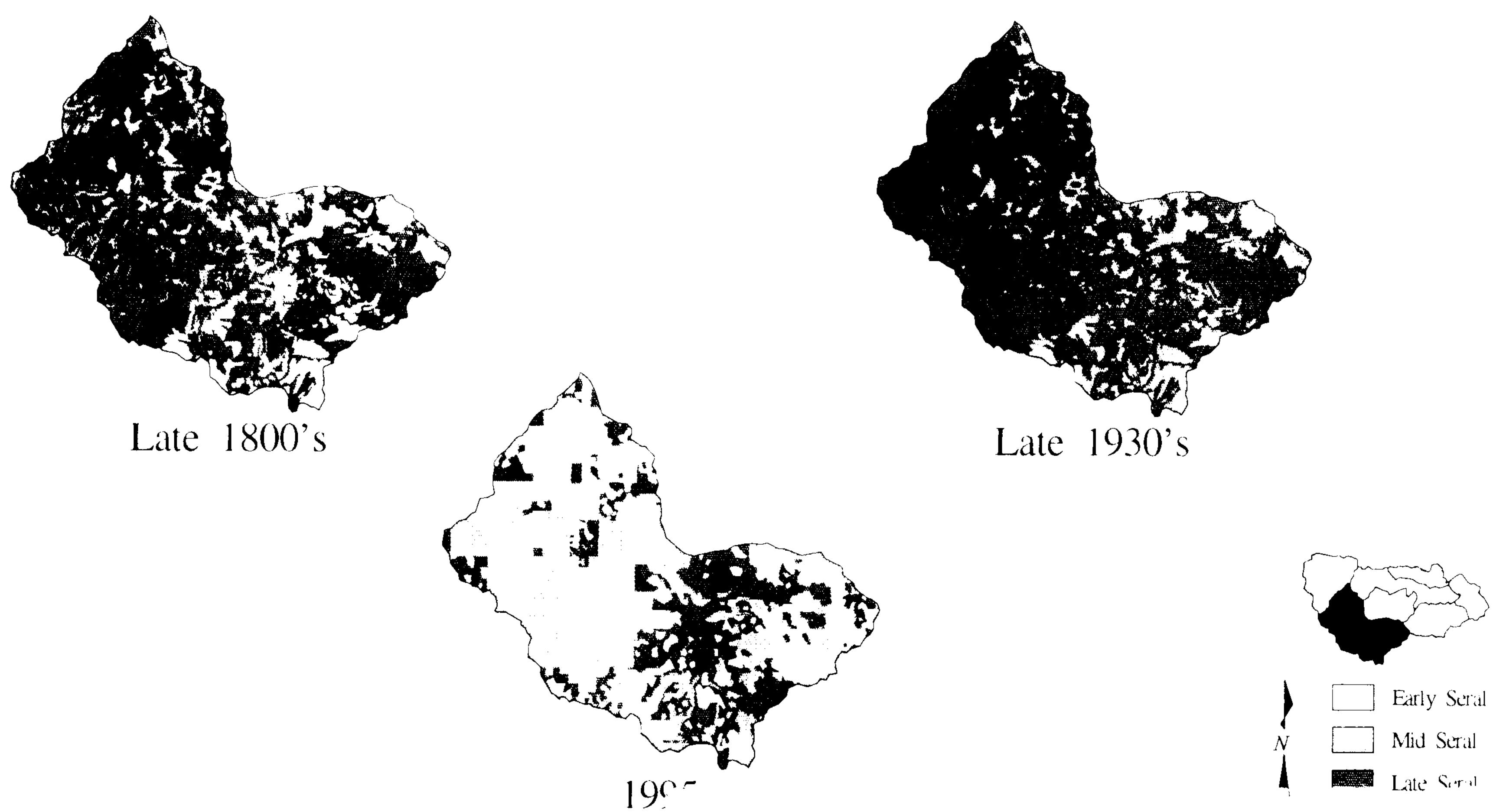


Figure 9

Landscape Pattern Changes

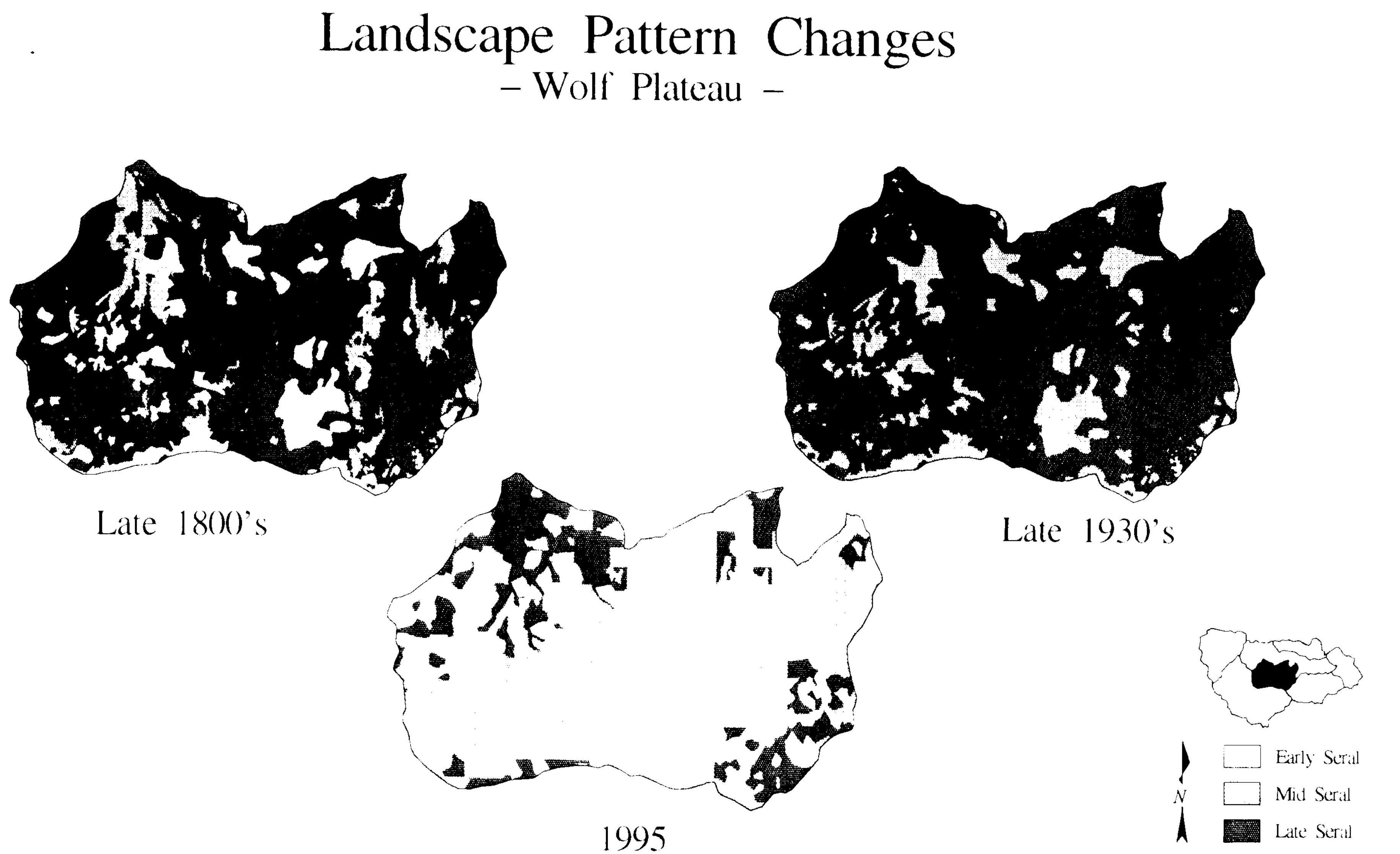
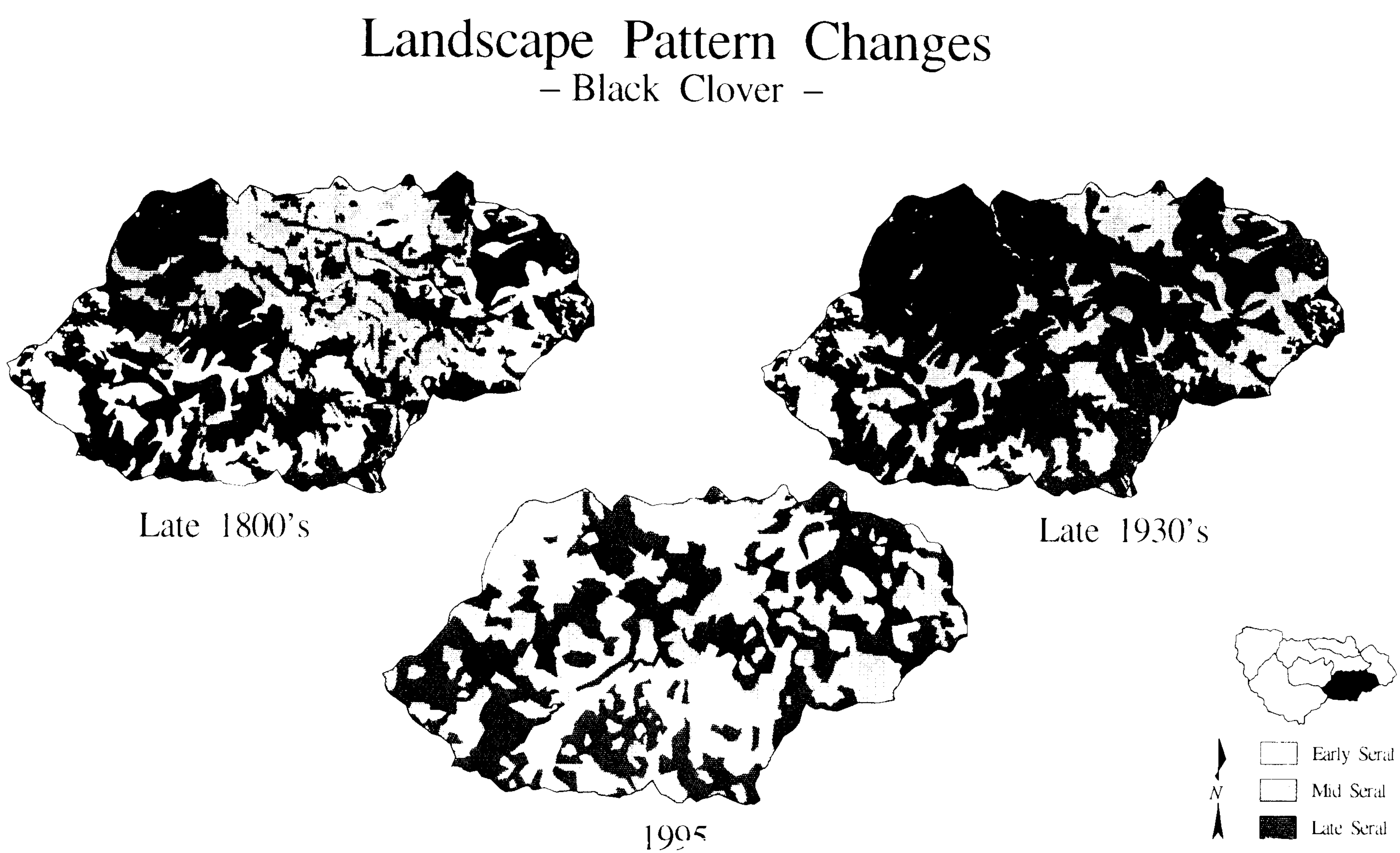


Figure 10


Landscape Pattern Changes
- Black Clover -
Late 1800's
Late 1930's
1995
N
Early Seral
Mid Seral
Late Seral

WILDLIFE HABITAT RELATIONSHIPS

Lists of local wildlife are shown in Tables 3-9 for species that require various structure stages for primary feeding and breeding. These tables also indicate if the animal is primarily terrestrial, riparian or associated with special habitats. They also include home range sizes defined in three broad categories (small, medium and large).

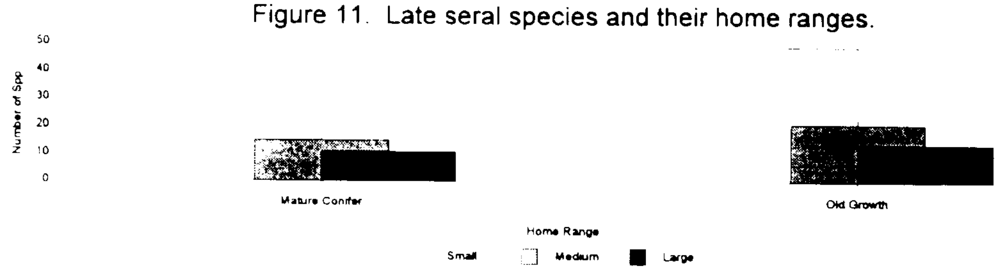
Small Home Range = 100 acres or less
Medium Home Range = 100-1,000 acres
Large Home Range = 1,000 acres or greater

These tables were compiled through the use of a wildlife habitat relationships database developed by Mellen et al. (1994). This database was updated for the Little River watershed area using local knowledge and professional opinion. The database, currently available, allows the user to query for groups (guilds) or individual species as desired. It relates habitat information from several literature sources to species use and other information. The data continues to be updated as more information is obtained. As this process progresses, the database will become more accurate for the local area.

Some species appear in more than just one table, these species are termed as "mosaic" (use from 1-2 structural stages) or "generalist" species (do well in all habitat types). The only species that occurs in all tables is the raccoon. For this analysis, only the primary breeding and feeding habitat was looked at. Many of the species listed use, as secondary habitat, other habitat types. Once again, the database can be queried to generate a list of these species if required.

Because of the major changes to late seral habitats within the watershed, species which occur in the mature conifer and old growth habitat types are of highest concern.

Figure 11. Late seral species and their home ranges.



Because of the high amount of habitat loss and fragmentation, animals that require late seral and that have large home ranges are more at risk. Those that can use small patch sizes and have small home ranges are at lower risk of immediate extirpation but if isolation of patches continues, the adverse effects of long term isolation may cause future extirpations. Tables 11-13 these species of concern.

Table 3. Wildlife that use grass-forb habitat within the Little River watershed for primary breeding and feeding functions.

Class	Common Name	Scientific Name	Group	Home Range
Amphibian	Clouded salamander	*Aneides ferreus*	TERR	SMALL
Amphibian	Long-toed salamander	*Ambystoma macrodactylum*	TERR	SMALL
Amphibian	Northwestern salamander	*Ambystoma gracile*	TERR	SMALL
Bird	American kestrel	*Falco sparverius*	TERR	MED
Bird	Anna's hummingbird	*Calypte anna*	TERR	SMALL
Bird	Common nighthawk	*Chordeiles minor*	TERR	MED
Bird	Lincoln's sparrow	*Melospiza lincolnii*	TERR	SMALL
Bird	Long-eared owl	*Asio otus*	TERR	MED
Bird	Mountain quail	*Oreortyx pictus*	TERR	SMALL
Bird	Rufous hummingbird	*Selasphorus rufus*	TERR	SMALL
Bird	Song sparrow	*Melospiza melodia*	TERR	SMALL
Bird	Tree swallow	*Tachycineta bicolor*	TERR	SMALL
Bird	Turkey vulture	*Cathartes aura*	TERR	LARGE
Bird	Vaux's swift	*Chaetura vauxi*	TERR	SMALL
Bird	Vesper sparrow	*Pooecetes gramineus*	TERR	SMALL
Bird	Water pipit	*Anthus spinoletta*	TERR	SMALL
Bird	Western bluebird	*Sialia mexicana*	TERR	SMALL
Bird	White-crowned sparrow	*Zonotrichia leucophrys*	TERR	SMALL
Mammal	Black-tailed deer	*Odocoileus hemionus*	TERR	MED
Mammal	Black-tailed jack rabbit	*Lepus californicus*	TERR	SMALL
Mammal	Brush rabbit	*Sylvilagus bachmani*	TERR	SMALL
Mammal	California ground squirrel	*Spermophilus beecheyi*	TERR	SMALL
Mammal	California myotis	*Myotis californicus*	TERR	MED
Mammal	Coast mole	*Scapanus orarius*	TERR	SMALL
Mammal	Columbian white-tailed deer	*Odocoileus virginianus leucurus*	TERR	LARGE
Mammal	Coyote	*Canis latrans*	TERR	LARGE
Mammal	Creeping vole	*Microtus oregoni*	TERR	SMALL
Mammal	Deer mouse	*Peromyscus maniculatus*	TERR	SMALL
Mammal	Elk	*Cervus elaphus*	TERR	LARGE
Mammal	Fringed myotis	*Myotis thysanodes*	TERR	MED
Mammal	Gray fox	*Urocyon cinereoargenteus*	TERR	LARGE
Mammal	Heather vole	*Phenacomys intermedius*	TERR	SMALL
Mammal	Little brown myotis	*Myotis lucifugus*	TERR	MED
Mammal	Long-tailed vole	*Microtus longicaudus abditus*	TERR	SMALL
Mammal	Long-tailed weasel	*Mustela frenata*	TERR	MED
Mammal	Northern pocket gopher	*Thomomys talpoides*	TERR	SMALL
Mammal	Pallid bat	*Antrozous pallidus*	TERR	MED
Mammal	Pika	*Ochotona princeps*	SPCL	SMALL
Mammal	Raccoon	*Procyon lotor*	TERR	SMALL
Mammal	Red fox	*Vulpes vulpes*	TERR	LARGE
Mammal	Ringtail	*Bassariscus astutus*	TERR	MED
Mammal	Snowshoe hare	*Lepus americanus*	TERR	SMALL
Mammal	Striped skunk	*Mephitis mephitis*	TERR	MED
Mammal	Townsend's mole	*Scapanus townsendii*	TERR	SMALL
Mammal	Townsend's vole	*Microtus townsendii*	TERR	SMALL
Mammal	Vagrant shrew	*Sorex vagrans*	TERR	SMALL
Mammal	Western pocket gopher	*Thomomys mazama*	TERR	SMALL
Reptile	Common garter snake	*Thamnophis sirtalis*	TERR	SMALL
Reptile	Common kingsnake	*Lampropeltus getulus*	TERR	SMALL
Reptile	Northern alligator lizard	*Elgaria coerulea*	TERR	SMALL
Reptile	Northwestern garter snake	*Thamnophis ordinoides*	TERR	SMALL
Reptile	Racer	*Coluber constrictor*	TERR	SMALL
Reptile	Ringneck snake	*Diadophis punctatus*	TERR	SMALL
Reptile	Rubber boa	*Charina bottae*	TERR	SMALL
Reptile	Sharptail snake	*Contia tenuis*	TERR	SMALL
Reptile	Southern alligator lizard	*Elgaria multicarinata*	TERR	SMALL
Reptile	Western fence lizard	*Sceloporus occidentalis*	TERR	SMALL
Reptile	Western rattlesnake	*Crotalus viridis*	TERR	MED
Reptile	Western skink	*Eumeces skiltonianus*	TERR	SMALL
Reptile	Western terrestrial garter snake	*Thamnopsis elegans*	TERR	SMALL

Table 4. Wildlife that use shrub habitat within the Little River watershed for primary breeding and feeding functions.

Class	Common Name	Scientific Name	Group	Home Range
Amphibian	Clouded salamander	*Aneides ferreus*	TERR	SMALL
Amphibian	Long-toed salamander	*Ambystoma macrodactylum*	TERR	SMALL
Amphibian	Northwestern salamander	*Ambystoma gracile*	TERR	SMALL
Bird	American goldfinch	*Carduelis tristis*	TERR	SMALL
Bird	American robin	*Turdus migratorius*	TERR	SMALL
Bird	Anna's hummingbird	*Calypte anna*	TERR	SMALL
Bird	Black-chinned hummingbird	*Archilochus alexandri*	TERR	SMALL
Bird	Blue grouse	*Dendragapus obscurus*	TERR	SMALL
Bird	Brewer's blackbird	*Euphagus cyanocephalus*	TERR	SMALL
Bird	Brown-headed cowbird	*Molothrus ater*	TERR	SMALL
Bird	Bushtit	*Psaltriparus minimus*	TERR	SMALL
Bird	Chipping sparrow	*Spizella passerina*	TERR	SMALL
Bird	Common nighthawk	*Chordeiles minor*	TERR	MED
Bird	Dark-eyed junco	*Junco hyemalis*	TERR	SMALL
Bird	Dusky flycatcher	*Empidonax oberholseri*	TERR	SMALL
Bird	Fox sparrow	*Passerella iliaca*	TERR	SMALL
Bird	Green-tailed towhee	*Pipilo chlorurus*	TERR	SMALL
Bird	Hermit thrush	*Catharus guttatus*	TERR	SMALL
Bird	Hutton's vireo	*Vireo huttoni*	TERR	SMALL
Bird	Long-eared owl	*Asio otus*	TERR	MED
Bird	MacGillivray's warbler	*Oporornis tolmiei*	TERR	SMALL
Bird	Mountain quail	*Oreortyx pictus*	TERR	SMALL
Bird	Nashville warbler	*Vermivora ruficapilla*	TERR	SMALL
Bird	Orange-crowned warbler	*Vermivora celata*	TERR	SMALL
Bird	Rufous hummingbird	*Selasphorus rufus*	TERR	SMALL
Bird	Rufous-sided towhee	*Pipilo erythrophtalmus*	TERR	SMALL
Bird	Song sparrow	*Melospiza melodia*	TERR	SMALL
Bird	Swainson's thrush	*Catharus ustulatus*	TERR	SMALL
Bird	Townsend's solitaire	*Myadestes townsendi*	TERR	SMALL
Bird	Vaux's swift	*Chaetura vauxi*	TERR	SMALL
Bird	Water pipit	*Anthus spinoletta*	TERR	SMALL
Bird	Western bluebird	*Sialia mexicana*	TERR	SMALL
Bird	White-crowned sparrow	*Zonotrichia leucophrys*	TERR	SMALL
Bird	Willow flycatcher	*Empidonax traillii*	TERR	SMALL
Bird	Wilson's warbler	*Wilsonia pusilla*	TERR	SMALL
Bird	Yellow-rumped warbler	*Dendroica coronata*	TERR	SMALL
Mammal	Black-tailed deer	*Odocoileus hemionus*	TERR	MED
Mammal	Bobcat	*Lynx rufus*	TERR	LARGE
Mammal	Coast mole	*Scapanus orarius*	TERR	SMALL
Mammal	Coyote	*Canis latrans*	TERR	LARGE
Mammal	Creeping vole	*Microtus oregoni*	TERR	SMALL
Mammal	Deer mouse	*Peromyscus maniculatus*	TERR	SMALL
Mammal	Dusky-footed woodrat	*Neotoma fuscipes*	TERR	SMALL
Mammal	Elk	*Cervus elaphus*	TERR	LARGE
Mammal	Ermine	*Mustela erminea*	TERR	SMALL
Mammal	Fringed myotis	*Myotis thysanodes*	TERR	MED
Mammal	Gray fox	*Urocyon cinereoargenteus*	TERR	LARGE
Mammal	Heather vole	*Phenacomys intermedius*	TERR	SMALL
Mammal	Little brown myotis	*Myotis lucifugus*	TERR	MED
Mammal	Long-tailed vole	*Microtus longicaudus abditus*	TERR	SMALL
Mammal	Long-tailed weasel	*Mustela frenata*	TERR	MED
Mammal	Mountain beaver	*Aplodontia rufa*	TERR	SMALL
Mammal	Mountain lion	*Felis concolor*	TERR	LARGE
Mammal	Porcupine	*Erethizon dorsatum*	TERR	MED
Mammal	Raccoon	*Procyon lotor*	TERR	SMALL
Mammal	Red fox	*Vulpes vulpes*	TERR	LARGE
Mammal	Ringtail	*Bassariscus astutus*	TERR	MED
Mammal	Snowshoe hare	*Lepus americanus*	TERR	SMALL
Mammal	Spotted skunk	*Spilogale gracilis*	TERR	MED
Mammal	Striped skunk	*Mephitis mephitis*	TERR	MED
Mammal	Townsend's vole	*Microtus townsendii*	TERR	SMALL
Reptile	California mountain kingsnake	*Lampropeltis zonata*	TERR	SMALL
Reptile	Common garter snake	*Thamnophis sirtalis*	TERR	SMALL
Reptile	Common kingsnake	*Lampropeltis getulus*	TERR	SMALL
Reptile	Northern alligator lizard	*Elgaria coerulea*	TERR	SMALL
Reptile	Northwestern garter snake	*Thamnophis ordinoides*	TERR	SMALL
Reptile	Racer	*Coluber constrictor*	TERR	SMALL
Reptile	Ringneck snake	*Diadophis punctatus*	TERR	SMALL

Table 4 (cont.)

Class	Common Name	Scientific Name	Group	Home Range
Reptile	Rubber boa	*Charina bottae*	TERR	SMALL
Reptile	Sharptail snake	*Contia tenius*	TERR	SMALL
Reptile	Southern alligator lizard	*Elgaria multicarinata*	TERR	SMALL
Reptile	Western fence lizard	*Sceloporus occidentalis*	TERR	SMALL
Reptile	Western rattlesnake	*Crotalus viridis*	TERR	MED
Reptile	Western skink	*Eumeces skiltonianus*	TERR	SMALL

Table 5. Wildlife that use open pole habitat within the Little River watershed for primary breeding and feeding functions.

Class	Common Name	Scientific Name	Group	Home Range
Amphibian	Clouded salamander	*Aneides ferreus*	TERR	SMALL
Amphibian	Western redback salamander	*Plethodon vehiculum*	TERR	SMALL
Bird	American goldfinch	*Carduelis tristis*	TERR	SMALL
Bird	American robin	*Turdus migratorius*	TERR	SMALL
Bird	Anna's hummingbird	*Calypte anna*	TERR	SMALL
Bird	Black-backed woodpecker	*Picoides arcticus*	TERR	MED
Bird	Black-throated gray warbler	*Dendroica nigrescens*	TERR	SMALL
Bird	Blue grouse	*Dendragapus obscurus*	TERR	SMALL
Bird	Brown-headed cowbird	*Molothrus ater*	TERR	SMALL
Bird	Bushtit	*Psaltriparus minimus*	TERR	SMALL
Bird	Chestnut-backed chickadee	*Parus rufescens*	TERR	SMALL
Bird	Chipping sparrow	*Spizella passerina*	TERR	SMALL
Bird	Dark-eyed junco	*Junco hyemalis*	TERR	SMALL
Bird	Dusky flycatcher	*Empidonax oberholseri*	TERR	SMALL
Bird	Evening grosbeak	*Coccothraustes vespertina*	TERR	SMALL
Bird	Golden-crowned kinglet	*Regulus satrapa*	TERR	SMALL
Bird	Gray jay	*Perisoreus canadensis*	RIPAR	MED
Bird	Green-tailed towhee	*Pipilo chlorurus*	TERR	SMALL
Bird	Hammond's flycatcher	*Empidonax hammondii*	TERR	SMALL
Bird	Hermit thrush	*Catharus guttatus*	TERR	SMALL
Bird	Hutton's vireo	*Vireo huttoni*	TERR	SMALL
Bird	MacGillivray's warbler	*Oporornis tolmiei*	TERR	SMALL
Bird	Mountain chickadee	*Parus gambeli*	TERR	SMALL
Bird	Nashville warbler	*Vermivora ruficapilla*	TERR	SMALL
Bird	Northern flicker	*Colaptes auratus*	TERR	MED
Bird	Northern three-toed woodpecker	*Picoides tridactylus*	TERR	MED
Bird	Orange-crowned warbler	*Vermivora celata*	TERR	SMALL
Bird	Pine grosbeak	*Pinicola enucleator*	TERR	SMALL
Bird	Pine siskin	*Carduelis pinus*	TERR	SMALL
Bird	Purple finch	*Carpodacus purpureus*	TERR	SMALL
Bird	Red-breasted nuthatch	*Sitta canadensis*	TERR	MED
Bird	Rufous hummingbird	*Selasphorus rufus*	TERR	SMALL
Bird	Rufous sided towhee	*Pipilo erythrophtalmus*	TERR	SMALL
Bird	Sharp-shinned hawk	*Accipiter striatus*	TERR	MED
Bird	Solitary vireo	*Vireo solitarius*	TERR	SMALL
Bird	Song sparrow	*Melospiza melodia*	TERR	SMALL
Bird	Steller's jay	*Cyanocitta stelleri*	TERR	SMALL
Bird	Townsend's solitaire	*Myadestes townsendi*	TERR	SMALL
Bird	Vaux's swift	*Chaetura vauxi*	TERR	SMALL
Bird	Western bluebird	*Sialia mexicana*	TERR	SMALL
Bird	Wild turkey	*Meleagris gallopavo*	TERR	MED
Bird	Willow flycatcher	*Empidonax traillii*	TERR	SMALL
Bird	Wilson's warbler	*Wilsonia pusilla*	TERR	SMALL
Bird	Yellow-rumped warbler	*Dendroica coronata*	TERR	SMALL
Mammal	Black bear	*Ursus americanus*	TERR	LARGE
Mammal	Black-tailed deer	*Odocoileus hemionus*	TERR	MED
Mammal	Bobcat	*Lynx rufus*	TERR	LARGE
Mammal	Brush rabbit	*Sylvilagus bachmani*	TERR	SMALL
Mammal	Coast mole	*Scapanus orarius*	TERR	SMALL
Mammal	Coyote	*Canis latrans*	TERR	LARGE
Mammal	Creeping vole	*Microtus oregoni*	TERR	SMALL
Mammal	Deer mouse	*Peromyscus maniculatus*	TERR	SMALL
Mammal	Dusky-footed woodrat	*Neotoma fuscipes*	TERR	SMALL
Mammal	Elk	*Cervus elaphus*	TERR	LARGE
Mammal	Ermine	*Mustela erminea*	TERR	SMALL
Mammal	Gray fox	*Urocyon cinereoargenteus*	TERR	LARGE
Mammal	Long-tailed weasel	*Mustela frenata*	TERR	MED
Mammal	Mountain beaver	*Aplodontia rufa*	TERR	SMALL
Mammal	Mountain lion	*Felis concolor*	TERR	LARGE
Mammal	Pallid bat	*Antrozous pallidus*	TERR	MED
Mammal	Porcupine	*Erethizon dorsatum*	TERR	MED
Mammal	Raccoon	*Procyon lotor*	TERR	SMALL
Mammal	Red tree vole	*Phenacomys longicaudus*	TERR	SMALL
Mammal	Ringtail	*Bassariscus astutus*	TERR	MED
Mammal	Spotted skunk	*Spilogale gracilis*	TERR	MED
Mammal	Townsend's chipmunk	*Eutamias townsendii*	TERR	SMALL
Mammal	Western red-backed vole	*Clethrionomys californicus*	TERR	SMALL
Mammal	Wolverine	*Gulo gulo*	TERR	LARGE

Table 5 (cont.)

Class	Common Name	Scientific Name	Group	Home Range
Reptile	California mountain kingsnake	*Lampropeltus zonata*	TERR	SMALL
Reptile	Common garter snake	*Thamnophis sirtalis*	TERR	SMALL
Reptile	Northern alligator lizard	*Elgaria coerulea*	TERR	SMALL
Reptile	Ringneck snake	*Diadophis punctatus*	TERR	SMALL
Reptile	Rubber boa	*Charina bottae*	TERR	SMALL
Reptile	Sharptail snake	*Contia tenuis*	TERR	SMALL
Reptile	Southern alligator lizard	*Elgaria multicarinata*	TERR	SMALL
Reptile	Western fence lizard	*Sceloporus occidentalis*	TERR	SMALL

Table 6. Wildlife that use closed pole habitat within the Little River watershed for primary breeding and feeding functions.

Class	Common Name	Scientific Name	Group	Home Range
Amphibian	Clouded salamander	*Aneides ferreus*	TERR	SMALL
Amphibian	Ensatina	*Ensatina eschscholtzii*	TERR	SMALL
Amphibian	Western redback salamander	*Plethodon vehiculum*	TERR	SMALL
Bird	American robin	*Turdus migratorius*	TERR	SMALL
Bird	Black-backed woodpecker	*Picoides arcticus*	TERR	MED
Bird	Black-throated gray warbler	*Dendroica nigrescens*	TERR	SMALL
Bird	Blue grouse	*Dendragapus obscurus*	TERR	SMALL
Bird	Brown creeper	*Certhia americana*	TERR	SMALL
Bird	Cassin's finch	*Carpodacus cassinii*	TERR	SMALL
Bird	Chestnut-backed chickadee	*Parus rufescens*	TERR	SMALL
Bird	Cooper's hawk	*Accipiter cooperii*	TERR	MED
Bird	Evening grosbeak	*Coccothraustes vespertina*	TERR	SMALL
Bird	Golden-crowned kinglet	*Regulus satrapa*	TERR	SMALL
Bird	Gray jay	*Perisoreus canadensis*	RIPAR	MED
Bird	Hammond's flycatcher	*Empidonax hammondii*	TERR	SMALL
Bird	Hermit thrush	*Catharus guttatus*	TERR	SMALL
Bird	Hermit warbler	*Dendroica occidentalis*	TERR	SMALL
Bird	Mountain chickadee	*Parus gambeli*	TERR	SMALL
Bird	Northern flicker	*Colaptes auratus*	TERR	MED
Bird	Northern three-toed woodpecker	*Picoides tridactylus*	TERR	MED
Bird	Pine siskin	*Carduelis pinus*	TERR	SMALL
Bird	Red-breasted nuthatch	*Sitta canadensis*	TERR	MED
Bird	Sharp-shinned hawk	*Accipiter striatus*	TERR	MED
Bird	Solitary vireo	*Vireo solitarius*	TERR	SMALL
Bird	Steller's jay	*Cyanocitta stelleri*	TERR	SMALL
Bird	Swainson's thrush	*Catharus ustulatus*	TERR	SMALL
Bird	Western tanager	*Piranga ludoviciana*	TERR	SMALL
Bird	Wild turkey	*Meleagris gallopavo*	TERR	MED
Bird	Willow flycatcher	*Empidonax traillii*	TERR	SMALL
Bird	Wilson's warbler	*Wilsonia pusilla*	TERR	SMALL
Bird	Winter wren	*Troglodytes troglodytes*	TERR	SMALL
Bird	Yellow-rumped warbler	*Dendroica coronata*	TERR	SMALL
Mammal	Black bear	*Ursus americanus*	TERR	LARGE
Mammal	Black-tailed deer	*Odocoileus hemionus*	TERR	MED
Mammal	Deer mouse	*Peromyscus maniculatus*	TERR	SMALL
Mammal	Douglas' squirrel	*Tamiasciurus douglasi*	TERR	SMALL
Mammal	Dusky shrew	*Sorex monticolus*	TERR	SMALL
Mammal	Dusky-footed woodrat	*Neotoma fuscipes*	TERR	SMALL
Mammal	Ermine	*Mustela erminea*	TERR	SMALL
Mammal	Porcupine	*Erethizon dorsatum*	TERR	MED
Mammal	Raccoon	*Procyon lotor*	TERR	SMALL
Mammal	Red tree vole	*Phenacomys longicaudus*	TERR	SMALL
Mammal	Townsend's chipmunk	*Eutamias townsendi*	TERR	SMALL
Mammal	Western gray squirrel	*Sciurus griseus*	TERR	SMALL
Mammal	Western red-backed vole	*Clethrionomys californicus*	TERR	SMALL
Mammal	Wolverine	*Gulo gulo*	TERR	LARGE
Reptile	California mountain kingsnake	*Lampropeltis zonata*	TERR	SMALL

Table 7. Wildlife that use mature conifer habitat within the Little River watershed for primary breeding and feeding functions.

Class	Common Name	Scientific Name	Group	Home Range
Amphibian	Ensatina	*Ensatina eschscholtzii*	TERR	SMALL
Amphibian	Western redback salamander	*Plethodon vehiculum*	TERR	SMALL
Bird	Barn owl	*Tyto alba*	TERR	MED
Bird	Barred owl	*Strix varia*	TERR	LARGE
Bird	Black-backed woodpecker	*Picoides arcticus*	TERR	MED
Bird	Black-throated gray warbler	*Dendroica nigrescens*	TERR	SMALL
Bird	Brown creeper	*Certhia americana*	TERR	SMALL
Bird	Cassin's finch	*Carpodacus cassinii*	TERR	SMALL
Bird	Chestnut-backed chickadee	*Parus rufescens*	TERR	SMALL
Bird	Common raven	*Corvus corax*	TERR	LARGE
Bird	Cooper's hawk	*Accipiter cooperii*	TERR	MED
Bird	Dark-eyed junco	*Junco hyemalis*	TERR	SMALL
Bird	Evening grosbeak	*Coccothraustes vespertina*	TERR	SMALL
Bird	Golden-crowned kinglet	*Regulus satrapa*	TERR	SMALL
Bird	Gray jay	*Perisoreus canadensis*	RIPAR	MED
Bird	Great gray owl	*Strix nebulosa*	TERR	LARGE
Bird	Great horned owl	*Bubo virginianus*	TERR	LARGE
Bird	Hairy woodpecker	*Picoides villosus*	TERR	SMALL
Bird	Hammond's flycatcher	*Empidonax hammondii*	TERR	SMALL
Bird	Hermit thrush	*Catharus guttatus*	TERR	SMALL
Bird	Hermit warbler	*Dendroica occidentalis*	TERR	SMALL
Bird	Lewis' woodpecker	*Melanerpes lewis*	TERR	SMALL
Bird	Mountain chickadee	*Parus gambeli*	TERR	SMALL
Bird	Northern flicker	*Colaptes auratus*	TERR	MED
Bird	Northern goshawk	*Accipiter gentilis*	TERR	LARGE
Bird	Northern pygmy owl	*Glaucidium gnoma*	TERR	SMALL
Bird	Northern saw-whet owl	*Aegolius acadicus*	TERR	MED
Bird	Northern three-toed woodpecker	*Picoides tridactylus*	TERR	MED
Bird	Olive-sided flycatcher	*Contopus borealis*	TERR	SMALL
Bird	Pacific slope flycatcher	*Empidonax difficilis*	TERR	SMALL
Bird	Pileated woodpecker	*Dryocopus pileatus*	TERR	LARGE
Bird	Pine grosbeak	*Pinicola enucleator*	TERR	SMALL
Bird	Pine siskin	*Carduelis pinus*	TERR	SMALL
Bird	Pygmy nuthatch	*Sitta pygmaea*	TERR	SMALL
Bird	Red crossbill	*Loxia curvirostra*	TERR	SMALL
Bird	Red-breasted nuthatch	*Sitta canadensis*	TERR	MED
Bird	Rufous hummingbird	*Selasphorus rufus*	TERR	SMALL
Bird	Sharp-shinned hawk	*Accipiter striatus*	TERR	MED
Bird	Solitary vireo	*Vireo solitarius*	TERR	SMALL
Bird	Steller's jay	*Cyanocitta stelleri*	TERR	SMALL
Bird	Swainson's thrush	*Catharus ustulatus*	TERR	SMALL
Bird	Townsend's solitaire	*Myadestes townsendi*	TERR	SMALL
Bird	Townsend's warbler	*Dendroica townsendi*	TERR	SMALL
Bird	Tree swallow	*Tachycineta bicolor*	TERR	SMALL
Bird	Varied thrush	*Ixoreus naevius*	TERR	SMALL
Bird	Western tanager	*Piranga ludoviciana*	TERR	SMALL
Bird	White-headed woodpecker	*Picoides albolarvatus*	TERR	MED
Bird	White-winged crossbill	*Loxia leucoptera*	TERR	MED
Bird	Wild turkey	*Meleagris gallopavo*	TERR	MED
Bird	Wilson's warbler	*Wilsonia pusilla*	TERR	SMALL
Bird	Winter wren	*Troglodytes troglodytes*	TERR	SMALL
Bird	Yellow-rumped warbler	*Dendroica coronata*	TERR	SMALL
Mammal	Black bear	*Ursus americanus*	TERR	LARGE
Mammal	Black-tailed deer	*Odocoileus hemionus*	TERR	MED
Mammal	Brush rabbit	*Sylvilagus bachmani*	TERR	SMALL
Mammal	Coast mole	*Scapanus orarius*	TERR	SMALL
Mammal	Douglas squirrel	*Tamiasciurus douglasii*	TERR	SMALL
Mammal	Dusky shrew	*Sorex monticolus*	TERR	SMALL
Mammal	Dusky-footed woodrat	*Neotoma fuscipes*	TERR	SMALL
Mammal	Ermine	*Mustela erminea*	TERR	SMALL
Mammal	Fisher	*Martes pennanti pacifica*	TERR	LARGE
Mammal	Marten	*Martes americana*	TERR	LARGE
Mammal	Mountain lion	*Felis concolor*	TERR	LARGE
Mammal	Northern flying squirrel	*Glaucomys sabrinus*	TERR	SMALL
Mammal	Pallid bat	*Antrozous pallidus*	TERR	MED
Mammal	Porcupine	*Erethizon dorsatum*	TERR	MED
Mammal	Raccoon	*Procyon lotor*	TERR	SMALL
Mammal	Red tree vole	*Phenacomys longicaudus*	TERR	SMALL

Table 7 (cont.)

Class	Common Name	Scientific Name	Group	Home Range
Mammal	Shrew-mole	*Neurotrichus gibbsi*	TERR	SMALL
Mammal	Townsend's chipmunk	*Tamias townsendii*	TERR	SMALL
Mammal	Trowbridge's shrew	*Sorex trowbridgei*	TERR	SMALL
Mammal	Western gray squirrel	*Sciurus griseus*	TERR	SMALL
Mammal	Western red-backed vole	*Clethrionomys californicus*	TERR	SMALL
Mammal	Wolverine	*Gulo gulo*	TERR	LARGE
Reptile	Sharptail snake	*Contia tenuis*	TERR	SMALL

Table 8. Wildlife that use old growth habitat within the Little River watershed for primary breeding and feeding functions.

Class	Common Name	Scientific Name	Group	Home Range
Amphibian	Clouded salamander	*Aneides ferreus*	TERR	SMALL
Amphibian	Ensatina	*Ensatina eschscholtzii*	TERR	SMALL
Amphibian	Western redback salamander	*Plethodon vehiculum*	TERR	SMALL
Bird	Barn owl	*Tyto alba*	TERR	MED
Bird	Barred owl	*Strix varia*	TERR	LARGE
Bird	Black-backed woodpecker	*Picoides arcticus*	TERR	MED
Bird	Black-throated gray warbler	*Dendroica nigrescens*	TERR	SMALL
Bird	Brown creeper	*Certhia americana*	TERR	SMALL
Bird	Cassin's finch	*Carpodacus cassinii*	TERR	SMALL
Bird	Chestnut-backed chickadee	*Parus rufescens*	TERR	SMALL
Bird	Common raven	*Corvus corax*	TERR	LARGE
Bird	Cooper's hawk	*Accipiter cooperii*	TERR	MED
Bird	Dark-eyed junco	*Junco hyemalis*	TERR	SMALL
Bird	Evening grosbeak	*Coccothraustes vespertina*	TERR	SMALL
Bird	Golden eagle	*Aquila chrysaetos*	TERR	LARGE
Bird	Golden-crowned kinglet	*Regulus satrapa*	TERR	SMALL
Bird	Gray jay	*Perisoreus canadensis*	RIPAR	MED
Bird	Great gray owl	*Strix nebulosa*	TERR	LARGE
Bird	Great horned owl	*Bubo virginianus*	TERR	LARGE
Bird	Hairy woodpecker	*Picoides villosus*	TERR	SMALL
Bird	Hammond's flycatcher	*Empidonax hammondii*	TERR	SMALL
Bird	Hermit thrush	*Catharus guttatus*	TERR	SMALL
Bird	Hermit warbler	*Dendroica occidentalis*	TERR	SMALL
Bird	Lewis' woodpecker	*Melanerpes lewis*	TERR	SMALL
Bird	Mountain chickadee	*Parus gambeli*	TERR	SMALL
Bird	Northern flicker	*Colaptes auratus*	TERR	MED
Bird	Northern goshawk	*Accipiter gentilis*	TERR	LARGE
Bird	Northern pygmy-owl	*Glaucidium gnoma*	TERR	SMALL
Bird	Northern saw-whet owl	*Aegolius acadicus*	TERR	MED
Bird	Northern spotted owl	*Strix occidentalis caurina*	TERR	LARGE
Bird	Northern three-toed woodpecker	*Picoides tridactylus*	TERR	MED
Bird	Olive sided flycatcher	*Contopus borealis*	TERR	SMALL
Bird	Pacific slope flycatcher	*Empidonax difficilis*	TERR	SMALL
Bird	Pileated woodpecker	*Dryocopus pileatus*	TERR	LARGE
Bird	Pine grosbeak	*Pinicola enucleator*	TERR	SMALL
Bird	Pine siskin	*Carduelis pinus*	TERR	SMALL
Bird	Pygmy nuthatch	*Sitta pygmaea*	TERR	SMALL
Bird	Red crossbill	*Loxia curvirostra*	TERR	SMALL
Bird	Red-breasted nuthatch	*Sitta canadensis*	TERR	MED
Bird	Red-tailed hawk	*Buteo jamaicensis*	TERR	LARGE
Bird	Sharp-shinned hawk	*Accipiter striatus*	TERR	MED
Bird	Solitary vireo	*Vireo solitarius*	TERR	SMALL
Bird	Steller's jay	*Cyanocitta stelleri*	TERR	SMALL
Bird	Swainson's thrush	*Catharus ustulatus*	TERR	SMALL
Bird	Townsend's solitaire	*Myadestes townsendi*	TERR	SMALL
Bird	Townsend's warbler	*Dendroica townsendi*	TERR	SMALL
Bird	Tree swallow	*Tachycineta bicolor*	TERR	SMALL
Bird	Turkey vulture	*Cathartes aura*	TERR	LARGE
Bird	Varied thrush	*Ixoreus naevius*	TERR	SMALL
Bird	Vaux's swift	*Chaetura vauxi*	TERR	SMALL
Bird	Western tanager	*Piranga ludoviciana*	TERR	SMALL
Bird	White-headed woodpecker	*Picoides albolarvatus*	TERR	MED
Bird	White winged crossbill	*Loxia leucoptera*	TERR	MED
Bird	Wild turkey	*Meleagris gallopavo*	TERR	MED
Bird	Wilson's warbler	*Wilsonia pusilla*	TERR	SMALL
Bird	Winter wren	*Troglodytes troglodytes*	TERR	SMALL
Bird	Yellow-rumped warbler	*Dendroica coronata*	TERR	SMALL
Mammal	Big brown bat	*Eptesicus fuscus*	TERR	MED
Mammal	Black bear	*Ursus americanus*	TERR	LARGE
Mammal	California myotis	*Myotis californicus*	TERR	MED
Mammal	Coast mole	*Scapanus orarius*	TERR	SMALL
Mammal	Douglas' squirrel	*Tamiasciurus douglasi*	TERR	SMALL
Mammal	Dusky-footed woodrat	*Neotoma fuscipes*	TERR	SMALL
Mammal	Ermine	*Mustela erminea*	TERR	SMALL
Mammal	Fisher	*Martes pennanti pacifica*	TERR	LARGE
Mammal	Little brown myotis	*Myotis lucifugus*	TERR	MED
Mammal	Long-eared myotis	*Myotis evotis*	TERR	MED
Mammal	Long-legged myotis	*Myotis volans*	TERR	MED

Table 8 (cont.)

Class	Common Name	Scientific Name	Group	Home Range
Mammal	Marten	*Martes americana*	TERR	LARGE
Mammal	Northern flying squirrel	*Glaucomys sabrinus*	TERR	SMALL
Mammal	Pallid bat	*Antrozous pallidus*	TERR	MED
Mammal	Porcupine	*Erethizon dorsatum*	TERR	MED
Mammal	Raccoon	*Procyon lotor*	TERR	SMALL
Mammal	Red tree vole	*Phenacomys longicaudus*	TERR	SMALL
Mammal	Shrew-mole	*Neurotrichus gibbsi*	TERR	SMALL
Mammal	Silver-haired bat	*Lasionycteris noctivagans*	TERR	MED
Mammal	Townsend's chipmunk	*Tamias townsendii*	TERR	SMALL
Mammal	Trowbridge's shrew	*Sorex trowbridgei*	TERR	SMALL
Mammal	Western gray squirrel	*Sciurus griseus*	TERR	SMALL
Mammal	Western red-backed vole	*Clethrionomys californicus*	TERR	SMALL
Mammal	Wolverine	*Gulo gulo*	TERR	LARGE
Mammal	Yuma myotis	*Myotis yumanensis*	TERR	MED
Reptile	Sharptail snake	*Contia tenuis*	TERR	SMALL

Table 9. Wildlife that use hardwood dominated habitat within the Little River watershed for primary breeding and feeding functions.

Class	Common Name	Scientific Name	Group	Home Range
Amphibian	Clouded salamander	*Aneides ferreus*	TERR	SMALL
Amphibian	Ensatina	*Ensatina eschscholtzii*	TERR	SMALL
Bird	Acorn woodpecker	*Melanerpes formicivorus*	TERR	SMALL
Bird	American goldfinch	*Carduelis tristis*	TERR	SMALL
Bird	American robin	*Turdus migratorius*	TERR	SMALL
Bird	Band-tailed pigeon	*Columba fasciata*	TERR	SMALL
Bird	Bewick's wren	*Thryomanes bewickii*	TERR	SMALL
Bird	Black-capped chickadee	*Parus atricapillus*	TERR	SMALL
Bird	Black-headed grosbeak	*Pheucticus melanocephalus*	TERR	SMALL
Bird	Brown-headed cowbird	*Molothrus ater*	TERR	SMALL
Bird	Bushtit	*Psaltriparus minimus*	TERR	SMALL
Bird	Cedar waxwing	*Bombycilla cedrorum*	TERR	SMALL
Bird	Chipping sparrow	*Spizella passerina*	TERR	SMALL
Bird	Common nighthawk	*Chordeiles minor*	TERR	MED
Bird	Cooper's hawk	*Accipiter cooperii*	TERR	MED
Bird	Dark-eyed junco	*Junco hyemalis*	TERR	SMALL
Bird	Downy woodpecker	*Picoides pubescens*	TERR	SMALL
Bird	European starling	*Sturnus vulgaris*	TERR	MED
Bird	Fox sparrow	*Passerella iliaca*	TERR	SMALL
Bird	Great horned owl	*Bubo virginianus*	TERR	LARGE
Bird	House wren	*Troglodytes aedon*	TERR	SMALL
Bird	Hutton's vireo	*Vireo huttoni*	TERR	SMALL
Bird	Lazuli bunting	*Passerina amoena*	TERR	SMALL
Bird	Loggerhead shrike	*Lanius ludovicianus*	TERR	SMALL
Bird	Mountain quail	*Oreortyx pictus*	TERR	SMALL
Bird	Mourning dove	*Zenaida macroura*	TERR	SMALL
Bird	Nashville warbler	*Vermivora ruficapilla*	TERR	SMALL
Bird	Northern flicker	*Colaptes auratus*	TERR	MED
Bird	Northern oriole	*Icterus galbula*	TERR	SMALL
Bird	Pine siskin	*Carduelis pinus*	TERR	SMALL
Bird	Purple finch	*Carpodacus purpureus*	TERR	SMALL
Bird	Red-tailed hawk	*Buteo jamaicensis*	TERR	LARGE
Bird	Ruffed grouse	*Bonasa umbellus*	TERR	SMALL
Bird	Rufous hummingbird	*Selasphorus rufus*	TERR	SMALL
Bird	Rufous-sided towhee	*Pipilo erythrophtalmus*	TERR	SMALL
Bird	Scrub jay	*Aphelocoma coerulescens*	TERR	SMALL
Bird	Solitary vireo	*Vireo solitarius*	TERR	SMALL
Bird	Song sparrow	*Melospiza melodia*	TERR	SMALL
Bird	Swainson's thrush	*Catharus ustulatus*	TERR	SMALL
Bird	Violet-green swallow	*Tachycineta thalassina*	TERR	SMALL
Bird	Warbling vireo	*Vireo gilvus*	TERR	SMALL
Bird	Western bluebird	*Sialia mexicana*	TERR	SMALL
Bird	Western wood pewee	*Contopus sordidulus*	TERR	SMALL
Bird	White-breasted nuthatch	*Sitta carolinensis*	TERR	SMALL
Bird	White-crowned sparrow	*Zonotrichia leucophrys*	TERR	SMALL
Bird	Wild turkey	*Meleagris gallopavo*	TERR	MED
Bird	Wilson's warbler	*Wilsonia pusilla*	TERR	SMALL
Bird	Yellow warbler	*Dendroica petechia*	TERR	SMALL
Mammal	Black-tailed deer	*Odocoileus hemionus*	TERR	MED
Mammal	Brush rabbit	*Sylvilagus bachmani*	TERR	SMALL
Mammal	Coast mole	*Scapanus orarius*	TERR	SMALL
Mammal	Columbian white-tailed deer	*Odocoileus virginianus leucurus*	TERR	LARGE
Mammal	Coyote	*Canis latrans*	TERR	LARGE
Mammal	Creeping vole	*Microtus oregoni*	TERR	SMALL
Mammal	Deer mouse	*Peromyscus maniculatus*	TERR	SMALL
Mammal	Dusky shrew	*Sorex monticolus*	TERR	SMALL
Mammal	Elk	*Cervus elaphus*	TERR	LARGE
Mammal	Ermine	*Mustela erminea*	TERR	SMALL
Mammal	Gray fox	*Urocyon cinereoargenteus*	TERR	LARGE
Mammal	Long-tailed weasel	*Mustela frenata*	TERR	MED
Mammal	Mountain beaver	*Aplodontia rufa*	TERR	SMALL
Mammal	Pacific jumping mouse	*Zapus trinotatus*	TERR	SMALL
Mammal	Porcupine	*Erethizon dorsatum*	TERR	MED
Mammal	Raccoon	*Procyon lotor*	TERR	SMALL
Mammal	Red fox	*Vulpes vulpes*	TERR	LARGE
Mammal	Snowshoe hare	*Lepus americanus*	TERR	SMALL
Mammal	Spotted skunk	*Spilogale gracilis*	TERR	MED
Mammal	Striped skunk	*Mephitis mephitis*	TERR	MED

Table 9 (cont.)

Class	Common Name	Scientific Name	Group	Home Range
Mammal	Virginia opossum	*Didelphis virginianus*	TERR	MED
Mammal	Western gray squirrel	*Sciurus griseus*	TERR	SMALL
Reptile	Common garter snake	*Thamnophis sirtalis*	TERR	SMALL
Reptile	Northern alligator lizard	*Elgaria coerulea*	TERR	SMALL
Reptile	Racer	*Coluber constrictor*	TERR	SMALL
Reptile	Sharptail snake	*Contia tenuis*	TERR	SMALL
Reptile	Southern alligator lizard	*Elgaria multicarinata*	TERR	SMALL
Reptile	Western fence lizard	*Sceloporus occidentalis*	TERR	SMALL
Reptile	Western pond turtle	*Clemmys marmota marmota*	RIPAR	SMALL
Reptile	Western skink	*Eumeces skiltonianus*	TERR	SMALL
Reptile	Western terrestrial garter snake	*Thamnopsis elegans*	TERR	SMALL

Table 10. Wildlife which may occur within the Little River watershed but for which documented sightings are non-existent.

Class	Common Name	Scientific Name
Amphibian	Oregon slender salamander	*Batrachoseps wrighti*
Amphibian	Cascade torrent salamander	*Rhyacotriton cascadae*
Bird	Flammulated owl	*Otis flammeolus*
Bird	Allen's hummingbird	*Selasphorus sasin*
Bird	Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Mammal	Gray wolf	*Canis lupus*
Mammal	White-footed vole	*Phenacomys albipes*
Mammal	Brazilian free-tailed bat	*Tadarida brasiliensis*
Mammal	Siskiyou chipmunk	*Tamias siskiyou*
Reptile	Western aquatic garter snake	*Thamnophis hydrophilus*

Table 11. Late seral species that have small home ranges (≤ 100 acres).

Class	Common Name	Scientific Name
Amphibian	Clouded salamander	*Aneides ferreus*
Amphibian	Ensatina	*Ensatina eschscholtzii*
Amphibian	Western redback salamander	*Plethodon vehiculum*
Bird	Black-throated gray warbler	*Dendroica nigrescens*
Bird	Brown creeper	*Certhia americana*
Bird	Cassin's finch	*Carpodacus cassinii*
Bird	Chestnut-backed chickadee	*Parus rufescens*
Bird	Dark-eyed junco	*Junco hyemalis*
Bird	Evening grosbeak	*Coccothraustes vespertina*
Bird	Golden-crowned kinglet	*Regulus satrapa*
Bird	Hairy woodpecker	*Picoides villosus*
Bird	Hammond's flycatcher	*Empidonax hammondii*
Bird	Hermit thrush	*Catharus guttatus*
Bird	Hermit warbler	*Dendroica occidentalis*
Bird	Lewis' woodpecker	*Melanerpes lewis*
Bird	Mountain chickadee	*Parus gambeli*
Bird	Northern pygmy-owl	*Glaucidium gnoma*
Bird	Olive-sided flycatcher	*Contopus borealis*
Bird	Pacific slope flycatcher	*Empidonax difficilis*
Bird	Pine grosbeak	*Pinicola enucleator*
Bird	Pine siskin	*Carduelis pinus*
Bird	Pygmy nuthatch	*Sitta pygmaea*
Bird	Red crossbill	*Loxia curvirostra*
Bird	Rufous hummingbird	*Selasphorus rufus*
Bird	Solitary vireo	*Vireo solitarius*
Bird	Steller's jay	*Cyanocitta stelleri*
Bird	Swainson's thrush	*Catharus ustulatus*
Bird	Townsend's solitaire	*Myadestes townsendi*
Bird	Townsend's warbler	*Dendroica townsendi*
Bird	Tree swallow	*Tachycineta bicolor*
Bird	Varied thrush	*Ixoreus naevius*
Bird	Vaux's swift	*Chaetura vauxi*
Bird	Western tanager	*Piranga ludoviciana*
Bird	Wilson's warbler	*Wilsonia pusilla*
Bird	Winter wren	*Troglodytes troglodytes*
Bird	Yellow-rumped warbler	*Dendroica coronata*
Mammal	Brush rabbit	*Sylvilagus bachmani*
Mammal	Coast mole	*Scapanus orarius*
Mammal	Douglas' squirrel	*Tamiascirius douglasi*
Mammal	Dusky shrew	*Sorex monticolus*
Mammal	Dusky-footed woodrat	*Neotoma fuscipes*
Mammal	Ermine	*Mustela erminea*
Mammal	Northern flying squirrel	*Glaucomys sabrinus*
Mammal	Raccoon	*Procyon lotor*
Mammal	Red tree vole	*Phenacomys longicaudus*
Mammal	Shrew-mole	*Neurotrichus gibbsi*
~~Mammal~~	~~Townsend's chipmunk~~	~~*Eutamias townsendi*~~
Mammal	Townsend's chipmunk	*Tamias townsendii*
Mammal	Trowbridge's shrew	*Sorex trowbridgei*
Mammal	Western gray squirrel	*Sciurus griseus*
Mammal	Western red-backed vole	*Clethrionomys californicus*
Reptile	Sharptail snake	*Contia tenius*

Table 12. Late seral species that have medium home ranges (100 - 1,000 acres).

Class	Common Name	Scientific Name
Bird	Barn owl	*Tyto alba*
Bird	Black-backed woodpecker	*Picoides arcticus*
Bird	Cooper's hawk	*Accipiter cooperii*
Bird	Gray jay	*Perisoreus canadensis*
Bird	Northern flicker	*Colaptes auratus*
Bird	Northern saw-whet owl	*Aegolius acadicus*
Bird	Northern three-toed woodpecker	*Picoides tridactylus*
Bird	Red-breasted nuthatch	*Sitta canadensis*
Bird	Sharp-shinned hawk	*Accipiter striatus*
Bird	White-headed woodpecker	*Picoides albolarvatus*
Bird	White-winged crossbill	*Loxia leucoptera*
Bird	Wild turkey	*Meleagris gallopavo*
Mammal	Big brown bat	*Eptesicus fuscus*
Mammal	Black-tailed deer	*Odocoileus hemionus*
Mammal	California myotis	*Myotis californicus*
Mammal	Little brown myotis	*Myotis lucifugus*
Mammal	Long-eared myotis	*Myotis evotis*
Mammal	Long-legged myotis	*Myotis volans*
Mammal	Pallid bat	*Antrozous pallidus*
Mammal	Porcupine	*Erethizon dorsatum*
Mammal	Silver-haired bat	*Lasionycteris noctivagans*
Mammal	Yuma myotis	*Myotis yumanensis*

Table 13. Late seral species that have large home ranges (> 1,000 acres).

Class	Common Name	Scientific Name
Bird	Barred owl	*Strix varia*
Bird	Common raven	*Corvus corax*
Bird	Golden eagle	*Aquila chrysaetos*
Bird	Great gray owl	*Strix nebulosa*
Bird	Great horned owl	*Bubo virginianus*
Bird	Northern goshawk	*Accipiter gentilis*
Bird	Northern spotted owl	*Strix occidentalis caurina*
Bird	Pileated woodpecker	*Dryocopus pileatus*
Bird	Red-tailed hawk	*Buteo jamaicensis*
Bird	Turkey vulture	*Cathartes aura*
Mammal	Black bear	*Ursus americanus*
Mammal	Fisher	*Martes pennanti pacifica*
Mammal	Marten	*Martes americana*
Mammal	Mountain lion	*Felis concolor*
Mammal	Wolverine	*Gulo gulo*

HABITAT SUITABILITY ANALYSIS

Habitat requirements for individual species of concern were summarized and used as criteria to run a habitat suitability model (Mellen et al., 1994) on the reference period and current condition seral stage mappings. Habitat suitability modeling was also done for the three groups of late seral species as describe in the wildlife habitat relationships section. Figures 12-14 show the results of this analysis. Analysis is pending (at time of this draft) for the three late seral guilds in Tables 11-13.

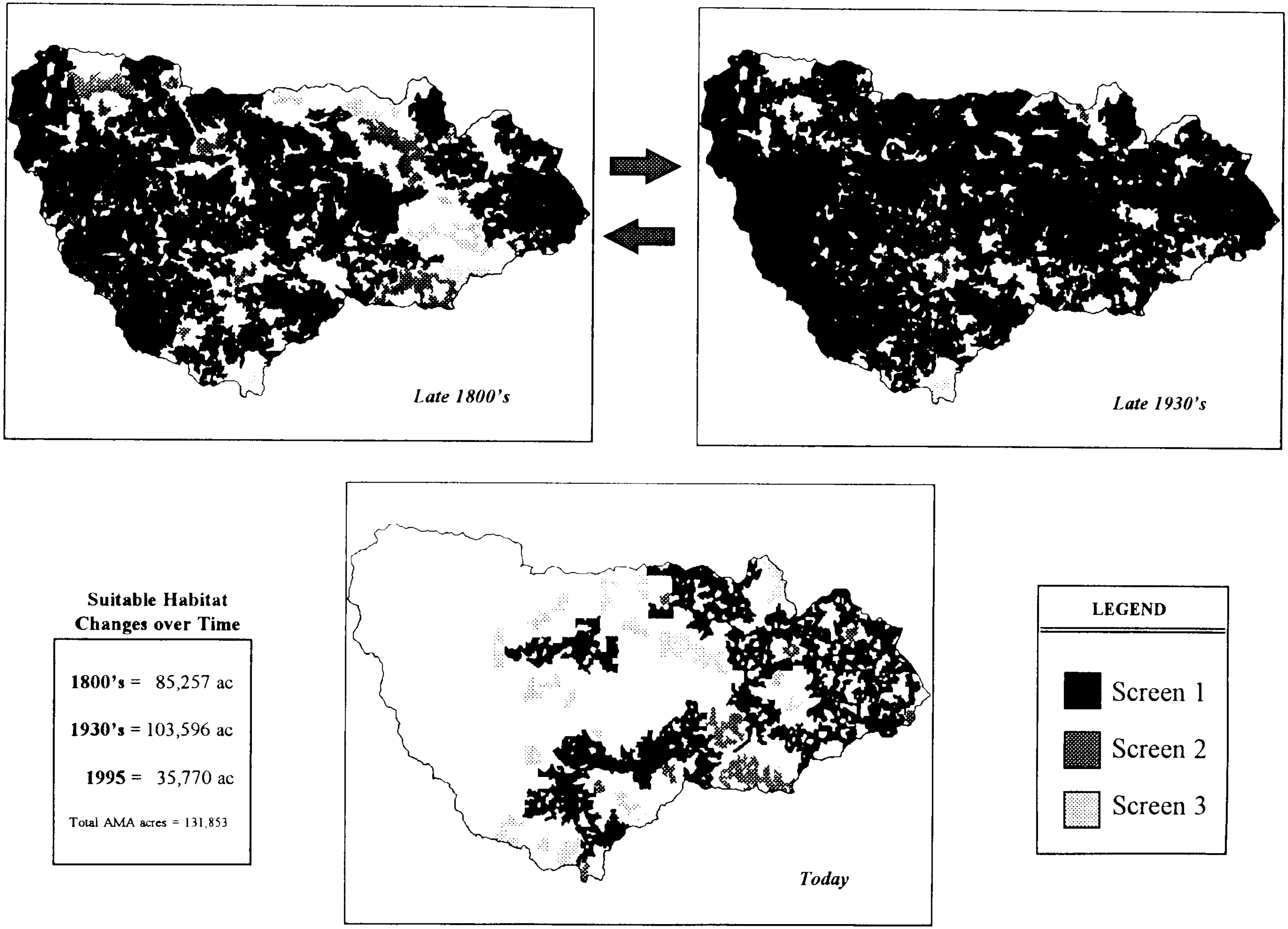
The following table summarizes criteria used for the individual species.

Table 14. Criteria used for running the habitat suitability program.

SPECIES	HABITAT TYPE	PATCH SIZE (acres)	HOME RANGE (acres)	SCREEN 1 (%)	SCREEN 2 (%)	SCREEN 3 (%)
Northern spotted owl	Late seral in all land units	80	2,895	40	40	80
Marten	Late seral in all moist/warm, moist/cool and wet-dry/warm land units	40	2,001	45	45	80
Red tree vole	Late seral on gentle to moderate slopes of the moist/warm, moist/cool and wet-dry/warm land units below 4,200 feet elev.	100	NA	NA	NA	NA
Great Gray Owl	Late seral within 300 meters from a natural meadow and above 3,000 feet elev.	NA	NA	NA	NA	NA
Late Seral Species/ Medium HR	Late Seral Habitat	20	500	50	50	70

Screen 1 = Part of a patch that is the equal to or greater than the designated percent of the home range for that species.
Screen 2 = Part of a habitat patch that meets the minimum patch size and greater than the designated percent of the circle is within suitable habitat conditions.
Screen 3 = Part of a habitat patch which meets minimum patch size and enough habitat is intersected by the home range circle that adjacent suitable habitat is greater than the designated percent.

Northern Spotted Owl Habitat



Suitable Habitat Changes over Time

1800's = 85,257 ac

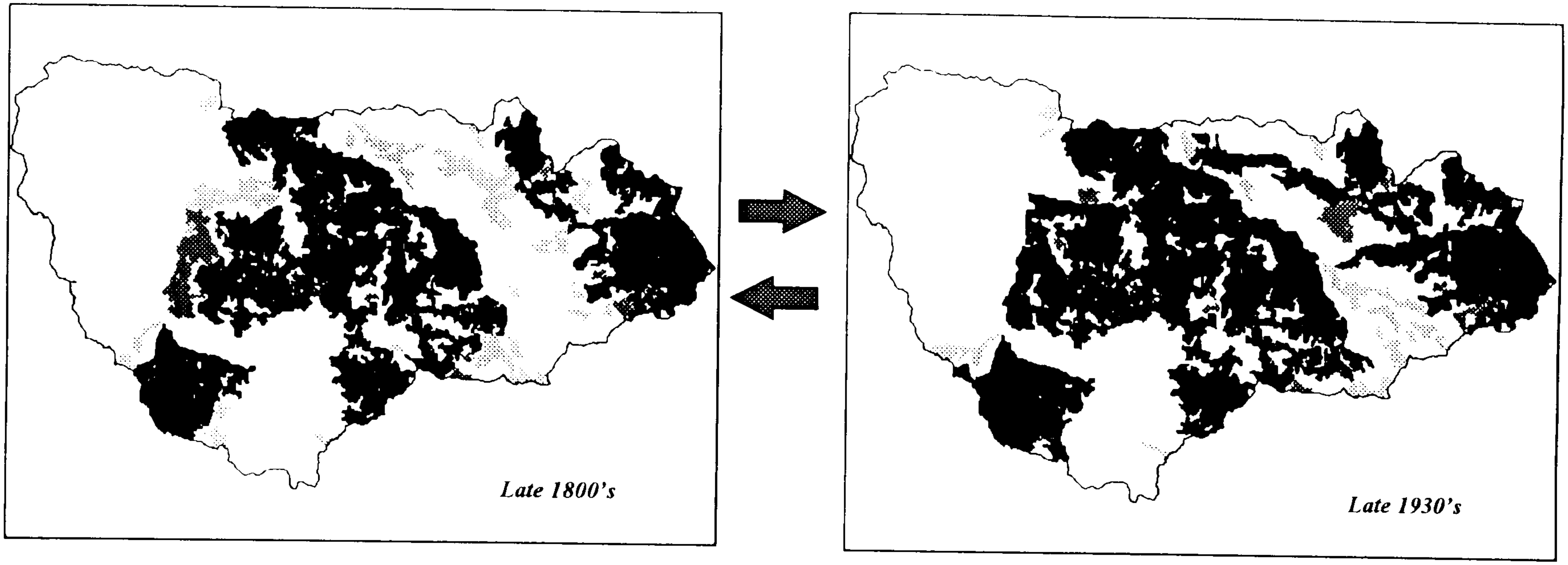
1930's = 103,596 ac

1995 = 35,770 ac

Total AMA acres = 131,853

Figure 12

Marten/Fisher Habitat



Suitable Habitat Changes over Time

1800's = 48,019 ac

1930's = 55,376 ac

1995 = 17,683 ac

Total AMA acres = 131,853

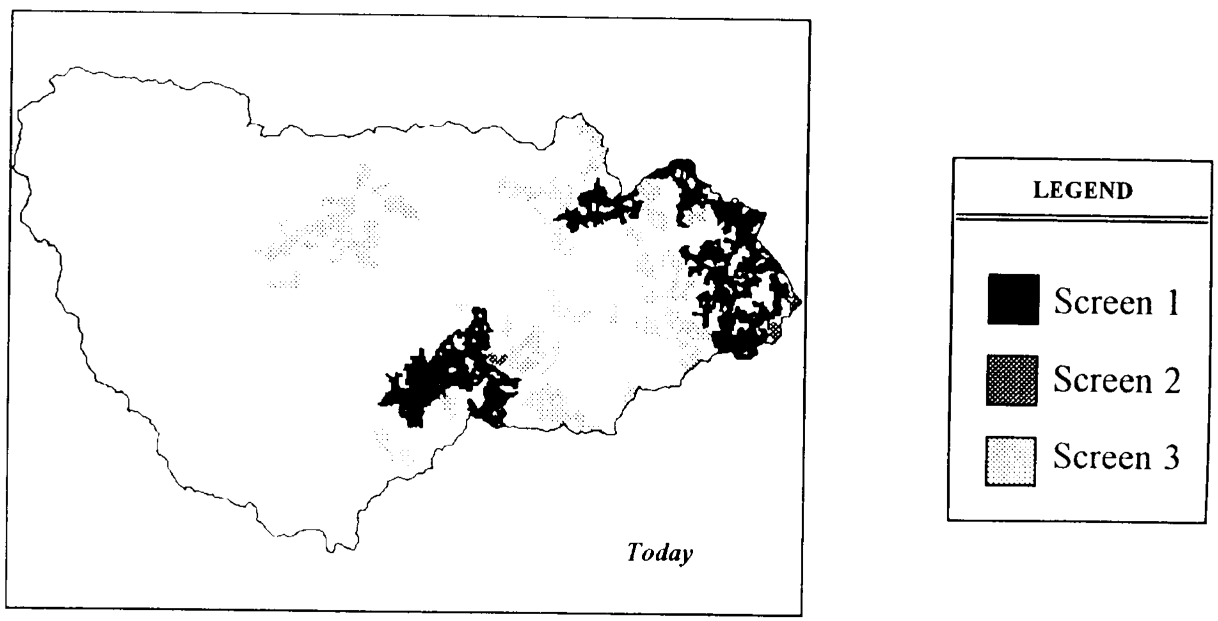
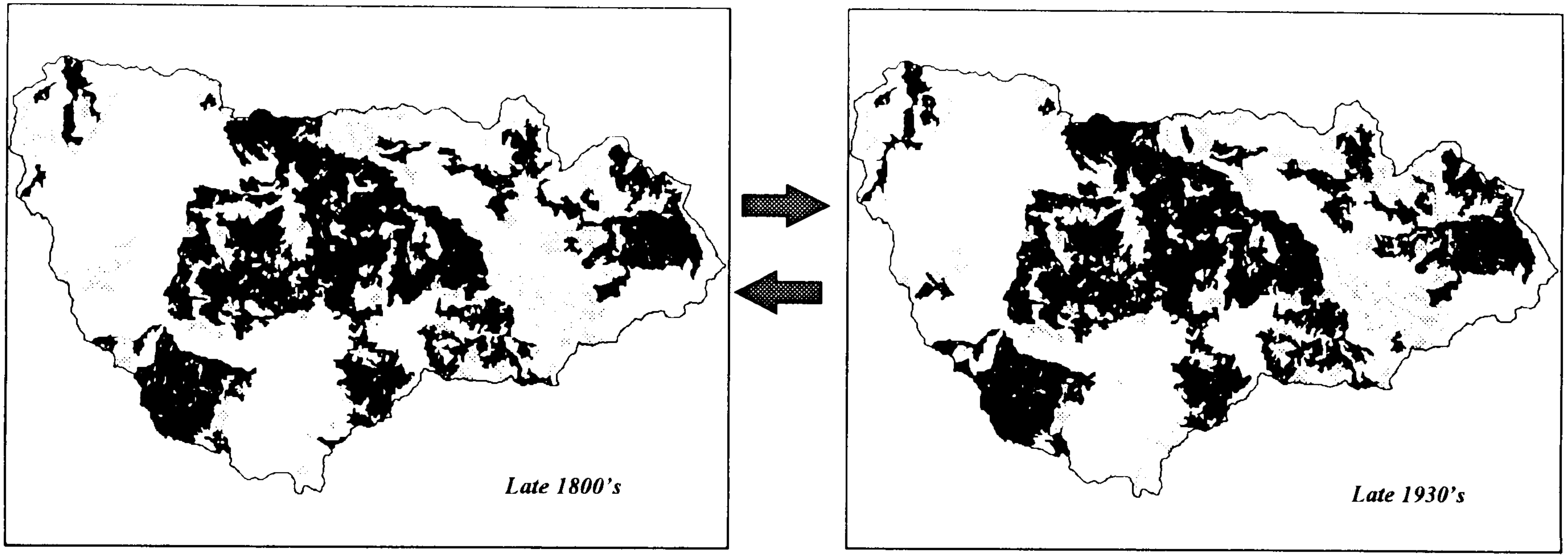
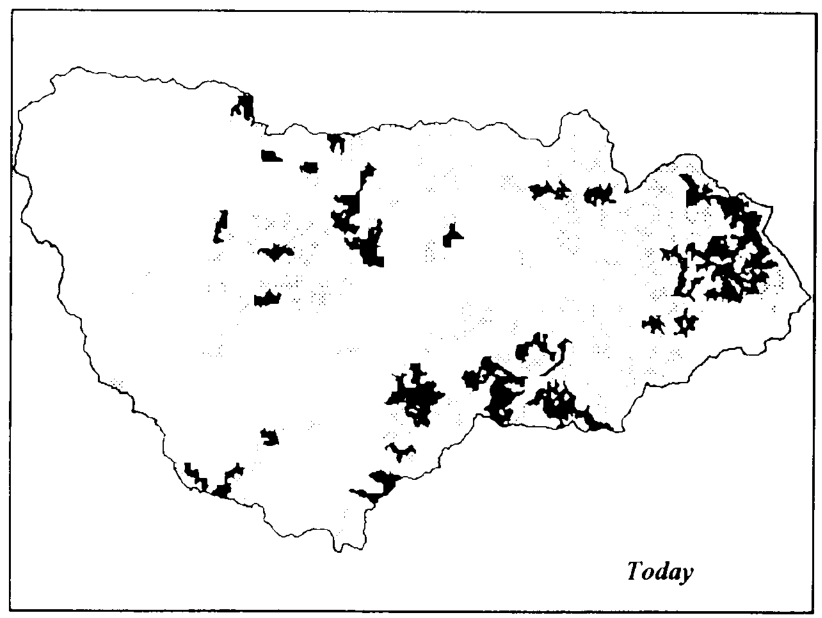


Figure 13

Red Tree Vole Habitat





Suitable Habitat Changes over Time

1800's = 42,868 ac

1930's = 46,063 ac

1995 = 9,616 ac

Total AMA acres = 131,853

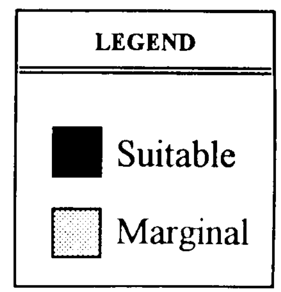
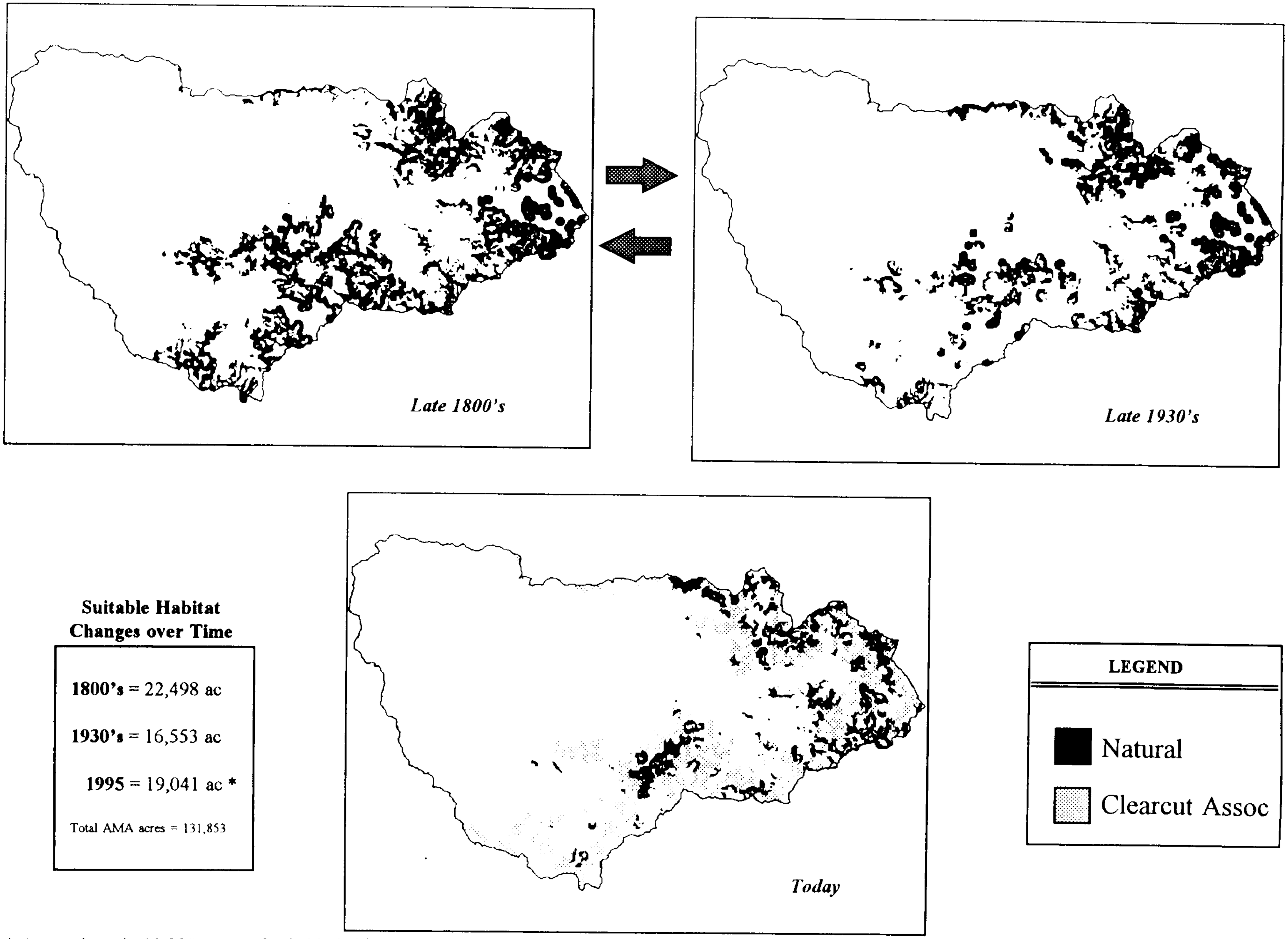


Figure 14

Great Gray Owl Habitat



* Approximately 12,220 acres of suitable habitat are related to openings resulting from clearcutting. Approximately 8,822 acres are related to natural meadows.

Figure 15

Late Seral Species with Medium Home Range

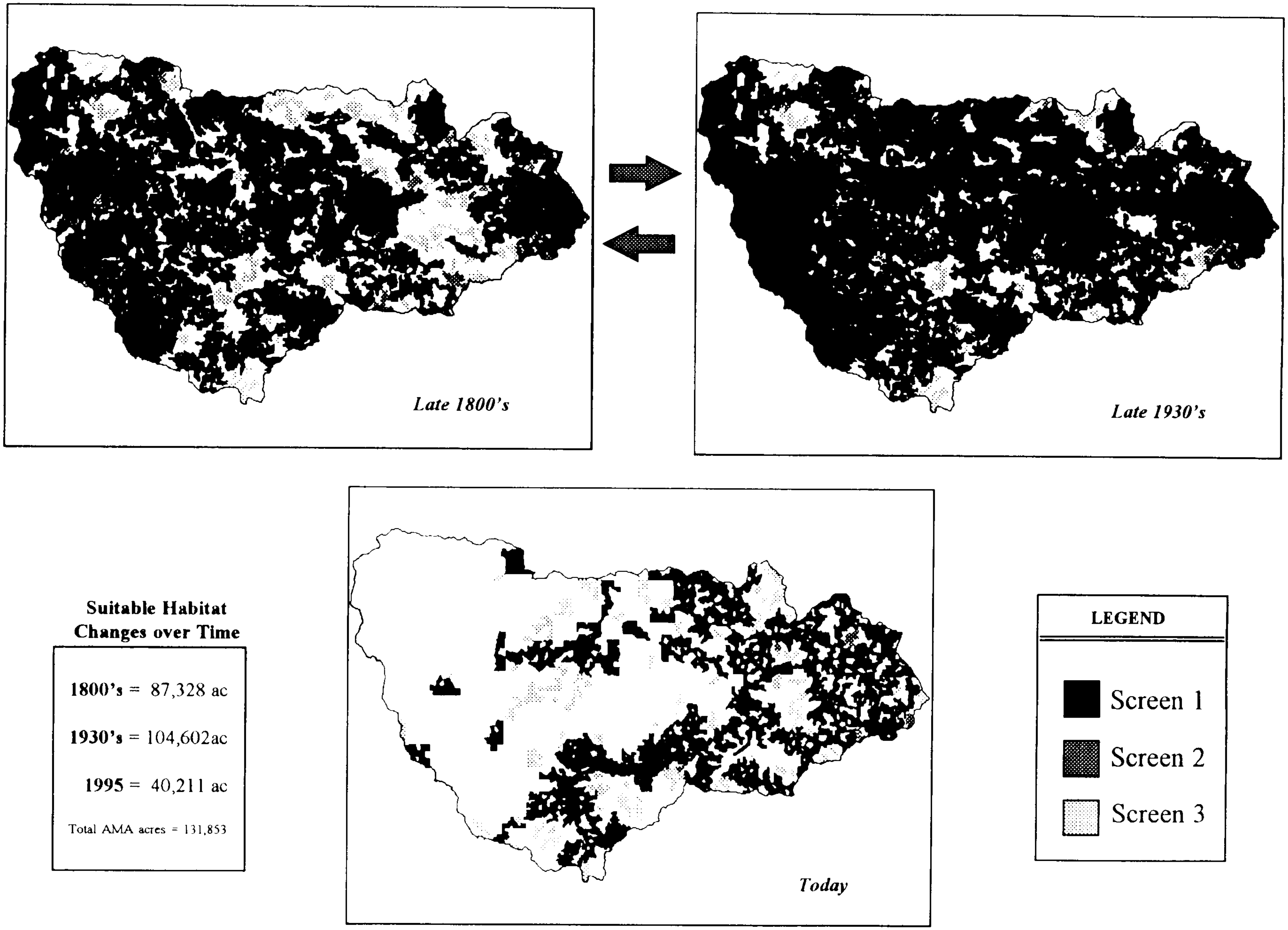


Figure 16

DISPERSAL HABITAT
(50-11-40)
ANALYSIS

Dispersal habitat for the northern spotted owl was analyzed using the GIS layer representing Brown's (1985) structure classes. Dispersal habitat for the owl is defined as areas forested by conifer, eleven inches or greater in DBH, which provide at least 40% canopy closure. The structure classes that meet this criteria are closed pole, mature conifer and old growth.

ArcView II (version 2.0) was used to calculate the proportion of various quarter townships within the watershed. Figure 17 shows the results of this analysis.

The eastern portions of the watershed (an all that lies within 4 miles of the adjacent designated Late Successional Reserve) contain more than 50% dispersal habitat by area. Most of the western half of the watershed (a mixture of BLM and private lands) contains less than 50% dispersal habitat.

NOTE: There are 21 owl activity centers located within the four mile zone.

Dispersal Habitat for the Northern Spotted Owl

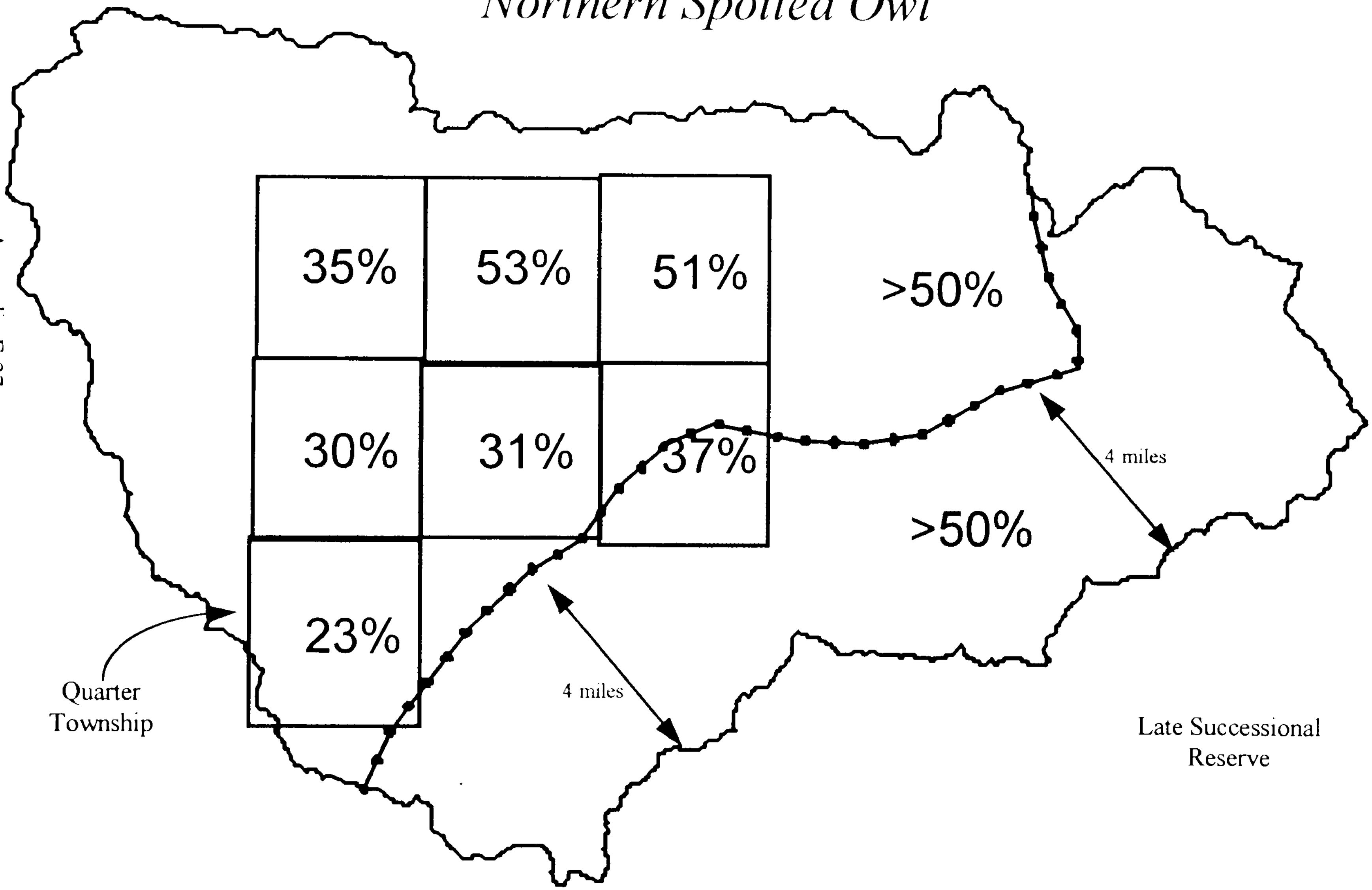


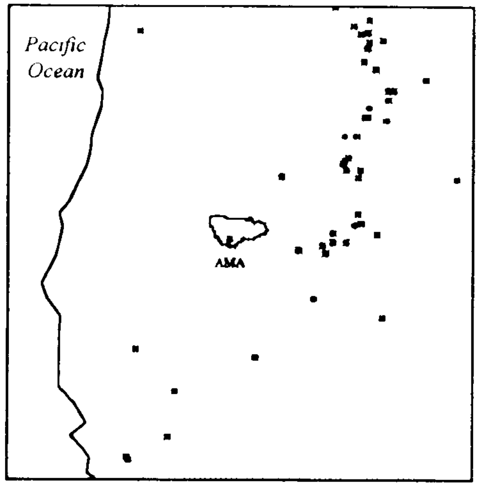
Figure 17

ONGOING WILDLIFE MONITORING

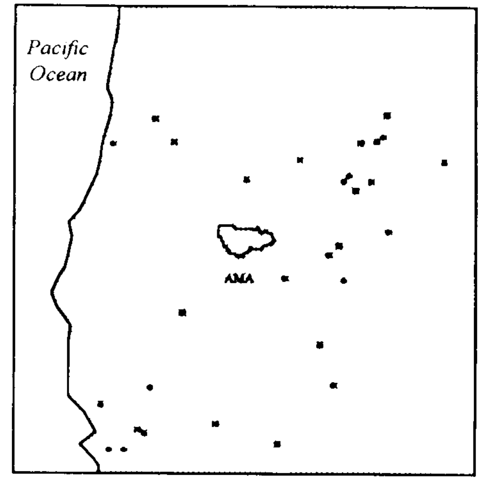
There is currently ongoing and planned efforts for monitoring for the occurrence and habitat use of mustelids, herptiles, small mammals (DEMO) and bats. To date, the results have not been adequately compiled. The following figure 18, depicts occurrence and results of camera monitoring for mustelids from an effort conducted in the winter of 1994-1995.

Results will be forthcoming for ongoing and recently completed monitoring.

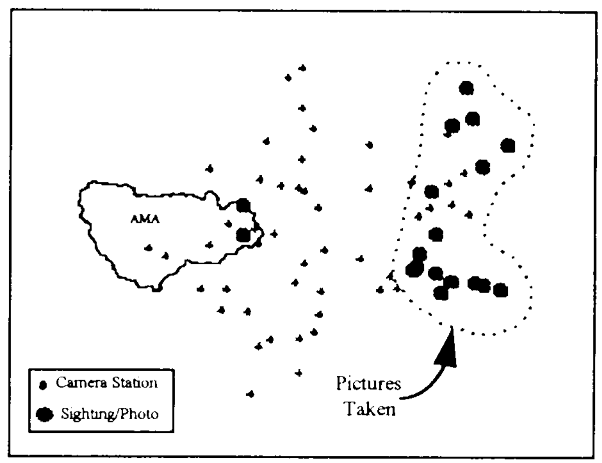
Mustelid Occurence & Monitoring



Wolverine Sightings



Fisher Sightings



Marten and Camera Stations

One wolvering sighting occurred within the watershed in the winter of 1984. The next nearest wolvering sighting is located approximately 15 miles to the east-southeast and was recorded in 1972.

The nearest fisher sighting occurred in 1980 approximately 16 miles to the southeast.

Two marten sightings are recorded in or adjacent to the watershed. These occurred in 1989. Camera monitoring indicates a concentration of marten approximately 25 miles to the east of the watershed as of 1995.

Fiqure 18